



National Symposium on Technological Advancements: Emerging Trends in Entomology

8-9 October, 2025

ESI-ETE-2025

BOOK OF ABSTRACTS

Organized by

DIVISION OF ENTOMOLOGY

Sher-e-Kashmir University of Agricultural Sciences &
Technology of Kashmir Shalimar Campus,
Srinagar -190025 (UT of Jammu and Kashmir), India

In collaboration with

THE ENTOMOLOGICAL SOCIETY OF INDIA

ICAR-IARI Pusa Campus, New Delhi - 110012, India



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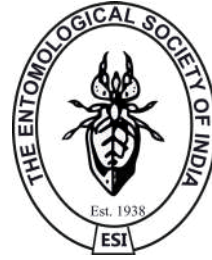
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National Symposium on Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)

October 08-09, 2025

Sher-e-Kashmir University of Agricultural Sciences &
Technology of Kashmir

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Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir
Shalimar Campus, Srinagar -190025 (UT of Jammu and Kashmir) India

In collaboration with

THE ENTOMOLOGICAL SOCIETY OF INDIA

Division of Entomology, Room no- 4A, ICAR-IARI Pusa Campus
New Delhi - 110012, India

Partner



HADP-20

**(Innovative Extension Approaches for
Promoting Agriculture in J&K)**



Book of Abstracts: National Symposium on Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)

Editors:

Abu Manzar, Sajad Mohi-Ud-Din, Munazah Yaqoob, A. A. Khan, Shashank P. R., Suresh Nabapure, Sajad A Ganie, S. Rajna, Suriya S., Showkat Ahmad Sheikh, Madhanram G. and Sachin S. Suroshe

Citation:

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The organizers of the symposium express their heartfelt thanks to all the agro-chemical industries, Government organizations and Bank who have financially supported the symposium.



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National Symposium on Technological Advancements: Emerging Trends in Entomology

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Acknowledgement

The organizers of the symposium express their heartfelt thanks to all the agro-chemical industries, government organizations and bank who have financially supported the symposium. We specially acknowledge the financial support of the following agencies:

- Dhanuka Agritech Ltd
- HADP-20 (Innovative Extension Approaches for Promoting Agriculture in J&K)
- Bayer Crop Science
- J&K Bank
- Syngenta
- Sumitomo Chemical India Limited
- PI Industries Ltd.
- Pherobank Technology



PREFACE

Entomology has always played a pivotal role in ensuring agricultural sustainability, food security, and ecological balance. In the present era, with the accelerating pace of technological innovation and the growing challenges of climate change, habitat loss, invasive species, and evolving pest dynamics, the discipline is entering a new phase. The integration of digital tools, cutting-edge molecular techniques, and sustainable management strategies is revolutionizing the way insects are studied, conserved, and managed for the benefit of society.

The two day National Symposium on “Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)” being organized by Division of Entomology, SKUAST-Kashmir, in collaboration with The Entomological Society of India, on 8 - 9 October, 2025 provides a timely platform for the exchange of knowledge and collaborative dialogue among scientists, academicians, students, and industry stakeholders. The selected thematic areas viz., Digital Entomology, Insect Conservation, Biodiversity and Climate Change, Insect Behavior and Genomics, Cutting-edge Technologies of Pest Management, Commercial Entomology, and Scientific-Industrial Interaction have been thoughtfully designed to address pressing challenges while exploring new opportunities in research, innovation, and commercialization.

The overwhelming response to this symposium from the scientific community has been very encouraging. We have received more than 200 research abstracts which have been compiled in this Abstract Book. This Book represents the collective contributions of participants from diverse institutions across the country, highlighting the breadth and depth of contemporary entomological research.

It is particularly heartening to note the active participation of young researchers, whose contributions reflect a positive trend towards innovation and scientific curiosity. We are confident that the vibrant exchange of ideas and interactions during the symposium will promote scientific temper, inspire fresh perspectives, and strengthen the bonds between academia and industry.

We hope that the deliberations during the symposium will stimulate novel approaches, foster academia-industry linkages, and contribute towards developing farmer-friendly, eco-resilient, and sustainable solutions for pest management and insect resource utilization.

We record our deep sense of gratitude to our Hon'ble Vice-Chancellor, Prof. Nazir Ahmad Ganai (Patron of the Symposium), for his constant encouragement and support in shaping this event.

We extend our sincere thanks to dignitaries from the Indian Council of Agricultural Research (ICAR), in particular Dr. Poonam Jasrotia, ADG (Plant Protection & Biosafety), and Dr. V. B. Patel, ADG (Fruits & Plantation Crops), for their invaluable guidance and support in making this symposium a reality.

Special thanks are also due to Dr. Haroon R. Naik, Director Research, SKUAST-Kashmir (Co-Patron of the Symposium), for his constant encouragement and facilitation of various aspects that enabled the successful take-off of the symposium.



We owe our sincere gratitude to Dr. V. V. Ramamurthy, President, The Entomological Society of India (ESI); Dr. Sachin S. Suroshe, General Secretary, ESI, Dr. P. R. Shashank, ESI, and Dr. Suresh Nabapure for their encouragement and giving an opportunity to SKUAST-K to host this prestigious event.

We, acknowledge with gratitude the efforts of the convenors Dr. Mohammad Altaf Bhat (Director Education), Dr. Raihana H. Kanth (Director Extension Education), Dr. Shabir A. Wani (Director DPMO), Dr. Nellofar (Dean, Horticulture), Dr. Shakeel A. Mir (Dean, Agriculture), Dr. S. A. Gangoo (Dean Student Welfare), Dr. Azmat Alam Khan (Registrar), Dr. Rohitashw Kumar (Associate Dean, Agricultural Engineering & Technology), Dr. Afshan Gul (Chief Librarian), Dr. Zahoor A. Dar (Associate Director Research, Agriculture) and Dr. Masood Saleem Mir (Associate Director Extension, Animal sciences) whose untiring efforts greatly contributed to the success of this symposium.

We also extend our thanks to the Co-Convenors Dr. M. K. Dhillon (ICAR-IARI), Dr. S. Subramanian (ICAR-IARI), and Dr. A. A. Khan (Professor & Head, Division of Entomology, SKUAST-K, Shalimar) for their cooperation and dedicated efforts to make this event successful.

We are highly indebted to all chairpersons and members of the Local Organizing Committee for their invaluable logistic support and teamwork.

Sincere appreciation is due to Organizing Secretary of the Symposium, Dr. Abu Manzar and Co-organizing Secretaries Dr. Sajad Mohi-Ud-Din, Dr. Munazah Yaqoob and Dr. Sajad A. Ganie. Their dedication, tireless efforts, and consistent support at every stage were instrumental in the successful conduct of this event.

A heartfelt gratitude is extended to the students Suriya S., Showkat A. Sheikh and Madhanram G. for their continuous effort in the compilation of Abstract Book.

We also thank Mr. Sharik Majid Narwari (Secretary to Hon'ble Vice-Chancellor), Mr. Muneer Ahmad (PA to Director Research), Mr Nisar Ahmad Bhat (PRO) and Mr. Aliyas Ahmad Bhat (Stenographer to the Hon'ble Vice-Chancellor) for their efficiency in ensuring smooth execution of symposium-related tasks.

We extend our heartfelt gratitude to all distinguished guests, resource persons, delegates, sponsors, and partners for their active participation and invaluable support. We firmly believe that this academic congregation will inspire new ideas, nurture meaningful collaborations, and significantly contribute to the advancement of entomological sciences.

The generous financial support from the sponsoring organizations is also gratefully acknowledged and deeply appreciated.

Organizing Committee

National Conference on Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)

October, 8-9, 2025





Prof. Nazir A. Ganai
Vice-Chancellor

MESSAGE

It gives me immense pleasure to learn that the Division of Entomology, Faculty of Horticulture, SKUAST-Kashmir in collaboration with the Entomological Society of India, is convening a Two-Day National Symposium on *“Technological Advancements: Emerging Trends in Entomology (ESI-E TE-2025)”* during 8–9 October, 2025.



The symposium’s thematic emphasis on digital innovations in Entomology, insect conservation and ecosystem services, biodiversity under climate change, behavioural and genomic frontiers in insects, next-generation pest management strategies, commercial prospects in Entomology, and academia–industry partnerships is highly pertinent in the present context of agricultural transformation and environmental challenges. In the era of global concerns ranging from climate variability to pest dynamics, these areas of focus are crucial for developing sustainable crop protection strategies, conserving biodiversity, and fostering economic growth through commercial entomology.

The symposium also aims to bridge the gap between traditional knowledge and modern scientific advancements, highlighting the role of cutting-edge technologies such as artificial intelligence, biotechnological approaches, and molecular tools in revolutionizing entomological research and practices. By fostering dialogue across disciplines, it is expected to generate innovative approaches that integrate ecological sustainability with technological progress, ensuring resilient agricultural systems for the future.

This academic congregation will provide a vital platform for eminent scientists, researchers, academicians, and students to deliberate on frontier research, share innovative ideas, and explore collaborative opportunities. I am confident that the recommendations emerging from this symposium will serve as valuable guidance for future research priorities and policy frameworks, ultimately benefitting farmers, industries, and society at large.

I extend my warm greetings to the organizers, participants, and distinguished guests, and wish the symposium grand success in achieving its objectives.

(Nazir Ahmad Ganai)

Place: SKUAST-K, Shalimar, Srinagar
Dated: 30.09.2025

डॉ. पूनम जसरोटिया
सहायक महानिदेशक
(पादप संरक्षण एवं जैव सुरक्षा)

Dr. Poonam Jasrotia
Assistant Director General
(Plant Protection and Biosafety)



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MESSAGE

It gives me an immense pleasure to know that Division of Entomology, Faculty of Horticulture, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)” during October 8-9, 2025 at SKUAST-Kashmir.

Recent years have witnessed remarkable technological progress that is transforming the field of entomology. Innovations in molecular biology, genomics, and bioinformatics are enabling a deeper understanding of insect physiology, genetics, and behaviour, facilitating targeted pest management strategies. Advanced imaging techniques, remote sensing, and drone-based surveillance are improving the monitoring of pest populations and their spatial distribution at landscape scales. Additionally, precision agriculture tools, including AI-driven predictive models and decision-support systems, are allowing farmers to implement timely and efficient pest control measures while minimizing chemical inputs. The development of environmentally friendly approaches such as RNA interference (RNAi), sterile insect techniques, and the use of beneficial insects reflects a shift towards sustainable pest management. These technological trends not only enhance our ability to protect crops effectively but also pave the way for innovative, eco-conscious, and resilient agricultural systems.

With these advancements, India can advance in entomology by combining modern tools like genomics, AI monitoring, and precision agriculture with traditional practices, enabling sustainable pest management, higher crop productivity, and stronger food security. I hope that ESI-ETE-2025 will serve as a dynamic platform for researchers and stakeholders to exchange innovative ideas and share advancements to foster collaborations between research institutions, industry, and policymakers for accelerating the adoption of these cutting-edge solutions, positioning India as a global leader in eco-friendly and technologically advanced pest management.

I extend my heartfelt greetings and commendations to everyone involved in organizing this symposium, and I wish the event great success.

(Poonam Jasrotia)

डा. विश्व बन्धु पटेल
सहायक महानिदेशक (फल एवं रोपण फसलें)

Dr. Vishaw Bandhu Patel
Assistant Director General (Fruits and Plantation Crops)



बागवानी विज्ञान संभाग
भारतीय कृषि अनुसंधान परिषद
कृषि अनुसंधान भवन, पूसा, नई दिल्ली- 110 012
Horticultural Science Division
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110 012

Date: 01.10.2025



Message

It gives me immense pleasure to learn that the Division of Entomology, Faculty of Horticulture, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “*Technological Advancements: Emerging Trends in Entomology (ESI-EET-2025)*” during 8-9 October, 2025.

Entomology plays a pivotal role in advancing horticultural productivity, sustainability, and resilience. Insects are not only key pollinators of fruit, vegetable, and ornamental crops but also vital components in maintaining ecosystem balance. At the same time, insect-pests pose major challenges to horticultural systems by reducing yields, compromising quality, and escalating production costs. Thus, innovative research and emerging technologies in entomology are indispensable for addressing these dual aspects of maximizing beneficial services while minimizing losses caused by pests.

The thematic focus of this symposium are Digital Entomology, Insect Conservation, Biodiversity and Climate Change Impacts, Insect Behaviour and Genomics, Cutting-edge Pest Management Technologies, Commercial Entomology and Scientific-Industrial Interactions. The deliberations, research contributions, and recommendations emerging from these thematic areas are expected to provide a strategic roadmap for strengthening sustainable crop protection initiatives in India.

I extend my heartfelt congratulations to the organizers for bringing together researchers, academicians, students, industry and policy personnel on one platform. I am confident that the deliberations and knowledge shared during this symposium will greatly contribute to developing innovative and sustainable solutions in horticulture through entomological advancements.

I wish the symposium grand success.

(Vishaw Bandhu Patel)



Prof. Haroon R. Naik

Sher-e-Kashmir
University of Agricultural Sciences and Technology of Kashmir
OFFICE OF DIRECTOR RESEARCH
SHALIMAR CAMPUS, SRINAGAR -190025

Message

It gives me sense of utmost pride to learn that the Division of Entomology, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “*Technological Advancements: Emerging Trends in Entomology (EST-E TE-2025)*” scheduled to be held on 8–9 October, 2025.

This symposium is envisioned as a dynamic forum for convergence of eminent researchers, academicians, students, and industry experts to deliberate on cutting-edge innovations and transformative trends in entomological science. In the context of accelerating technological evolution within agricultural systems, the event is poised to foster interdisciplinary approaches, promote scientific exchange, and catalyze the development of forward-looking strategies to address contemporary entomological challenges.



The symposium’s thematic sessions will encompass diverse areas such as digital entomology, insect conservation and ecosystem services, biodiversity and climate change, behavioural and genomic frontiers, next-generation pest management strategies, and commercial prospects in entomology. By integrating both fundamental and applied perspectives, the event aims to strengthen the bridge between academia and industry, thereby facilitating the translation of research into tangible solutions for agricultural and societal needs.

I anticipate robust participation from stakeholders across the nation, contributing to insightful discussions under diverse thematic areas. Such engagement is vital for advancing the frontiers of entomological research and its applications in sustainable agricultural systems.

I extend my sincere commendation to the organizing committee, contributors, and institutional collaborators for their meticulous planning and unwavering commitment to the success of this symposium. May this academic congregation inspire meaningful collaborations, innovative research trajectories, and impactful outcomes.

Wishing all delegates, a productive, intellectually stimulating, and enriching experience.

(Prof. (Dr.) Haroon Rashid Naik)
Director Research, SKUAST-K



THE ENTOMOLOGICAL SOCIETY OF INDIA

(Established 1938)

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Dr. Badal Bhattacharya

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Mr. M Sai Manoj



Message

It is a matter of immense pride and privilege for the Entomological Society of India to partner with the Division of Entomology, SKUAST-Kashmir, in organizing the Two-Day National Symposium on "Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)" during October 8–9, 2025, in Srinagar, Jammu and Kashmir.

The science of entomology has always stood as a cornerstone of agricultural progress, safeguarding crops, protecting biodiversity, and ensuring food, nutritional, and livelihood security for millions. At a time when our planet faces daunting challenges posed by climate change, rapid biodiversity loss, and the ever-changing dynamics of pest populations, our discipline continues to lead innovations that both protect crops and preserve the delicate balance of our ecosystems. This symposium is thus timely and significant, as it seeks to explore frontiers ranging from digital and genomic tools to climate-smart pest management, insect conservation, biodiversity restoration, commercial ventures in entomology, and deeper partnerships between science and industry. These deliberations hold the potential to shape policies, guide innovations, and inspire breakthroughs that will support farmers, entrepreneurs, and society at large in the years ahead.

What excites me most is the opportunity this platform provides for diverse minds to interact: eminent academicians, experienced researchers, visionary entrepreneurs, and passionate young scholars. Together, such interactions will ignite ideas, foster collaborations, and lay down a roadmap for sustainable, eco-friendly, and economically viable solutions in agriculture. The collective wisdom and energy gathered here will, I am confident, shine far beyond this conference, inspiring work that touches fields and farms across India.

On behalf of the Entomological Society of India, I extend my warmest wishes and heartfelt greetings to the organizers and all participants. May these two days of dialogue and discovery strengthen our shared mission of advancing science for the well-being of humanity and the preservation of our natural world. I wish the symposium grand success and trust that it will inspire each participant to carry forward its spirit of innovation, collaboration, and service to society.

Dr. V. V. Ramamurthy
President
Entomological Society of India



SKUAST
KASHMIR

Directorate of Education

Message

It is a matter of profound satisfaction and pride that the Division of Entomology, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025) during 8-9 October, 2025.



Learning, inquiry, and innovation from the very foundation of advancement in every discipline, and the field of Entomology is no different. With the advent of digital technologies, breakthroughs in genomics, climate-smart strategies, and novel approaches to pest management, it becomes imperative to equip our students and budding researchers with the skills and vision to not only keep pace with these transformations but also to drive them forward. Academic events like this symposium provide invaluable educational opportunities, enabling learners to engage directly with distinguished scientists, scholars, and professionals. Such interactions not only enhance their knowledge base but also ignite curiosity, nurture critical thinking, and motivate them to undertake research that can create meaningful impact for agriculture and society at large.

I am confident that this event will enrich the academic community by fostering critical discussions, building interdisciplinary linkages, and promoting innovative thinking among students, scholars and practitioners. The deliberations and out comes will undoubtedly strengthen the educational foundation and research orientation in Entomology, ensuring that future generations are equipped to meet the challenges of sustainable agriculture and biodiversity conservation.

I extend my best wishes to the organizers, participants, and contributors for the grand success of this symposium.

Date: September 30, 2025

(Prof. Mohd Altaf Bhat)



DIRECTORATE OF EXTENSION SKUAST-Kashmir, Shalimar Srinagar-190025

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Message

It fills me with profound joy and satisfaction to learn that the Division of Entomology, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “*Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)*” during 8–9 October, 2025.



In the present era of dynamic agricultural challenges, the role of Entomology is not confined to laboratories and classrooms alone but extends directly to the fields and farming communities. With increasing incidences of insect-pest outbreaks, climate change impacts, and the rising demand for eco-friendly pest management strategies, there is a strong need to translate cutting-edge research into practices that are adoptable by farmers. This symposium, with its emphasis on digital innovations, biodiversity, insect conservation, genomic frontiers, and next-generation pest management, is a timely initiative that will provide a platform for researchers, extension professionals, and industry partners to deliberate on strategies for bridging the gap between science and field application.

I am confident that the outcomes of this symposium will generate practical insights and strengthen the interface between research, extension, and farmers, thereby contributing significantly to sustainable plant protection and enhanced livelihoods of farming communities.

I extend my best wishes to the organizers, delegates, and participants for the grand success of this symposium and for meaningful deliberations that will pave the way for innovations in entomology to reach the grassroot level.

Date: 30-09-2025

(Prof. Raihana Habib Kanth)
Director Extension, SKUAST-K



Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Shalimar-Sgr, J&K, India-190025

FACULTY OF HORTICULTURE

Message

I am delighted and deeply gratified to know that the Division of Entomology, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “*Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)*” during 8–9 October, 2025.



Horticultural crops, with their immense commercial importance, nutritional value, and pivotal role in ensuring livelihood and nutritional security, demand comprehensive and science-driven management. Yet, they remain highly vulnerable to insect pests, erratic climatic fluctuations, and dynamic market requirements. In this context, advances in Entomology hold strategic significance for safeguarding crop health, optimizing productivity, and strengthening ecological sustainability in horticultural systems.

Emerging frontiers such as digital agriculture, molecular and genomic applications, bio-rational interventions, and climate-resilient pest management offer transformative opportunities to reshape the future of horticulture. These technologies not only enhance the efficiency of crop protection strategies but also align with the broader goals of sustainability, profitability, and environmental stewardship.

This symposium, by bringing together horticultural scientists, entomologists, industry partners, and young researchers, provides an ideal platform to deliberate on cutting-edge innovations, foster collaborations, and address pressing challenges. The knowledge exchanged will undoubtedly contribute to the advancement of resilient and eco-friendly horticultural practices across the country.

I convey my heartfelt congratulations to the organizers and extend my best wishes for the success of this important scientific event.

(Prof. Neelofer)

Date:

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Sher-e-Kashmir
University of Agricultural Sciences and Technology of Kashmir
Faculty of Agriculture Wadura Sopore -193201

Prof. Shakeel Ahmad Mir
Dean,
Faculty of Agriculture, SKUAST-K



Message

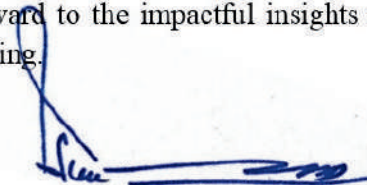
I am pleased to note that the Division of Entomology, SKUAST-Kashmir, in collaboration with the Entomological Society of India, is organizing a Two-Day National Symposium on “*Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)*”, scheduled to take place on 8–9 October 2025.

Agriculture, the cornerstone of our nation’s economy, hinges significantly on the dynamic interactions between crops and insect species. While insect pests continue to pose serious threats to crop productivity and food security, beneficial insects play a pivotal role in pollination, natural pest regulation, and sustaining vital ecosystem services. In this light, the advancement of **entomological research and technology** becomes indispensable for achieving sustainable agricultural development.

The thematic breadth of this symposium—encompassing **digital innovations, molecular tools, integrated pest management strategies, and the commercialization of entomological advancements**—is both timely and highly relevant. These emerging trends are expected to contribute meaningfully to the development of eco-friendly and precision-based pest management solutions. Such innovations are crucial for empowering farmers, enhancing resilience in agricultural systems, and ensuring long-term food and nutritional security.

I commend the organizers for curating this important academic event and creating a platform for meaningful scientific exchange. I am confident that the discussions and outcomes of the symposium will foster new collaborations, inspire actionable research, and contribute to the evolving landscape of agricultural entomology.

I extend my **best wishes to all the organizers, delegates, and participants** for the **successful conduct of the symposium** and look forward to the impactful insights and innovations that will emerge from this esteemed gathering.


(Prof. Shakeel Ahmad Mir)
Dean



DIVISION OF ENTOMOLOGY

Faculty of Horticulture,

**Sher-e-Kashmir University of Agricultural Sciences & technology of Kashmir
Shalimar Campus, 190025**

**Akhtar Ali Khan
Prof. & Head**

Message

It is with great pleasure and pride that I extend my warmest greetings to all participants of the National Symposium on “*Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025)*,” jointly organized by Division of Entomology, SKUAST-Kashmir and the Entomological Society of India.

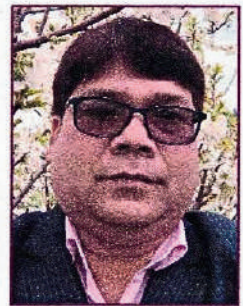
This symposium marks a significant milestone in our collective pursuit of innovation and excellence in entomological science. As we confront the evolving challenges of agriculture, climate change, and biodiversity conservation, the role of entomology becomes ever more critical.

The integration of cutting-edge technologies—ranging from molecular tools to AI-driven pest forecasting—has opened new frontiers for sustainable pest management and ecological stewardship. Advances in insect microbiome studies, pheromone-based biocontrol, and digital diagnostics are also transforming how we understand and manage insect-plant interactions, vector-borne diseases, and pollinator health.

The compilation of abstracts in this volume reflects the depth and diversity of research being undertaken across the country. It is heartening to witness the enthusiasm of young scholars, seasoned scientists, and educators converging to share insights, spark collaborations, and shape the future of entomology.

I commend the organizing committee for their dedication and vision in curating this event. May the deliberations and exchanges during the symposium inspire actionable solutions and enduring partnerships.

Wishing the symposium grand success and all participants a rewarding experience.



(Prof. Akhtar Ali Khan)

Date: 30.09.2025

ABOUT SKUAST-K

Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir is a multi-campus university established in 1982 at Shalimar, Srinagar, with territorial jurisdiction spread over temperate Kashmir and cold arid region of Ladakh. The university has five faculties, two colleges, 12 research stations and 14 Krishi Vigyan Kendras in Kashmir division and Ladakh UT. Besides teaching, research and extension the varsity has added innovation and entrepreneurship as its 4th mandate enabling it to develop the ecosystem of research and innovation focussed on food and nutritional security, socio-economic security and ecosystem health. Over the last four decades, SKUAST-K has been contributing significantly to the agricultural sector of the J&K UT by development of high-yielding crop varieties and locally relevant production technologies. The university is entrusted by the J&K Government on human resource development, training, and policy issues related to agriculture production and agricultural education.

SKUAST-K took a big leap to make J&K a model bioeconomy in the country. A pivotal role was played in scripting and now implementation of Rs.5012 crore Holistic Agriculture Development Program (HADP) for the Jammu and Kashmir, which is poised to revamp the agriculture sector of the UT. To boost the agri-exports of the region, we have framed JK EXIM Policy, as a guideline for the UT and all stakeholders.

For global competitiveness, SKUAST-K is at the forefront in embracing emerging technologies like Artificial Intelligence, IoTs and Automation, Precision and Smart Agriculture, Speed Breeding, Gene Editing through CRISPR Cas, Vaccine Technology, Regenerative Medicine using Stem Cell Technology & Conservation Technologies. Integrated Pest & Disease Management and Integrated Nutrition Management through development of bio-control agents, bio-fertilizers and bio-pesticides, is our renewed approach for protecting the soil, environment and human health. To be there, we aim to build a globally competitive human capital and in pursuit, we have developed our own Model of Agri-Education that places focus on the outcome-based education - characterized by creative, entrepreneurial and industry-ready graduates.

Presently, as per NIRF ranking (2025), SKUAST-K ranks as 7th in Agriculture & allied sectors, 36th among all state Public Universities, 75th in University category, 9th in overall category, 1st in innovations among all SAUs in the band of 11-50, & 1st in innovation & Start-Ups among Universities in J&K, SKUAST-K has earned 97 patents till date. It has nurtured and established 90 Start-Ups with Technology Readiness levels 6-7. These patents and Start-Ups shared by the students & faculty, reflect the true mission of the University of churning the bright, innovative Next Gen Global Leaders.

The Slogan, Vision, Mission, and Mandate of the University have been redefined to enable the UT of J&K to be progressive and future-ready, and lead the country in its Vision 2047 of developed India





Research Gaps in Entomological Research: A perspective

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In a globalized world, the movement of men and material has been rapidly increasing. Climate change, large-scale floriculture trade, weak quarantine, and insecticide resistance difficulty of synthesizing/market release of new molecules have all contributed to the growing problem of pest control. It is not limited to agriculture alone, but veterinary, medical, field too.

While many still believe that chemicals are the ultimate solution to insect problems, recent reports indicate that insecticides are rapidly losing their effectiveness. For instance, Rynaxypyr (Coragen, DuPont) was initially extremely effective against Lepidopteran pests but is now largely ineffective. Similarly, black thrips—accidentally introduced into India—show resistance to nearly every available insecticide and cannot be managed chemically. Red spider mites and Tetranychid mites have developed extremely high levels of resistance, leaving farmers uncertain about which chemicals to use, while also raising concerns about pesticide residues and food safety. Entomologists have yet to fully differentiate between insecticide resistance management (IRM) and pest management in general.

Furthermore, dimensions of IPM vastly differ under open-field and protected cultivation in horticulture. Similarly, IPM challenges in seed production present unique problems. The issue is not limited to crops alone. The management of ticks, mites, and other parasitic insects in livestock has also become highly challenging, with little success in controlling tick-borne diseases.

When it comes to Lepidoptera, the damage caused by caterpillars is often overestimated, while the damage caused by small sucking pests is underestimated. As Dr. C.A Viraktamath Professor of Entomology, has pointed out, pests such as leafhoppers, aphids, whiteflies, psyllids, and mites can cause enormous damage. Under global warming and with the cultivation of more susceptible varieties, the damage caused by these pests is expected to increase significantly.

In cotton, Bt cotton was initially hailed as a revolution, particularly in controlling Lepidoptera. At the same time, neonicotinoids such as imidachlopid/thiamethoxam provided excellent control of leafhoppers, leading to great success in Bt cotton IPM. However, within 10–15 years, pink bollworm evolved resistance to Bt cotton, becoming a major problem. Additionally, mealybugs and whiteflies emerged as





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serious pests, especially in Punjab. On a positive note, recent advances—such as Bayer’s work on Bt and other microbial pathogens targeting sucking pests like thrips—offer new hope. Likewise, entomopathogenic nematodes, once considered only of academic interest, are now proving effective in managing pests like white grubs.

Yet, pests once considered controllable—such as the red palm weevil, coconut rhinoceros beetle, and leaf-feeding caterpillars like *Opisina*—are re-emerging as serious threats. In Kashmir, pesticide consumption has nearly doubled in recent years (compared to fungicides), particularly following the introduction of the apple leaf miner.

Quarantine remains one of our weakest links. India’s long porous borders with China, Pakistan, Nepal and Bangladesh, along with free movement of agricultural commodities, facilitate free entry of pests and nematodes. Trans boundary movement of pests and diseases is a critical issue that the nation must address. For effective IPM, preventing the entry of major pests is far easier than managing them after establishment. When invasive pests are detected, identifying the epicentre of introduction, ensuring rapid coordination between scientists and administrators, destroying pest populations at the epicentre, and carefully monitoring surrounding areas (2–5 km radius) are essential steps. Australia and New Zealand provide excellent models of strict quarantine, whereas in India both international and domestic quarantine measures need vast improvement. Ornamental plants, particularly woody perennials, are a major pathway for pests and phytoplasma diseases. Vectors such as leafhoppers (*Hishimonus phycitis*) play a crucial role in transmitting phytoplasma which can replicate inside these vectors. Thrips are always associated with flowers and in many species of thrips the tospovirus, replicate. We may not import a plant which is carrying a virus but a leafhopper or a thrips or a psyllid vector carrying the virus which is replicating in its salivary glands to further spread of the virus. Vector components in spread of plant pathogens, especially vector efficiency, propensity are poorly understood so also the mode of transmission.

Host plant resistance remains the foundation for sustainable IPM. While breeding for resistance is extremely challenging, modern tools such as molecular breeding, MAS, gene silencing, and CRISPR-Cas technologies appear promising.

Resistance breeding or the identification of source of resistance and introgression with least linkage drag in those genes is the foundation on which IPM should rest. In an ecological world where environment is of a main concern, insecticides will not be the method of choice. Unfortunately, insect resistance through traditional breeding is





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difficult. But molecular biology offers a great challenge, great opportunity, as we saw in the case of Bt cotton, gene silencing, CRISPR-Cas and such other technologies should come very handy in IPM.

Management of vector-borne diseases require special attention. Similarly, declining organic carbon, reduced pH, and micronutrient deficiencies increase nematode infestations. Nematodes, often invisible, are a hidden threat that could undermine food and nutritional security if left unchecked. Nematicides are not long-term solutions in management. Instead, increasing soil organic matter to ~1.5%, using bio-pesticides, oil cakes provide sustainable alternative.

IPM and IRM are dynamic. Today's minor pests may become tomorrow's major pests, while some historically important pests may decline. For example, the citrus blackfly, once devastating enough to establish NRC-Citrus, has now nearly disappeared, while many minor pests have risen to prominence. While financial support from the government is necessary, what is equally important is scientific commitment, irrespective of personal gain.

Every agricultural university and entomology division should specialize in particular insect groups (families or orders), creating a pool of experts with deep taxonomic and ecological knowledge. This must go hand in hand with molecular systematics, which will be crucial when dealing with invasive pests. Awareness of global pest scenarios is vital

Temperate pests have received very little attention despite their economic importance. For example, in Kashmir and other hilly regions, nearly 70% of the economy depends on temperate fruits and industrial opportunities are limited. IPM is critical for farmer livelihoods. Reducing cultivation costs—by minimizing pesticide use and promoting science-led, sustainable agriculture—will be key to improving farmer income and ensuring food security.



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Insect-Plant Interactions under Changing Climate Conditions: Implications for Pest Management

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Climate change is profoundly altering insect–plant interactions by influencing pest distribution, life cycles, and feeding behaviour, thereby disrupting the natural balance in agroecosystems. Rising temperatures, erratic rainfall, and elevated CO₂ levels can increase pest outbreaks and reduce the effectiveness of conventional pest control methods. Further, unsustainable agricultural practices like indiscriminate use of agro-chemicals are negatively impacting climate change, soil quality and biodiversity, environment and human health. In this context, natural farming (NF) offers a sustainable alternative by fostering biodiversity, enhancing soil and plant health, and promoting ecological resilience. Through the use of bio-inputs, habitat diversification, and conservation of beneficial insects, NF strengthens the crop's inherent defense mechanisms, reducing pest pressure and dependence on chemical pesticides. Thus, integrating NF principles into pest management strategies becomes crucial for maintaining agricultural productivity and ecological balance under changing climate conditions.

Several studies have reported that the beneficial effects of NF in insect pest management. The companion crops (non-host crops) grown with the main crop can emit organic chemicals which attract biocontrol agents and repel the insect pests. They also restrict or hinder the movements of insect pests thereby damage to susceptible plants will be minimised. Rana et al. (2021) reported delayed pest incidence by 1-3 weeks under NF system when cabbage (cv. Pride of India) was intercropped with chickpea (legume), radish (cash crop) and mustard (trap crop) in comparison to chemical based farming system (CF) where cabbage was grown as the sole crop. NF attracted more natural enemies (7 species) than CF (5 species), with the occurrence of *Diadegma semiclausum* (Hellen) as an additional important bioagent. The Shannon Index described the NF system as a more diverse ecosystem in terms of natural enemies against insect-pests. Vishwajeet (2020) recorded five species of insect-pests viz. jassid, *Amrasca biguttula biguttula* (Ishida), brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guen), greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), cotton aphid, *Aphis gossypii* (Glover), serpentine leaf

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miner, *Liriomyza trifolii* (Burgess) and blister beetle, *Mylabris pustulata* (Latreille) in both the Farming Systems. Among natural enemies *C. septempunctata*, *H. variegata*, *E. balteatus*, *Ischiodon scutellaris* (F), were present in CF system whereas *C. septempunctata*, *H. variegata*, *Oenopia sexareata* (Mulsant), *E. balteatus*, *I. scutellaris* were present in SPNF system. Yankit *et al.* (2021) cultivated tomato under NF, organic (OF) and CF, and observed that incidence of invasive leaf miner (*Tuta absoluta*) was significantly less in NF as compared to OF and CF. They further observed that *T. absoluta* appeared 4 weeks later in NF than CF. In Spiti Valley, NF practices successfully controlled woolly apple aphid, *Eriosoma lanigerum* (Hausmann) by using low-cost locally sources inputs when compared to CF methods (Vashisth *et al.*, 2023). Bakshi *et al.* (2023) reported 11 species of natural enemies in apple orchards maintained under NF system and out of these eleven species, four species of coccinellids, five species of syrphids, one species of green lacewing and one species of Chalcidoid wasp and in CF system only 08 species of natural enemies in apple ecosystem were recorded. Simpson index, Shanon index, maximum diversity, species evenness (J), species dominance were 1.50, 0.88, 2.16, 2.39, 0.90 and 0.10, respectively, whereas in CF system the value of these indices were 1.33, 0.86, 2.07, 0.94 and 0.06, respectively. Survey conducted in six apple growing district of HP revealed that the natural enemies population were comparatively higher in NF orchards as compared to CF orchards (Verma *et al.* 2025).

The interactions among the different crop plants in the NF ecosystem have a great impact on insects diversity. Intercropping/ cover cropping/ border crop, traditional agricultural methods and insect biodiversity in an agroecosystem have important consequences for the conservation of biodiversity, contributing to the efficient biological control programme, besides NF helps in recycling of nutrients, improving soil health, increasing productivity and crop health. Several studies have reported the benefits of agroecological interventions under NF in protection of natural ecosystems, promoting profitability and environmental sustainability (Berger *et al.* 2025; Yadav *et al.* 2025; Behl *et al.* 2024).

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Crop Grouping and Harmonised use of Pesticides

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Globally 40% of crop is lost to pests and diseases. To prevent such losses chemical pesticides are employed to protect crops and food commodities from insect pests, weeds and diseases. Pesticides play a key role not only to prevent crop losses but also improve farmers livelihood from farm income. Their non-judicious use, however, can result the residues to exceed above the MRL and challenge food safety and international trade. Any pesticide for its use on crop needs to possess legal sanction with an approved limit of residues called MRL. Of more than 554 crops grown in India hardly 15-20% of the high-volume low value crops enjoy label claim for use of pesticides. While rest of the crops, mostly constituting minor crops (spices, specialty, vegetable and most fruits etc.), do not enjoy approved use of pesticides and contributes to off-label use of pesticides. Cost of registration of each crop-pesticide combination needs approx. INR one crore (INR 10 million). Theoretically, if a pesticide could manage pest on every crop (about 554) and is intended to be registered for use, then the total cost would work out to be INR 554 crores. To enable use of all 339 pesticides (pesticides & biopesticides) registered in the country, this cost would assume a whopping dimension to the tune of INR 1,87,806 crores. Ironically, the industry finds uneconomical to register pesticides on every crop, individually as their returns do not commensurate with the trade they do. The helpless farmers, howsoever concerned, are compelled to use them invariably, to protect their crops from the losses irrespective of their approval or not, for use on crops. Thus, the off-label use of pesticides for crop protection is a necessary evil, not only in India but world over. Consequentially, it is the consumers and the nation at large who suffer respectively, from the compromised biosafety and trade restrictions of the importing countries. For farming under such challenging conditions of biotic stresses, crop grouping and group based MRL, becomes a compelling case for science-backed, biosafety compliant, and economically rational solution for harmonised use group of pesticides.

This presentation outlines the strategies that could help mitigate the challenges arising out of the off-label use of pesticides through adoption of group MRLs approach.





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ABSTRACTS



Theme I

Digital Entomology - Insect Pest Surveillance, Pest Diagnostics and AI Applications.





Artificial Intelligence (AI) and Digital Entomology: Applications, Challenges, and Future Prospects

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Artificial Intelligence (AI) is a broad discipline of computer science that enables machines to perform tasks which normally need human intelligence. Machine Learning (ML), a subset of AI, allows computers to learn patterns from data and makes predictions. Deep Learning (DL), an advanced form of ML, uses artificial neural networks, similar to the human brain, to automatically find, extract and learn complex features from large amount of data. In entomology, AI-powered tools have proven invaluable by enabling quick insect identification, and recognition of pest damage symptoms. These applications also assist in monitoring insect behaviour, assessing their physical attributes and growth patterns, and determining sex, necessary for breeding studies. Furthermore, AI models support the conservation of insect pollinators, while also forecasting pest populations and outbreaks, thereby strengthening early warning systems and timely management. Such technologies have revolutionized traditional entomological studies by making them faster, scalable, and more accurate. However, several challenges remain, including scarcity of large and entomologically validated balanced datasets; difficulties posed by field conditions such as variable light, occlusion, and overlapping insects; often high computational demands; and limited accessibility for small farmers. Addressing these challenges requires collective efforts to establish open-access image repositories, standardize annotation protocols, and design lightweight models deployable on mobile platforms. Integration with digital tools such as Internet of Things (IoT) sensors, unmanned aerial vehicles (UAVs), and cloud-based decision support systems will further enhance the role of AI in entomology. The prospects of digital entomology extend beyond pest management into biodiversity monitoring, conservation biology, ecological modelling, and early detection systems for invasive species. By reducing the over-reliance on pesticides, improving diagnostic efficiency, and enabling precise interventions, AI can significantly contribute to sustainable agriculture and ecological resilience.



Recent developments in forecasting and modelling: A case study of cotton pink bollworm using Degree Day approach

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The pink bollworm (*Pectinophora gossypiella*) remains a major threat to cotton, with outbreaks closely linked to temperature variations. Accurate prediction of pest development and emergence is vital for effective pest management under changing climates. Degree-day (DD) models, which estimate insect development based on cumulative heat units, have emerged as robust tools for forecasting pest phenology. Building on extensive field and laboratory data, a DD-based phenology model for pink bollworm has been developed and validated across diverse cotton-growing regions of India, spanning subtropical and semi-arid tropics. The model successfully predicted developmental thresholds, thermal requirements, and stage-specific phenology with high accuracy, enabling reliable forecasts of moth emergence, population peaks, and infestation risk windows. Such predictive capacity is invaluable for optimizing sowing dates, scheduling timely interventions, and reducing pesticide dependence. Recent advances incorporating **rate summation and cohort updating approaches** further refine DD-based models by capturing variability in stage transitions and age-structured populations. These modelling frameworks provide deeper insights into temperature–life cycle interactions and are essential for developing climate-resilient, pest-smart cotton protection strategies.





DIGE 01

Assessment of Imidacloprid Residues in Apples from High-Density Orchards of Kashmir: Detection, Quantification, and Health Risk Evaluation

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The widespread and indiscriminate use of pesticides, coupled with their environmental persistence, has led to contamination of water bodies, vegetation, and aquatic life. Human exposure occurs routinely, particularly through food commodities, fruits often exceeding Maximum Residue Limits (MRLs), posing potential health risks. In light of this, a study was undertaken to evaluate the dissipation behaviour and health risk of imidacloprid residues in apple fruit. Imidacloprid 17.8 SL was applied at 0.03 percent (recommended) and 0.06 percent (double dose) on the Red Delicious cultivar in a High-density Plantation (HDP) orchard at SKUAST K, Shalimar, one month before harvest. Fruit samples were collected at 0, 1, 3, 5, 7, 10, 15, 20 and 30 days post application and analysed using High Performance Liquid Chromatography (HPLC). At 0.03 percent, initial deposits were 1.79 ± 0.012 , dissipating 98.82 percent in 15 days, with a half-life of 2.56 days and a waiting period of 5.8 days. At 0.06 percent, initial deposits were 2.10 ± 0.012 , dissipating 99.38 percent in 20 days, with a half-life of 3.01 days and a waiting period of 8.47 days. Theoretical Maximum Residue Contribution (TMRC) values at both concentrations remained below the Maximum Permissible Intake (MPI) of 3.6 milligrams per day throughout. These findings underscore the importance of monitoring pesticide residues to ensure consumer safety and guide responsible agricultural practices.

Keywords: Dissipation, HPLC, Half-life, HDP orchard, Imidacloprid, Pesticide residue, TMRC, Waiting period.





Host Plant Preference based on Comparative Life Table Analysis of *Tetranychus urticae* Koch (Acari: Tetranychidae) on Selected Vegetable Crops

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The quality of host plants plays a critical role in the survival, development, and reproductive success of the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), a major pest affecting vegetable crops globally in both open and protected cultivation systems. This study evaluated the host preference and life table parameters of *T. urticae* on four widely cultivated vegetable crops, viz; Tomato (*Solanum lycopersicum*), Brinjal (*Solanum melongena*), Cucumber (*Cucumis sativus*), and Bottle gourd (*Lagenaria siceraria*) under controlled laboratory conditions (25 ± 2 °C, 65 ± 5 % RH, and a 16:8 h light: dark photoperiod). Although *T. urticae* completed its life cycle on all hosts, significant differences were observed in survival, developmental time, and reproductive performance. Survival rates ranged from 39.12 per cent on tomato to 98.5 per cent on cucumber. Key life table parameters, including the intrinsic rate of increase (r_m), net reproductive rate (R_0), finite rate of increase (λ), and doubling time (DT), varied significantly across host plants. The highest R_0 (4.87) and λ (1.22) were recorded on cucumber, while tomato showed the lowest values ($R_0 = 1.97$; $\lambda = 1.02$). Similarly, r_m was highest on cucumber (0.217), followed by bottle gourd (0.213) and lowest on tomato (0.185). Doubling time was shortest on cucumber (2.01 days) and longest on tomato (5.11 days). These results suggest that cucumber, bottle gourd, and brinjal are highly suitable hosts for *T. urticae*, whereas tomato is relatively less conducive to its development and reproduction, suggesting host plant selection may be critical for pest management strategies.

Keywords: Fecundity, Life table parameters, Plant resistance, *Tetranychus urticae*, Vegetable crops





DIGE-P 01

Antixenotic Resistance Mechanisms in Brinjal (*Solanum melongena* L.) Genotypes against Shoot and Fruit Borer (*Leucinodes orbonalis*) Under Kashmir Conditions

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Brinjal (*Solanum melongena* L.) is a vital vegetable crop, but its production is severely threatened by the shoot and fruit borer, *Leucinodes orbonalis*, a pest that causes significant yield and quality losses. To identify resistant sources, the present study was conducted at the Urban Technology Park, Habak, SKUAST-Kashmir during Kharif 2024, where forty genotypes (20 round and 20 long) were evaluated under unsprayed field conditions in a randomized complete block design with three replications. Seasonal pest incidence was monitored using pheromone traps baited with SKUAST-K lure and commercial lures. The first moth catch was recorded in the 27th SMW (0.67 moths/trap), peaking at the 32nd SMW (6.33 moths/trap), and declining thereafter, with trap catches showing positive correlation with evening relative humidity and negative correlation with wind speed. Significant differences in resistance were observed: shoot damage ranged from 1.71–11.21% (round) and 3.49–10.03% (long), fruit damage on number basis from 3.18–14.28% (round) and 2.66–17.52% (long), and on weight basis from 2.01–11.50% (round) and 2.01–13.29% (long). Genotypes HVR-18 and HVL-19 showed the lowest infestation, while VR-03 and VL-07 were highly susceptible. Morphological attributes such as greater pericarp thickness, higher ratio of seedless area (RLSA), rough calyx, and light fruit colour were strongly associated with reduced pest preference, indicating their role as antixenotic resistance traits. These findings highlight the potential of resistant genotypes in developing sustainable and eco-friendly pest management strategies for brinjal cultivation.

Keywords: Antixenosis, Brinjal, Morphological traits, Resistance, Screening





DIGE-P 02

Artificial Intelligence and Detection of Insect Pests Using Machine Learning Architecture Approach

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Automatic identification and detection of insect pests are of great importance for decision-making in pest control. Automated insect identification has attracted increasing attention across several research domains, including entomology, environmental science, and agricultural engineering. A variety of factors influence the advancement of automated insect detection and monitoring systems. Traditionally, insect monitoring has relied on attractants and traps; however, computer-based automatic detection and monitoring methods have now been developed for many pest species. The use of artificial neural networks (ANNs), sensors, and machine learning algorithms is particularly valuable for understanding insect population decline, species distribution, and long-term monitoring. Deep learning models, especially those designed for image analysis, can extract meaningful features from images and learn to distinguish between species. These approaches hold significant potential for automatic detection and classification of insects in videos and time-lapse images for monitoring purposes. Deep learning and computer vision technologies can be leveraged to create novel, high-throughput systems for pest identification, detection, and monitoring. Such systems can improve predictions of pest occurrence and abundance, particularly for economically important species, thereby strengthening integrated pest management (IPM) strategies. The present paper aims to provide an overview of methods for automatic detection and monitoring of insect pests, with a focus on major orders such as Diptera (fruit flies), Lepidoptera (moths and butterflies), Hemiptera (sucking insects), and Coleoptera (beetles and weevils), which have been the subject of most relevant research. This integrated approach highlights the potential of artificial intelligence in advancing automated insect classification and IPM practices.

Keywords: Artificial Intelligence (AI), Computer Vision, Deep Learning (DL), Machine Learning (ML), Sensors and Smart Traps.





DIGE-P 03

Development of Murder Hornet Detection, Tracking and Neutralization System Based on Artificial Intelligence and Machine Learning

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Honeybees are vital to India's agriculture, sustaining pollination, biodiversity, and rural livelihoods. Yet, invasive hornet species particularly the Asian giant hornet (*Vespa velutina*) pose a severe threat, decimating colonies, reducing honey yields, and endangering food security. Conventional control strategies such as bait traps and nest destruction are hazardous, inefficient, and inaccessible to small-scale beekeepers. Addressing this urgent challenge, the present study introduces an Artificial Intelligence (AI) and Machine Learning (ML)-enabled smart detection and neutralization system designed to protect beehives through precision automation. The system integrates advanced computer vision with real-time actuation. A curated and annotated dataset of hornets and honeybees was developed using Roboflow, enabling robust training of a YOLOv11n object detection model. Optimized for edge computing, this lightweight architecture employs transfer learning to deliver high accuracy while minimizing false positives that could endanger pollinators. In operation, the trained model runs on Python to process live video streams from hive-mounted cameras. Upon hornet detection, positional data are transmitted via serial communication to an Arduino Mega2560 microcontroller, which actuates a high-torque servo motor linked to neutralization mechanisms such as trap doors or deterrent sprays. This closed-loop design ensures near-instantaneous response, with detection-to-action completed in milliseconds. System validation in controlled and semi-field conditions demonstrated high mean average precision (mAP), minimal latency, and effective neutralization. These results confirm the feasibility of AI-driven apiculture defense systems. Beyond safeguarding bee colonies, the framework offers broader applications in pest surveillance, precision agriculture, and sustainable ecosystem management positioning it as a scalable solution for climate-resilient food security.

Keywords: Arduino automation, Artificial Intelligence, Computer vision, Honeybees, Murder hornets, Machine Learning, YOLOv11n





DIGE-P 04

Hyperspectral Imaging for Pest-Induced Stress: Early Detection for Apple and Saffron in Kashmir

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The apple orchards and saffron fields are vital to Kashmir's agriculture and overall economy. However, pests like apple aphids, codling moths, woolly apple aphids, and saffron thrips cause huge yield and quality losses each year. Traditional scouting methods are slow, labour-intensive, and do not fit the valley's fragmented, terraced farms. Hyperspectral imaging is an innovative, non-invasive approach which can be used to capture plant stress signals that are not visible to the naked eye in the early stages. Unlike the human eye, which sees only red, green, and blue wavelengths, hyperspectral imaging records hundreds of continuous spectral bands. Each plant has a unique spectral signature which allows for the detection of subtle changes caused by pest feeding long before any visible symptoms show. Thus, hyperspectral fingerprint library of pest-induced stress in apple and saffron crops will help to detect any stress signals. The main innovation in adapting advanced Hyperspectral Imaging technology for agriculture in Kashmir is the smart and easy data access farmers and cooperatives will get through: i) Drone-mounted sensors that scan orchards and saffron fields at scale, ii) Portable handheld devices at KVKs and farmer cooperatives for on-site scans. iii) A mobile app that gives real-time, easy-to-understand alerts. Hyperspectral Imaging provides an early warning system for pest outbreaks ensuring sustainable, climate-smart agriculture while protecting the region's ecological and economic heritage. Economic stability will improve because of reduced yield losses. It promotes scientific progress and helps to build a region-specific spectral stress library for Kashmiri crops, positioning local institutions as leaders in digital entomology.

Keywords: Early detection, Fingerprint library, Hyperspectral imaging, Pest-induced stress, Spectral signature





DIGE-P 05

Key Pests of Kalazeera (*Bunium persicum*) and Their Sustainable Management Through Integrated and AI-Based Approaches

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Kalazeera (*Bunium persicum*), commonly known as black cumin, is a high-value medicinal and spice crop cultivated in temperate regions. Despite its economic and therapeutic significance, its production is severely constrained by a range of insect pests and diseases. Major pests affecting *Kalazeera* include aphids, cutworms, white grubs, and seed borers, while fungal pathogens such as *Alternaria* and *Fusarium* further aggravate crop losses. Effective pest management in *Kalazeera* remains challenging due to the crop's cultivation in marginal and hilly areas, limited availability of chemical control recommendations, and growers' preference for eco-friendly practices. Integrated Pest Management (IPM) strategies are emerging as sustainable solutions, combining cultural practices (timely sowing, crop rotation, and field sanitation), biological control (use of natural predators and entomopathogenic fungi), and judicious application of biopesticides and need-based insecticides. Recent advances also highlight the potential of botanical extracts, microbial formulations, and pheromone-based monitoring for reducing pest pressure without compromising crop quality. Nowadays new AI based methods like Smart traps, Drone/UAV scouting and target spraying, IOT sensor network & target AI (early warning), automated pheromone traps & smart dispenser's, AI enhanced bio-control (mass rearing and release timing), Low-cost smart phone image recognition for farmers is also used to control pests of *Kalazeera*. This paper reviews pest diversity, their economic impact, and eco-friendly management approaches for *Kalazeera*. It emphasizes the need for location-specific IPM models and strengths pest management in *Kalazeera* and also contributes to the livelihood security of small and marginal farmers cultivating this niche spice crop.

Keywords: AI based methods, *Bunium persicum*, Eco-friendly control, Insect pests, *Kalazeera*





DIGE-P 06

Pheromone Mediated Monitoring of *Plutella xylostella* L. (Lepidoptera: Plutellidae) Infesting Cruciferous Crops in Kashmir, India

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Plutella xylostella, commonly known as the Diamondback moth poses significant challenges to Cole crops, impacting their growth and ultimately affecting yields. Its rapid reproduction coupled with its ability to develop pesticide resistance has elevated the Diamondback moth to a critical concern for farmers and agricultural systems worldwide. The adult population of Diamondback moth was monitored during the year 2023 and 2024 for two cropping seasons (Kharif and Rabi season) at Vegetable Experimental Field, Faculty of Horticulture, SKUAST-K Shalimar using three different traps (Polyethylene funnel trap, yellow sticky trap and Water pan trap) lured with two *P. xylostella* synthetic sex lures (Commercial Tapas and SKUAST-K lure). During the year 2024 in both the Kharif and Rabi season, in all the traps (Polyethylene funnel traps, Water Pan trap and yellow sticky trap) baited with Tapas lure, the adult moth catch of *P. xylostella* was highest (26.14, 19.57 and 12.99; and 21.81, 15.24 and 8.66 moths per trap in both the respective seasons) in comparison to adult moth trap catch in year, 2023 (23.81, 17.23 and 10.66; 16.44, 12.05 and 3.26 moths per trap in Kharif and Rabi season, respectively). Similarly, in SKUAST-K lure baited in all the three traps, during both the Kharif and Rabi season, 2024, the trap catch of adult moth *P. xylostella* was on a higher side (16.57, 12.48 and 6.54; and 12.24, 8.15 and 2.66 moths per trap) in comparison to adult moth trapped during the respective seasons in the year, 2023 (14.23, 10.14 and 4.21; 10.35, 4.81 and 1.54 moths per trap).

Keywords: Diamondback Moth, Lures, Monitoring, Polyethylene Funnel Trap, Water Pan Trap





DIGE 01

**Development of Simple Template-Based LAMP Assay for Rapid,
On-Site Detection of Melon Fly, *Zeugodacus cucurbitae* (Coquillett)
(Diptera: Tephritidae)**

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The melon fly, *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae), is an economically significant invasive tephritid pest native to India, known for its broad host range and severe infestation. Accurate and rapid identification of this pest is critical for effective management. To facilitate specific detection, a Loop-Mediated Isothermal Amplification (LAMP) assay, termed Melon fly-LAMP has been developed targeting the mitochondrial gene cytochrome c oxidase subunit I (COI). This assay enables identification of all stages of *Z. cucurbitae* within 40 minutes at 60 °C. Cross-reactivity test with five closely related non-target species, *Zeugodacus tau*, *Bactrocera dorsalis*, *B. divenderi*, *B. zonata*, and *B. correcta* confirmed the assay's high species specificity. Sensitivity analyses demonstrated detection limits of 1×10^{-12} ng/ μ L for genomic DNA and 1×10^{-16} ng/ μ L for plasmid DNA. The assay was also effective in detecting all stages of *Z. cucurbitae* under laboratory set up. Field applicability was assessed using various crude extraction methods, and extraction using bidest (ddH₂O) was found ideal. This assay was successfully validated under field and vegetable market conditions using pheromone-trapped flies and larva from infested fruits, achieving consistent detection within 40 minutes at 60°C following ddH₂O-based crude extraction and incubation. The assay was further validated using target insects from six geographical location across the India. The Melon fly-LAMP assay demonstrates high sensitivity, specificity, repeatability, and field compatibility, making it a robust molecular tool for surveillance and biosecurity interventions against *Z. cucurbitae* at sensitive points.

Keywords: Crude insect-extract, Fruit flies, Identification, LAMP, Point of care





Role of Domain Expert in Digital Applications-Crop Protection in Rice -A Case Study

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Many digital technologies with emphasis on delivering pest diagnosis at the farmers doorstep are available. In this endeavour many images based mobile applications, videos, web-based apps etc. have been developed having crossed the language barriers. Most of the applications do identify the damage and serve as tutorials giving instructions with the description of ETL in the recommendation to correct the pest / disease problem. But by the time symptoms appear, the damage is already visible in the field for example silver shoots by gall midge or white ear by stem borer. In how many instances could he get the diagnosis well in time to take the preventive measures before the damage reaches the ETL level. Some of the white heads are confused with symptoms of neck blast or Bakanae where the intervention of domain experts is essential to incorporate the decisions through queries. How would these apps address a situation of problem of multiple stress in high production systems where the symptoms are more complex. Hence, the development of apps should aim at prognosis. The model would be to have a query inserted to complement the images in the data base. There is a dire need to explore the utility of AI models for identifying the incidence of cryptic pests like midges and borers. The app. should be dynamic to update the latest recommendations in the pest management with the knowledge of the domain expert. Integration of a tutorial app with actual diagnosis would be more apt.

Keywords: AI Model, Diagnosis, Diseases, Pests, Diseases Digital applications





Short Term Cold Storage and Emergence Dynamics of Cocoons of *Cotesia ruficrus*, a larval Parasitoid of *Mythimna separata*

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Freshly formed cocoons of *Cotesia ruficrus* were stored at -1, 5, 10 and 15 °C for a duration of 5, 10, 15, 20, 25 and 30 days and their viability studied. The study revealed adult emergence as 85.06, 76.52, 73.29, 72.45, 66.80, and 61.91 per cent at -1°C when stored for 5, 10, 15, 20, 25 and 30 days respectively. Adult emergence tended to increase with increase in temperature and storage duration. Emergence of parasitoids ranged 85.06 to 92.19, 76.52 to 89.08, 73.29 to 87.73, 72.45 to 84.62, 66.80 to 81.22 and 61.91 to 0.00 when stored for 5, 10, 15, 20, 25 and 30 days respectively. The cocoon could not be stored beyond 25 days at 15°C and started emerging in the refrigerator itself. Cold storage of cocoons of *Cotesia ruficrus* for 5 to 30 days at -1°C to 15°C indicated a gradual fall in female emergence from 71.20 to 45.69. Maximum and minimum female emergence was noticed at 15 °C for 5 days and -1°C for 30 days of storage. Male emergence depicted a gradual rise from 5 to 30 days at all low temperature storage. Maximum and minimum emergence of males was found at -1°C and 15 °C at all storage duration. Sex ratio (F:M) was female biased for 25 days of cold storage except at -1°C where male sex ratio was observed and it tended to rise with increase in storage temperature but decreased with period of storage. Longevity of emerged female and male individuals under unfed condition, was found maximum and minimum at 15°C (69.60 and 55.20 hrs) and -1°C (8.16 & 3.84 hrs) when stored for 5 and 30 days respectively.

Keywords: Cold storage, *Cotesia ruficrus*, Emergence, Longevity, *M. separata*





DIGE 04

Survey and Molecular Identification of *Brevicoryne brassicae* (Linnaeus, 1758) in Cruciferous Crops of Ladakh, India

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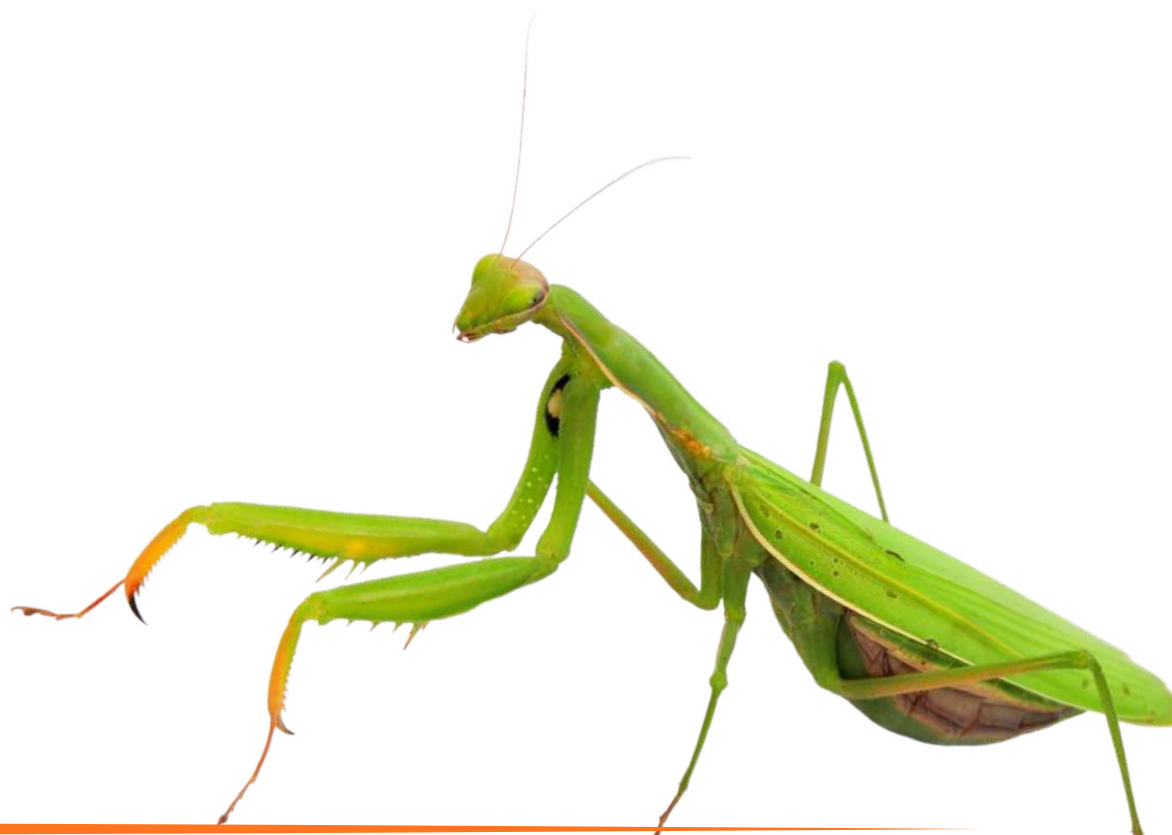
The cabbage aphid, *Brevicoryne brassicae*, is a serious pest of cruciferous vegetables, but its distribution in high-altitude regions like Ladakh is not well documented. A survey of 15 villages in Leh district, Chuchot, Phey, Thiksay, Sabo, Tukcha, Gangles, Sakti, Chemray, Alchi, Saspol, Achinathang, Garkon, Baima, Dhomkar, and Lehdo, revealed infestations of *B. brassicae* on multiple cruciferous hosts, including cabbage, cauliflower, knol khol, broccoli, swede, and collard. The pest was present at all surveyed sites, indicating its widespread occurrence in local vegetable production. Morphological identification was supported by DNA barcoding of the mitochondrial COI gene, and three sequences of *B. brassicae* from Ladakh were successfully submitted to the NCBI GenBank database under accession numbers PV661931, PV662038, and PV662054. This represents the first molecular confirmation of *B. brassicae* from the region. Our findings provide baseline information on its distribution and highlight the need for targeted management strategies to protect cruciferous crops in this fragile agroecosystem.

Keywords: *Brevicoryne brassicae*, Cruciferous crops, DNA barcoding, Ladakh, Pest



Theme II

**Insect Conservation, Biodiversity and
Climate Change Impact - Invasive
Insect Species: Global Challenges
Strategies & Opportunities, Impact of
Climate Change on Insect-Pest
Dynamics, Insect-Plant Interactions
in a Changing Climate.**





Plant Quarantine: A Vital Strategy for Managing Invasive Agricultural Pests

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Invasive alien species (IAS) are organisms that spread beyond their natural range and pose threats to native biodiversity, ecosystems, and even the economy. India has been heavily impacted by these species, with nearly 40% of its flora consisting of non-native plants, many of which are invasive. Such invasions often result in certain species turning into pests or driving native species towards extinction. Their significance is evaluated in terms of the damage they cause to human health, livelihoods, biodiversity, and the economy. As a member of both the Convention on Biological Diversity (CBD) and the World Trade Organization (WTO), India is obligated to manage IAS. Article 8(h) of the CBD stresses the need to prevent their introduction, while the WTO's Sanitary and Phytosanitary Agreement seeks to stop the spread of exotic plant and animal pests, some of which can become invasive in new regions. To address these risks, most countries enforce quarantine regulations to limit the movement of commodities that may harbor invasive species. In India, any alien species not yet recorded but with invasive potential is treated as a quarantine pest, requiring a thorough Pest Risk Analysis (PRA) before being allowed entry. The Plant Quarantine (Regulation of Import into India) Order, 2003, which ensures compliance with both CBD and WTO requirements which categorizes agricultural imports into four groups: (a) prohibited species (Schedule IV); (b) restricted species, importable only through designated institutions (Schedule V); (c) restricted species permitted with additional pest-free declarations and treatment certifications (Schedule VI); and (d) plant material meant for consumption or processing, allowed with a standard Phytosanitary Certificate (Schedule VII). It also specifies requirements for over 700 agricultural commodities, more than 1,200 quarantine pests, and 57 invasive weeds. The Ministry of Environment, Forest and Climate Change (MoEF&CC) is the lead agency for India's negotiations under the CBD, while the Ministry of Agriculture and Farmers Welfare oversees quarantine, surveillance, and control measures. However, MoEF&CC still lacks a clear policy or mechanism for IAS management. This gap highlights the urgent need for a unified strategy that integrates existing fragmented regulations, strengthens biosecurity, and aligns with global standards. Additionally, India must invest in research, training, capacity building, collaboration, and information exchange at both national and regional levels to effectively tackle the growing challenges posed by IAS.





Exploring Innovative Ecological Engineering approaches in Insect-Pests Management

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Ecological Engineering emerged as an innovation technology for considering pest management tactics that are created on cultural practices and up-to-date by ecological information rather than on high technology methods such as synthetic pesticides and genetically engineered crops. Usually, agro-ecosystems are unfavorable environments for natural enemies due to high levels of disturbance. There is need to integrate new approach to interface ecosystems with technology to create new, hybrid systems. Ecological engineering, a form of conservation biological control, is an ecologically based approach aimed at favoring natural enemies and enhancing biological control in agricultural systems. The goal of ecological engineering is to create a suitable ecological infrastructure within the agricultural landscape to provide resources such as food for adult natural enemies, alternative prey or hosts, and shelter for survival in adverse conditions. Most of the Ecological engineering techniques attempts with alternative food sources have involved hymenopteran parasitoids, Diptera may benefit as well. Quantifying the impact of different nectar sources on parasitoid survival and fecundity has yielded important information on which plant species to retain or introduce into an agroecosystem. These resources must be integrated into the landscape in a way that is spatially and temporally favorable to natural enemies and practical for producers to implement. The potential of integrating the goals of ecological engineering for the conservation of natural enemies, enhanced biodiversity and natural agricultural pest management with organic amendments. Many of the proximate factors identified as limiting the effectiveness of natural enemies in agro-ecosystem can be viewed as direct results of the disturbance regimes imposed on these systems. In particular, the ubiquity of pesticides use in crop production systems has posed a limitation to the successful implementation of biological control. A focus of many past conservation efforts has been to seek more selective pesticides, or to time the use of pesticides to minimize their negative impacts on natural enemies. Recently, increasing attention has been paid to conservation practices that seek to alter the quality of the natural enemies habitat for biodiversity conservation and sustainable pest management.





Seed Spices Crops: Important Source for Predators/parasitoids and Pollinators

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Seed spices represent the largest group within the spice category, comprising crops such as coriander, cumin, fennel, fenugreek, celery, ajowan, dill, and anise. These spices are valued for their aromatic and pungent properties and are consumed both in whole and processed forms, primarily as flavoring and seasoning agents. While most seed spices belong to the family *Apiaceae*, exceptions include fenugreek (*Fabaceae*) and nigella (*Ranunculaceae*), with their primary centers of origin in the Mediterranean region and Southern Europe. In India, commercial cultivation is concentrated in Rajasthan and Gujarat, with smaller-scale production in Madhya Pradesh, Punjab, Uttar Pradesh, Bihar, and Andhra Pradesh. The flowers of seed spice crops are typically colourful, strongly fragrant due to volatile compounds, and rich in nectar produced by well-developed nectaries. Flowering generally extends for a month or longer, making these crops highly attractive to a wide diversity of insects, including beneficial groups such as predators, parasitoids, and pollinators. Crops like cumin (*Cuminum cyminum L.*), fennel (*Foeniculum vulgare L.*), coriander (*Coriandrum sativum L.*), dill (*Anethum graveolens L.*), and anise (*Pimpinella anisum L.*) are particularly rich in insect visitors. Among predators, coccinellids such as *Coccinella septempunctata*, *Menochilus sexmaculatus*, *Hippodamia variegata*, *Cheilomenes sexmaculata*, and *Brumoides suturalis* occur abundantly, with populations reaching 4–6 beetles per umbel over three consecutive weeks. Other important predators include syrphid flies (*Episyrphus balteatus*, *Ischiodon scutellaris*) and lacewings (*Chrysoperla carnea*). Parasitoids are also significant, with *Aphidius* spp. recorded as key regulators of aphid populations, showing more than 25% parasitism rates. Pollinators, especially honey bees, constitute the major floral visitors and play a vital role in enhancing pollination and yield. Species-specific preferences have been observed: *Apis florea* dominates on most crops except nigella and fenugreek, where *Apis dorsata* is more abundant, while *Apis mellifera* is frequently associated with anise, nigella, coriander, and fennel. In addition, several other insect groups belonging to *Diptera*, *Hymenoptera*, *Lepidoptera*, and *Neuroptera* also contribute significantly as flower visitors. Overall, seed spice crops serve as an important resource for sustaining beneficial insects. Their role extends beyond self-pollination and pest regulation within spice ecosystems, as they can also be strategically integrated into cropping systems. For instance, coriander has been





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Theme-II

Insect Conservation, Biodiversity and Climate Change
Impact - Invasive Insect Species: Global Challenges Strategies &
Opportunities, Impact of Climate Change on Insect-Pest Dynamics,
Insect-Plant Interactions in a Changing Climate

recommended in cotton-based Integrated Pest Management (IPM) programs. Thus, seed spice crops not only provide ecological services by supporting natural enemies and pollinators but also hold considerable potential for enhancing sustainable crop production in diversified agro-ecosystems.



Lead Presentation



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Harnessing Indian Genetic Heritage: Plant Genetic Resources as Foundational Tools for Sustainable Plant Health Management

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Sustainable agriculture faces a critical challenge. Feeding a growing global population while mitigating the impacts of climate change, pest evolution, and a reliance on chemical inputs. This review argues that Plant Genetic Resources (PGR) serve as a foundational, pre-emptive toolkit for achieving sustainable plant health. We explore how genetic diversity, particularly in landraces and crop wild relatives (CWRs), provides durable, multi-gene resistance against biotic and abiotic stresses. This principle is demonstrated through compelling case studies across major crops, including wheat, rice, and maize, and a few vegetable crops. The paper highlights the role of modern tools such as high-throughput phenotyping, genomic sequencing, and CRISPR-Cas9 in rapidly identifying and deploying these valuable traits. While India possesses a vast and rich genetic heritage, its effective utilization is currently hindered by a significant utilization deficit, fragmented data systems, and complex policy hurdles. We propose a proactive roadmap to address these challenges, focused on the creation of a national "PGR-to-product" pipeline, seamless digital integration of data, and robust institutional support for Community Seed Banks (CSBs), to transform India's genetic heritage from a conserved asset into a dynamic engine for resilient, sustainable agriculture.

Lead Presentation





Biochemical Responses of Canola and Non- Canola Oilseed Brassicaceae to *Pieris brassicae* Herbivory

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The Brassicaceae family, comprising around 375 genera and 3,200 species, includes a range of economically significant crops, ornamentals, and weeds, with oilseed brassicas such as *Brassica juncea*, *B. rapa*, and *B. napus* forming an important group of winter oilseeds that contribute nearly 11.3% of global rapeseed–mustard production, where India plays a prominent role. However, the productivity of these crops is challenged by a diverse complex of insect pests, nearly 50 of which are recorded in India, among which the cabbage butterfly, *Pieris brassicae* (L.), stands out as one of the major defoliators. The interaction between *P. brassicae* and Brassica plants is complex and often varies depending on the cultivar. Understanding these interactions is crucial for identifying resistant cultivars and for the development of pest-tolerant or resistant Brassica varieties. To understand plant-mediated defense mechanisms, we quantified biochemical changes in plant tissues following insect herbivory and mechanical damage. Assessed parameters included glucosinolate content, total phenols, flavonols, phenylalanine ammonia lyase, polyphenol oxidase, peroxidase, and superoxide dismutase activity. These assays were intended to clarify the role of induced defenses and secondary metabolites in modulating host suitability for *P. brassicae*. The differential biochemical responses among cultivars suggest that induced plant defenses, such as elevated phenolics and oxidative enzymes, play a vital role in modulating pest interactions. The study contributes to a deeper understanding of plant–insect interactions in oilseed brassicas and underscores the importance of both constitutive and inducible defenses in shaping host resistance, offering valuable insights for developing integrated pest management strategies.

Keywords: Biochemical, Canola, Glucosinolates, *Pieris brassicae*, Plant-insect interaction





Diversity and Management of Predominant Chrysomelidae (Insecta: Coleoptera) Beetles in Vegetable Agroecosystems of Kashmir, India

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The leaf beetles are diverse and dominant family of Coleopteran insects, highly specialized for feeding on varied range of plant groups. The diversity of Chrysomelidae (Leaf beetles) in Kashmir was studied during 2019-2021 in different agroecosystems of Kashmir. The study documented different species of leaf beetles viz., *Altica himensis*, *Phyllotreta striolata*, *Plagioderma versicolora*, *Chaetocnema bretinghami*, *Monolepta signata*, *Psylloides tenebrosus*, *Apthona Kashmirensis*. The management of predominant leaf beetle viz., *Altica himensis* on cabbage crop with use of mixed cropping was also studied during this period. The modification of habitat leads to the conservation of natural enemies that helps in pest management strategies. The exploitation of natural enemies lowers the chemical dependence. The natural enemy biodiversity, as expressed by various diversity indices was significantly higher in complex plots than simple plots. During the present study the effect of different combinations of crops on pests and natural enemies in different treatments was evaluated in the field. The diversity indices of natural enemies in control and intercrop systems were also worked. The findings of the study confirmed the role of crop diversification as tool to enhance biodiversity of natural enemies for efficient biological control.

Keywords: *Apthona Kashmirensis*, Biodiversity, Chrysomelidae, Conservation, Kashmir





Diversity of Stathmopodidae (Lepidoptera: Gelechioidea) in India

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The family Stathmopodidae, a charismatic group of Microlepidoptera, plays a crucial role in various ecosystems. This study presents a comprehensive review of the diversity and distribution of Stathmopodidae in India, cataloging 53 species across 10 genera. The subfamily Stathmopodinae emerges as the most diverse, with 43 species in 5 genera. Stathmopoda, the most speciose genus, encompasses 31 Indian species. Geographically, Meghalaya exhibits the highest diversity with 19 species, followed by Karnataka with 13 species and Bihar with 9 species. A bipartite network analysis reveals complex host-insect relationships, with most species associated with various plant families, while some feed on dried products and soft-bodied insects. This study highlights the importance of understanding microlepidopteran diversity for conservation efforts and elucidates the intricate host-insect interactions associated with this group of insects.

Keywords: Stathmopodinae, Stathmopoda, Micro-moths, Biodiversity, Host-insect interactions, Conservation





Evaluation of Two Native isolates of Entomopathogenic Nematodes Against Gram Pod Borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae)

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Gram pod borer, *Helicoverpa armigera* is a notorious pest of Kashmir valley causing devastating damage to chickpea, lowering down the yield and quality of the crop. The pest has developed resistance to several conventional insecticides including synthetic pyrethroids. Additionally, higher costs of chemicals and their hazardous effects on the environment are well known. Thus, in the present study entomopathogenic nematodes have been used as an alternative pest management option as they are eco-friendly, non-hazardous and cost-effective. Two native isolates of entomopathogenic nematodes, *Heterorhabditis bacteriophora* MK256358 and *Steinernema feltiae* ON798417 isolated from hilly areas of Kashmir valley were evaluated for their efficacy against different larval instars of *H. armigera*. Both *H. bacteriophora* MK256358 and *S. feltiae* ON798417 were found effective against *H. armigera*. Median lethal concentration values of both the EPNs decreased with the increase in time interval, however the values for *H. bacteriophora* MK256358 were less than *S. feltiae* ON798417 for each larval instar at each time interval. Calculated value of Median lethal time was directly proportional to the size of the larva. Time consumed by entomopathogenic nematodes to cause mortality to 2nd instar larva was lowest followed by 3rd, 4th and 5th instar larva at all the time intervals used in the study. Median lethal time values for *H. bacteriophora* were less in comparison to *S. feltiae* ON798417 for all the larval instars of *H. armigera*.

Keywords: *Helicoverpa armigera*, *Heterorhabditis*, Median lethal concentration, Median lethal time, *Steinernema*





First Record of Two Natural Enemies *Tachina sobria* and Mermithid Nematode of Oriental Armyworm, *Mythimna separata* (Walker) in Kashmir Valley

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The current observation on two newly reported natural enemies of the Oriental armyworm, *Mythimna separata* (Walker) was made in the Faculty of Agriculture, Wadura, SKUAST-Kashmir during 2023-24 and 2024-25. In the Kashmir valley, *M. separata* acts as a sporadic pest of oats, wheat, rice and maize voraciously feeding in a sequential manner causing around 50-70 per cent yield loss. However, the valley being the house of several beneficial insects also hosts the two agents *viz.* *Tachina sobria* (Tachinidae) and a mermithid nematode (unidentified) parasitising effectively and therefore managing the larval population of *M. separata* under open choice conditions. After field collection and laboratory studies, molecular identification of tachinid fly through DNA barcoding, phylogenetic tree construction and inter specific distance computation revealed a first record of a new species *Tachina sobria* acting as a koinobiont larvo-pupal parasitoid of *M. separata* larva. Parasitisation studies of the tachinid fly and the mermithid nematode on the pest larva witnessed around 35 and 4 per cent parasitisation, respectively. Simultaneously, Buckwheat, *Fagopyrum esculentum* recorded a high population of the parasitoid adult fly because of its abundant floral reserve in terms of nectar, proving to be an excellent parasitoid food resource. Knowing the immense potential of these beneficial agents in managing such devastating pest, their proper conservation, mass multiplication and utilization need to be studied in future.

Keywords: First record, Natural enemies, *Mermithid nematode*, *Mythimna separata*, *Tachina sobria*



Life Cycle and Bio-Intensive Management of Greater Wax Moth (*Galleria mellonella* L.) Under Kashmir Conditions

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The greater wax moth (*Galleria mellonella* L.) is a major pest of honeybee colonies, causing substantial damage to combs, hive products, and colony strength. The present study, conducted at the Research and Training Centre for Pollinators, Pollinizers and Pollination Management (RTCPPM), Division of Entomology, SKUAST-K, Shalimar, aimed to document the life cycle of *G. mellonella* and evaluate Bio-intensive management approaches. Wax moth samples were collected from Srinagar, Kupwara, and Pulwama districts and identified as *Galleria mellonella*. Rearing on an artificial diet under in-vitro condition, developmental duration ranged from 4-10 days for eggs, 20-36 days for larvae, 5-19 days for pupae, and 4-25 days for adults. Various treatments i.e; *Bracon hebetor*, neem oil, *Metarhizium anisopliae*, *Pseudomonas fluorescens*, *Artemisia* powder, lavender powder, sulphur dust, formic acid, and control were evaluated under both in-vitro and storage conditions. All the treatments showed positive results over Control in the management of wax moth, but Formic acid, Sulphur and Neem oil were comparatively found to be the best, both under in-vitro conditions as well as under storage conditions. The findings highlight the potential of integrating botanicals, biocontrol agents, and safe chemicals for sustainable management of wax moth in apiculture under cold-arid conditions of Kashmir.

Keywords: Apiculture, Bio-intensive management, *Galleria mellonella*, Kashmir, Life cycle





Mineral Oil Spray as a Management Strategy against Overwintering Population of Apple Leaf Blotch Miner, *Leucoptera Malifoliella* Costa

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Apple leaf blotch miner (ALBM), *Leucoptera malifoliella* Costa is a recently established invasive pest of Apple in Kashmir valley. It overwinters in pupal stage and resumes its metabolic activity causing fresh infestation in spring on onset of favorable environmental conditions. Horticultural mineral oil and its combination with different insecticides were evaluated against overwintering pupal stages of ALBM in Entomology laboratory at Mountain Research Centre for Field Crops, Khudwani SKUAST Kashmir during year 2025. The nine different treatments evaluated are T1-HMO only; T2-HMO+ Chloropyrifos 20EC @1ml/L; T3-HMO+ Dimethoate 30EC @1ml/L; T4-HMO+ Chloropyrifos 20EC + Cypermethrin 5EC; T5-HMO + Quinalphos 25EC @1ml/L; T6-HMO+ Ethion 10EC; T7-HMO+ Azadirachtin; T8-HMO+ Imidacopirid @ 0.5ml/L and T9-Untreated (Control). All the treatments displayed significant control in terms of mortality percentage over untreated. Pupal mortality of 18.06 per cent was recorded in untreated (Treatment 9) and highest mortality of 75.34 per cent in HMO+ Chloropyrifos 20EC + Cypermethrin 5EC (Treatment 4). The cumulative adult emergence was highest (40.97 per cent) and lowest (12.33 per cent) in untreated (Control/Treatment 9) and in HMO+ Chloropyrifos 20EC + Cypermethrin 5EC (Treatment 4), respectively. Horticulture mineral oil (Treatment 1) recorded pupal mortality and cumulative adult emergence of 63.98 and 18.01 per cent respectively. Hence, it is concluded that mineral oil sprays, alone or impregnated with other insecticide molecules hold promising control of overwintering populations of ALBM and timely spray can reduce pest population build up in early growing season.

Keywords: Invasive pests, Integrated Pest Management, Mineral oil, Pest buildup, Residual population





Molecular Evidence and Phylogeography of *Altica aenescens* feeding on Grapes: Revisiting the Oscillation Hypothesis

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This study provides a comprehensive interpretation of data on *Altica aenescens* (Coleoptera: Chrysomelidae), a flea beetle traditionally known as a birch specialist, newly documented as a pest on grapevines (*Vitis vinifera*) in Kashmir, India (Srinagar and Ganderbal districts), with its first record in the country. Integrating morphological and field evidence, weather correlations, mitochondrial cytochrome c oxidase subunit I (mtCOI) genetic analyses, phylogenetic reconstruction, amino acid composition comparisons, and phylogeographic analysis, the findings suggest a recent host shift from birch to grapevine and demographic expansion driven by ecological opportunities. Phylogenetic analyses place the Kashmir grapevine population within the *A. aenescens* clade, with ancestral state reconstruction (ASR) indicating birch as the ancestral host and grapevine colonization as a derived condition, confirmed by shared haplotypes across birch- and grapevine-feeding populations in a star-like haplotype network. Phylogeographic analysis reveals a spatial distribution of haplotypes, with the dominant Indian haplotype (Hap_1) centered in Kashmir and peripheral German haplotypes (Hap_2–7) indicating recent dispersal or gene flow, suggesting a rapid range expansion following host shift. The high haplotype diversity ($Hd = 0.944$) with low nucleotide diversity ($\pi = 0.00551$), negative Fu's F_s (-2.547 , $P \approx 0.06$), and excess segregating sites (observed = 8, simulated = 5.938) indicate a recent population expansion. Neutrality tests (Tajima's $D = 0.087$, Fu & Li's $D^* = 0.135$, Fu & Li's $F^* = 0.126-0.138$) reflect a stable demographic background, while amino acid profiles show strong conservation relative to European birch-feeding populations, supporting genetic continuity during host transition. Field observations reveal positive correlations with temperature ($r = 0.578-0.784$, $P \leq 0.01$) and negative correlations with maximum humidity ($r = -0.187$ to -0.337 , $P \leq 0.05$), suggesting ecological conditions facilitate this host range





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Theme-II

Insect Conservation, Biodiversity and Climate Change
Impact - Invasive Insect Species: Global Challenges Strategies &
Opportunities, Impact of Climate Change on Insect-Pest Dynamics,
Insect-Plant Interactions in a Changing Climate

shift. These molecular, demographic, ecological, and phylogeographic findings provide converging evidence that the Kashmir population of *A. aenescens* is undergoing an early phase of host range expansion, consistent with the oscillation hypothesis, where birch is retained as the ancestral host and grapevine represents a derived, recently colonized host. This interpretation, supported by literature on flea beetle host shifts and population genetics, underscores implications for pest management in viticulture amid climate change.

Keywords: *Altica aenescens*, Grapevine, Host shift, Neutrality tests, Oscillation hypothesis, Population expansion.

Oral Presentation



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Physiological Mechanisms Underlying Thermal Tolerance in Parthenium Beetles

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Abiotic factors, particularly temperature, play a crucial role in shaping the physiology of insect herbivores. This study investigates how temperature fluctuations affect nutrient assimilation and antioxidant enzyme activity in *Zygogramma bicolorata*, a beetle used in the biological control of the invasive parthenium weed. Beetles were exposed to heat stress ($42 \pm 2^\circ\text{C}$), cold stress ($10 \pm 2^\circ\text{C}$), and an optimal temperature ($27 \pm 2^\circ\text{C}$). The activity of key antioxidant enzymes superoxide dismutase (SOD), catalase (CAT), and lipid peroxidation (LPO) along with glucose and triglyceride assimilation was measured. Heat stress significantly elevated SOD, CAT, and LPO activity, while cold and optimal temperatures led to reduced enzyme responses. Upon return to optimal conditions, enzyme activities increased across treatments. Glucose uptake peaked under cold stress, whereas triglyceride assimilation was highest at the optimal temperature. After thermal stress relief, glucose uptake declined, and triglyceride assimilation increased across all groups. Notably, male beetles exhibited higher antioxidant enzyme activity, while females absorbed more glucose and triglycerides, suggesting enhanced resilience to temperature stress. These findings indicate that female *Z. bicolorata* may possess greater tolerance to thermal extremes, which could influence their effectiveness in Parthenium weed management under climate variability.

Keywords: Antioxidant enzymes, Nutrients assimilation, Parthenium beetle, Thermal stress, Weed





Seasonal Incidence of Walnut Aphid, *Chromaphis juglandis* and Dusky-veined aphid, *Panaphis juglandis* on Walnut (*Juglans regia* L.) under temperate conditions of Kashmir Valley

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Walnut (*Juglans regia* L.) is a vital horticultural crop extensively cultivated in the temperate regions of Kashmir Valley for its edible nuts, valuable timber, and diverse commercial uses. However, its productivity is often threatened by insect pests, notably the walnut aphid (*Chromaphis juglandicola*) and dusky-veined aphid (*Panaphis juglandis*), which severely impair tree health and reduce both the quality and quantity of the produce. To investigate their population dynamics, a field experiment on seasonal incidence of Walnut aphid, *Chromaphis juglandicola* and Dusky-veined aphid, *Panaphis juglandis* under temperate conditions of Kashmir valley was conducted at the Faculty of Agriculture, Wadura. The study recorded the seasonal incidence of both aphid species on walnut foliage. The incidence of *C. juglandicola* commenced from the 13th standard meteorological week (SMW) with a mean density of 1.4 aphids per leaf, peaked at 28.3 aphids per leaf during the 25th SMW, and declined to 1.2 aphids per leaf by the 43rd SMW. The monthly mean population was highest in June (24.72 ± 1.47) and lowest in October (1.85 ± 0.23). The coefficient of variation (CV) was highest in May (43.57%) and lowest in July (9.45%). Similarly, *P. juglandis* appeared from the 13th SMW (3.7 aphids per leaf), reached its maximum density (29.4 per leaf) during the 28th SMW, and dropped to 1.5 per leaf by the 43rd SMW. Its monthly mean population was highest in July (25.4 ± 1.20) and lowest in October (1.92 ± 0.16), with the highest CV in September (34.47%) and lowest in April (6.79%). Correlation analysis indicated that *C. juglandicola* populations showed positive significant correlations with maximum temperature ($r = 0.881$) and morning relative humidity ($r = 0.226$), and negative significant correlation with rainfall ($r = -0.425$). *P. juglandis* exhibited similar trends, with $r = 0.784$ (maximum temperature), $r = 0.320$ (morning humidity), and $r = -0.425$ (rainfall). Regression analysis revealed that meteorological parameters influenced 79.8 per cent of the walnut aphid and 70 per cent of the dusky-veined aphid populations. Therefore, showing that climate plays a key role in aphid outbreaks.

Keywords: Aphids, Kashmir, Meteorological factors, Seasonal incidence, Walnut





Taxonomic Studies on Tortricid Moths (Lepidoptera: Tortricidae) from Himachal Pradesh

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Tortricidae are micromoths commonly known as leaf rollers and ranked second only to Gelechioidea in species diversity within the 'microlepidoptera.' They are highly diverse and widely distributed across tropical, subtropical, and temperate forest ecosystems. They are economically important because of the significant damage they cause to agricultural, horticultural, and forest plants. The present study recorded 26 species belonging to six tribes from ten locations in Himachal Pradesh, namely Dharmshala, Neri, Berthin, Palampur, Kalpa, Sundernagar, Nauni, Kangra, and Katrine, between 2017 and 2023, representing subfamilies Tortricinae and Olethreutinae. These species were redescribed with complete diagnostic details and distributional records. The study also provides updated information on valid names, synonyms, distribution, and authorship. The adult moths typically appear bell-shaped at rest, with labial palps often projecting upward. Most species were identified based on genitalia characters, including the shape of the valva, uncus, sacculus, tegumen, and aedeagus in males, and the signum and ostium in females. High-quality illustrations were provided for habitus, wing venation, and genitalia. In addition, 22 DNA barcodes representing 11 species were generated. The sexual dimorphism of *Archips machlopi*s was further confirmed using DNA barcoding. The present study describes four species new to science: *Terthreutis subrectangulus* sp. nov., *Toonavora valvispinosa* sp. nov., *Microsarotis spatulata* sp. nov., and *Ulodemis* sp. nov. Two species were reported as new country records for India: *Clepsis laetornata* and *Argyroptocha phalaenopa*. Additionally, twelve species of tortricids were documented as first records for Himachal Pradesh, thereby contributing significantly to the updated fauna of Tortricidae.

Keywords: DNA barcoding, India, Microlepidoptera, Micromoths, New species





The Impact of Spatiotemporal Climate Change on Sericulture Performance in the Kashmir Valley

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Sericulture, a cornerstone of the Kashmir Valley's economy, faces increasing vulnerability to climatic shifts. This study provides a comprehensive, data-driven assessment of climate change's impact on silkworm performance using a 11-year dataset (2013-2023) from Central Sericultural Research and Training Institute, Pampore (J&K). The analysis begins with Random Forest-based imputation to handle missing data, followed by Principal Component Analysis (PCA) to derive a unified Composite Performance Score, with the first component accounting for 26.69 per cent of the total variance. Advanced Artificial Intelligence models, including Random Forest and Gradient Boosting, were utilized to identify and rank bio-predictor variables, revealing key climatic variables like BIO13 and PREC1 as primary drivers of performance. A Generalized Linear Model (GLM) confirmed significant performance variability across different years, while K-Means clustering successfully identified distinct pheno-climatic clusters, including a highly resilient and a particularly vulnerable group. The findings provide a robust framework for predicting climate-induced risks and developing targeted adaptive strategies, ensuring the long-term sustainability of the sericulture industry.

Keywords: Artificial intelligence, Climate change, GLM, PCA, Sericulture





Varietal Screening and Seasonal Incidence of Pear Psylla (*Cacopsylla pyricola* Forster) in High Density Plantation of Pear in Kashmir

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Four pear varieties viz., Early Desire, Lucas, Conference and William were screened for seasonal incidence of pear psylla in the High-Density Plantation fruit block of Shalimar, Kashmir from March to October 2022. Among the varieties, Lucas was found more susceptible in terms of pest incidence. Pear psylla eggs were observed on twigs from first week of March till the end of September, with varying density-10 cm/twig. All the varieties displayed an increase in egg density from March, which peaked in June and gradually decreased thereafter. Nymphs appeared first on twigs during March then on leaves during first week of April. Substantial increase in nymphal population was observed from May to June. Adults of pear psylla were initially recorded during first week of April which continued till the end of October. All the varieties exhibited an increase in adult densities from April and peak incidence was observed in July, followed by a progressive fall. Twelve natural enemies including Coccinellids, Chrysopid and predatory mite were recorded. Nine variants of *Calvia punctata* were also recorded. An endo parasitoid, *Trechnites insidious* of pear psylla was also recorded first time from Jammu and Kashmir as well as India. Positive and highly significant correlation was observed between population density of pear psylla and sooty mold.

Keywords: High density plantation, Kashmir, Pear, Pear psylla, Varietal screening



Assessment of Insect Pest Diversity and Infestation levels in Button Mushroom (*Agaricus bisporus*) from Kashmir, India

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Mushroom farming has gained popularity worldwide as the enterprise that transforms agricultural wastes into highly nutritious foods. However, one of the major constraints in commercialization of mushroom production is the damage caused by the insect pests. Kashmir valley represents a promising region for mushroom cultivation, therefore, the present study was undertaken to document the insect pest complex infesting button mushroom (*Agaricus bisporus*) and to quantify the pest incidence at different locations (SKUAST-K, Shalimar; Budgam; Baramulla; and Pulwama) of the valley. The results revealed that various insect pests *viz.*, sciarid fly (*Lycoriella castanescens*), picture winged fly (*Physiphora sericea*), springtail (*Achorutes armatus*), mould mite (*Tyrophagus putrescentiae*) and flour mite (*Acarus siro*) were found associated with button mushroom. The overall incidence of different pests was highest (75 %) at Budgam, followed by 70 per cent at Baramulla, 68 per cent at Pulwama, while the lowest incidence of 63.80 per cent at SKUAST-K, Shalimar. Seasonal variation was evident, with maximum pest incidence reported during July and August with highest and lowest incidence of sciarid flies and mites, respectively. Mushroom being a perishable edible food, this study would be of considerable importance for understanding the pest complex of mushroom and for designing effective management strategies against the major pests.

Keywords: Agricultural Waste, Button Mushroom, Pest Complex, Per cent Incidence, Sciarid fly





Bioacoustic Insights into Eneopterinae Crickets: First Acoustic Record of *Indigryllus kudremu* and Comparative Analyses with Related Species

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The Indian subcontinent, a hub of global biodiversity exhibits outstanding arthropod diversity yet many taxa are still poorly documented. Crickets of the subfamily Eneopterinae (Orthoptera: Gryllidae) are ecologically important as herbivores, prey and acoustic signallers, they also present taxonomic complexity due to their diverse morphologies. Despite their significance, *Eneopterinae* in India are poorly studied as only two genera (*Indigryllus* and *Xenogryllus*) and three species are documented. Our lab first discovered the genus *Indigryllus* in 2019 and since then all known research on this lineage from India has been carried out exclusively by our group. While acoustic data was available only for *Indigryllus sagani*, we here report the first-ever acoustic record with its range expansion in Western Ghats of *Indigryllus kudremu* providing novel insights into its communication system and ecological data. In this study, we compared the acoustic signals of *Indigryllus kudremu* with *Indigryllus sagani* and *Xenogryllus transversus* using detailed statistical analyses of song parameters. As cricket calls are highly species-specific, our results revealed that acoustic characters provide reliable markers for species delimitation and identification. This integrative approach highlights the role of bioacoustics as a powerful tool in resolving taxonomic boundaries within Eneopterinae.

Keywords: Acoustics, Biodiversity, Eneopterinae, India, Species delimitation





Biodegradation of Plastics by Gut Microbes of the Greater Wax Moth (*Galleria mellonella*)

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Plastic pollution is one of the most serious environmental problems of our time, with millions of tons accumulating in landfills, soils, and oceans every year. Conventional plastics such as polyethylene (PE) and polystyrene (PS) are highly resistant to natural breakdown, making them especially harmful to ecosystems. Recent studies have shown that some insects, including the larvae of the greater wax moth *Galleria mellonella*, are able to chew, ingest, and degrade plastic materials. This unusual ability is thought to be linked to their natural diet of beeswax, which is chemically similar to plastics. Research has demonstrated that waxworm larvae can consume PE and PS and convert them into smaller, less harmful compounds such as ethylene glycol. Both the insect's own enzymes and its gut microbiota may contribute to this process, although evidence suggests that enzymatic activity of the larvae alone can play a key role in polymer breakdown. Investigations using chemical, metabolomic, and microscopic analyses have provided direct in vivo evidence that *G. mellonella* can depolymerize and digest microplastics. Proposed pathways include the conversion of PS into styrene oxide, phenylacetaldehyde, and other intermediate products. Meanwhile, bacteria isolated from waxworm guts, such as *Enterobacter asburiae* and *Bacillus* species, have also been shown to degrade plastics under laboratory conditions, highlighting the combined role of insect hosts and their symbiotic microbes. The discovery of plastic-digesting ability in *G. mellonella* has opened a promising new field of research in biological plastic degradation. Understanding the interaction between waxworms, their gut microbiota, and plastic polymers could help in designing eco-friendly strategies for plastic waste management. However, further work is needed to isolate the key enzymes, assess their efficiency, and explore how such natural processes can be scaled up for practical applications.

Keywords: Bioremediation, *Galleria mellonella*, Gut microbiota, Plastic biodegradation, Polyethylene, Polystyrene, Waxworm





ICBC-P 04

Comparative Efficacy of Different Insecticides in Mitigating Trunk Borer (*Sphenoptera laferti*) Infestation across Different Cherry varieties

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The cherry trunk borer (*Sphenoptera laferti* Thomson) represents a major constraint to cherry cultivation in North-Western Himalayan region of Kashmir, with severity varying across cultivars. Six varieties were tested, with field trials evaluated chemical management trials on Karina, Lapins, and Hertford at Fruit Experimental of SKUAST-K. Four insecticides namely Dimethoate 30EC (0.03%), Chlorpyrifos 20EC (0.02%), Imidacloprid 17.8SL (0.005%), and Quinalphos 25EC (0.025%) were evaluated both in dormant season (as paste with Bordeaux mixture) and in active growth season (as sprays). Bordeaux pastes alone and water-sprayed controls served as checks. Pre-treatment counts of borer exit holes were recorded and compared with post-treatment observations at 10–60-day intervals. The research conducted revealed that Dimethoate as the most effective insecticide by reducing new hole emergence by 76–79 % across cultivars and seasons followed by Imidacloprid, achieving 69–75% reduction. The Quinalphos recorded the per cent reduction (61–66%) and Chlorpyrifos (56–63%). Bordeaux paste alone was least effective, suppressing less than 25% of fresh holes, while untreated controls exhibited the highest infestation levels. Among cultivars, Lapins responded most effectively to the treatments, while Hertford showed lowest reduction despite chemical applications. Statistical analysis confirmed the superiority of chemical treatments over controls during both dormant and active seasons, with negligible differences between paste and spray modules. These findings highlight Dimethoate and Imidacloprid as key components for chemical suppression of *S. laferti*. However, considering sustainability, integration of these insecticides with eco-friendly tactics such as biological agents, pheromone-based monitoring, and cultural practices is recommended for long-term management of cherry trunk borer in the Kashmir valley.

Keywords: Cherry, Cultivars, Management, *Sphenoptera laferti*, Sustainability, Trunk borer





Effect of Sowing Dates on the Incidence of Ear head borer, *Helicoverpa armigera* on Finger Millet (*Eleusine coracana* L. Gaertner) Under Temperate Kashmir Conditions

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The present study evaluated the effect of different sowing dates on the incidence of *Helicoverpa armigera* in finger millet (*Eleusine coracana* L. Gaertner) during the 2023 cropping season. The crop was sown on five dates: 17 May, 27 May, 6 June, 16 June, and 26 June. The lowest incidence 3.34 per cent was recorded in the earliest sowing (17 May), followed by 3.82 per cent in the second sowing. Pest incidence increased with crop growth and favourable weather, peaking at 4.45 per cent in the third sowing, before slightly declining to 3.95 per cent and 3.81 per cent in later sowings. The *H. armigera* population exhibited positive and significant correlation with maximum temperature and relative humidity (evening) while relative humidity (morning) was found to be negatively and significantly correlated, sunshine and minimum temperature were found to be positively but non-significantly correlated with *H. armigera* population in 1st, 2nd, 3rd, 4th and 5th dates of sowings. The average number, length and weight of fingers ranged from 7.14-8.87 fingers/plant, 6.07-8.25cm and 6.70-8.70g at different sowing dates, respectively. The weight of 1000 seeds and that of grain yield ranged from 3.52-4.33g/1000 seed grains and 6.63-12.67t/ha due to different sowing dates, respectively.

Keywords: Sowing dates, meteorological factors, *Helicoverpa armigera*, finger millet, yield characters





ICBC-P 06

Evaluation of the Pheromone baited of Sticky Traps in the Attraction of Apple Leaf Blotch Miner, *Leucoptera malifoliella* (Costa) on Apple

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The present study on “Evaluation of the Pheromone baited Sticky Traps in the Attraction of Apple Leaf Blotch Miner, *Leucoptera malifoliella* (Costa) on Apple” was conducted in an orchard at Goshbugh, Pattan, Baramulla district of North Kashmir during 2025, from first week of May to the last week of August. The objective was to assess the relative efficacy of pheromone-baited sticky traps of different colours (yellow, green, blue, and white) installed at varying heights (1.0, 1.5, 2.0, and 2.5 m), for monitoring the population dynamics of apple blotch leaf miner (*L. malifoliella*). Each colour-height combination was replicated three times, and weekly observations of adult catches were recorded throughout the study period. Data analysis revealed significant variation in trap attractiveness. Yellow traps, with an average of 33.01 catches per trap per week and green traps with 27.73 catches per trap per week, consistently recorded the highest captures throughout the study period, while blue and white traps were comparatively less effective. Trap height also influenced catches, with the maximum average recorded at 1.5 m followed by 2.0 m and 1.0, whereas the lowest number of moths was captured at 2.5 m. Peak catches (approximately 40 moths per trap per week) were observed in yellow and green sticky traps at 1.5 m during the first week of July, indicating the peak activity-period of the moth. The findings suggest that yellow, followed by green sticky traps placed at height of 1.5 m, are the most efficient for monitoring of *L. malifoliella* populations in apple orchards of North Kashmir. Optimizing trap placement in this way provides a reliable, eco-friendly, and cost-effective tool for early detection and population assessment of the pest, thereby aiding in timely management decisions.

Keywords: Apple, Colour, Height, *Leucoptera malifoliella*, Monitoring, Sticky trap





ICBC-P 07

From Nursery Hotspots to Orchards: Unmasking the Hidden Menace of Curculionid Green Weevil in Apple

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Curculionid green weevil, an overlooked foliage feeder infesting apple has recently emerged as a serious and expanding threat infesting not only nursery rootstocks but also bearing orchards under high density plantation systems. During 2023, an alarming sight was recorded: bright green weevils notching tender leaves, leaving young plants severely defoliated. A detailed study with regular field surveys and observations was undertaken to document the seasonal incidence and damaging symptoms of this emerging pest. The pest activity commenced on 20th Standard Meteorological Week (SMW) with 3.02 weevils/four branches in apple cultivars and 5.89 weevils plant⁻¹ in rootstocks. Thereafter, the pest population increased gradually and reached to its peak (9.93 weevils/four branches) during 26th SMW. Afterwards, it started declining up to 38th SMW, wherein no infestation was recorded. Among four selected varieties *viz.*, Red Velox, Gala Redlum, Super Chief and Pinnova, the cumulative mean weevils per four branches was recorded highest (6.30 ± 1.75 weevils) in Red Velox and the lowest (2.63 ± 0.95 weevils) in Pinnova, throughout the season. Among, four selected rootstocks *viz.*, M9Pajam, M27, M9T337 and M9T339, the cumulative mean weevils recorded was highest (6.48 ± 1.98 weevils plant⁻¹) in M9Pajam and the lowest (5.62 ± 1.60 weevils plant⁻¹) in M9T339 throughout the season. Analysis of critical weather variables revealed that the pest population exhibited a strong positive and significant correlation with maximum and minimum temperature, while it showed non-significant relationship with rainfall and relative humidity. These findings establish green weevil as a climate driven, nursery originating invader demanding urgent incorporation into apple integrated pest management programs.

Keywords: Apple, Emerging pest, Green weevil, Seasonal incidence, Weather parameters





ICBC-P 08

Geo-spatial Variability in Pest and Natural Enemy Complex in Temperate and Sub-tropical Rice Ecosystem Across Indian Himalayan Region

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Rice (*Oryza sativa* L.), a popular cereal crop is staple food feeding millions and shaping local livelihoods. In order to better understand the risk analysis of rice insect pests, a comparative multi-locational investigation was conducted during *Kharif 2024* in Indian Himalayan region. The study was carried out at 03 locations, 02 from north-western Himalayan region (North Kashmir-Faculty of Agriculture, Wadura; South Kashmir-Mountain Research Centre for Field Crops Khudwani), and 01 from north-eastern Himalayan region (Assam Agricultural University, Jorhat). The study documented the species composition of rice insect pests and their associated natural enemies at different locations providing the first comprehensive and comparative baseline data. The results revealed the entomofauna of 09, 13 & 23 insect pests as well as 18, 23 & 18 natural enemies were recorded from Wadura, Khudwani and Jorhat, respectively. These spanned orders Orthoptera, Lepidoptera, Hemiptera, Coleoptera, Diptera, Odonata, Hymenoptera, Araneae, and Neuroptera. The dominant population of insect pests included short-horn grasshopper (*Oxya nitidula*), rice skipper (*Parnara guttata*), and armyworm (*Mythimna separata*) in Kashmir, whereas yellow stem borer (*Scirpophaga incertulas*), leaf folder (*Cnaphalocrocis medinalis*), and plant hoppers (*Nephotettix* spp.) were most abundant in Jorhat. Among natural enemies, Ladybird beetles (*Coccinella* spp.), rove beetles (*Paederus* sp.), green lacewings (*Chrysoperla zastrowi*), tachinid flies (*Cylindromyia* sp.), parasitoid wasps (*Charops* sp., *Cotesia parnarae*), odonates (*Crocothemis servilia*, *Pantala flavescens*, *Ischnura inarmata*), and spiders (*Tetragnatha* sp., *Pardosa* sp., *Oxyopes* sp.) emerged as the ecological guardians of rice and their abundance closely tracked pest incidence, underscoring their ecological role in suppressing outbreaks especially in Kashmir rice agroecosystem.

Keywords: Entomofauna, Incidence, IPM, *Oryza sativa*, Pest diversity





Impact of Climate Change on Agricultural Pest Dynamics

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Climate change and food security are two of the most pressing issues of the 21st century. The global population is projected to reach 9 billion by the end of 2050, leading to an anticipated 85% increase in food requirements (FAO, 2017). The agriculture sector faces significant threats from the increasing frequency of droughts, heavy rainfall, temperature fluctuations, salinity, and pest attacks (Dhankher and Foyer, 2018; Hussain *et al.*, 2019). According to the FAO, agriculture and land use practices account for 20% of total greenhouse gas emissions. Changes in precipitation patterns, increasing temperatures and rising sea levels all have detrimental effects on agricultural production. Climate change has significant impacts on agriculture, as well as on agricultural insect pests. Agricultural crops and their corresponding pests are directly and indirectly affected by climate change. Insects are poikilothermic organisms therefore, temperature is likely the most important environmental factor affecting insect behavior, distribution, development, and reproduction (Kocmankova *et al.*, 2010). Consequently, it is very likely that the main drivers of climate change viz increased atmospheric CO₂, rising temperatures, and decreased soil moisture could affect the population dynamics of insect pests and, in turn, lead to higher percentages of crop losses (Fand *et al.*, 2012). Climate change creates new ecological niches that provide opportunities for insect pests to establish and spread in new geographic regions and shift from one region to another (FAO, 2020). The complexity of physiological effects exerted by rising temperatures and increased CO₂ levels can profoundly affect interactions between agricultural crops and insect pests (Hare *et al.*, 1992). Therefore, farmers can expect to face new and intensified pest problems in the coming years due to the changing climate.

Keywords: Climate change, Agricultural pest, Elevated CO₂, Temperature





Pest Monitoring and Trunk Incidence of Flat Headed Borer, *Sphenoptera lafertei* (Coleoptera: Buprestidae) Infesting Cherry and Nectarine in Kashmir

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Cherries are small stone fruits belonging to genus *Prunus* and subgenus *Cerasus* of the Rosaceae, or Rose family. Cherry trees are infested by various borers like stem borer, round headed borer, shot hole borer, flat headed borer etc. The investigation on "Monitoring and Trunk incidence of Flat Headed Borer, *Sphenoptera lafertei* (Coleoptera: Buprestidae) infesting Cherry and Nectarine" was undertaken at Fruit Experimental Farm, SKUAST-K, Shalimar during the year 2024 and 2025. Pest monitoring was conducted both in Cherry and Nectarine Fields by using Light trap and Solar operated light trap during the both the years; a total adult trap catch of 45 beetles per trap in Cherry and 46 beetles per trap in Nectarine field was recorded from a period of 18th SMW (first week of May 2024) to 24 SMW (third week of June 2025). Extensive surveys at fortnightly intervals were conducted to assess the infestation of *S. lafertei* across different cherry varieties. The surveys revealed that cherry variety Regina was more susceptible to the attack of *S. lafertei* with an overall infestation of 63.07 per cent and variety Merchant was least susceptible to Flat headed borer the attack with the infestation level of 36.29 per cent. Among Nectarine varieties, Snow Queen had the highest trunk incidence of 60.00 per cent and the least pest infestation was recorded in Sun Red as 50.76 per cent. The total trunk infestation during all surveys across all varieties of Cherry and Nectarine varieties was 48.50 and 56.70 per cent, respectively. The body and appendages of adult Flat headed borer beetle were shiny and lustrous and the emergence occurs through D or Oval shaped holes which are formed on the bark of tree trunk.

Keywords: Cherry trunk borer, Monitoring, *Sphenoptera lafertei*, Trap catch, Trunk incidence





Phytophagous and Predatory Mites in Kashmir's Vegetable Ecosystems: A Study of Species Diversity and Weather Correlation

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The population dynamics of both phytophagous and predatory mites infesting major vegetable crops of the Kashmir Valley were investigated during the year 2024. The primary goal of this study was to identify and document mite diversity and to track their population trends across major vegetable crops (brinjal, tomato, cucumber, chilli, amaranthus, and beans). During the study, three major phytophagous mite species were identified. Additionally, five predatory mite species were also recorded. The study further evaluated how changes in temperature impact the population dynamics of mites. For phytophagous mite population peak incidence was recorded in the month of August. The predatory mite population followed a similar seasonal trend. The data, when subjected to statistical analysis, revealed a strong and positive correlation with maximum and minimum temperature. The results played an important role in establishing a baseline on mite diversity and their pest-predator balance in vegetable ecosystems of Kashmir. Such knowledge is crucial for understanding how these interactions might change under shifting climate conditions and provides useful advice about managing mite populations while supporting sustainable vegetable production in the region.

Keywords: Correlation, Diversity, Phytophagous mites, Predatory mites, Vegetable crops.





ICBC-P 12

Response of Apple Cultivars in Different Apple Plantation Systems to Incidence of Woolly Apple Aphid, *Eriosoma lanigerum* Hausman (Hemiptera: Aphididae)

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The investigations entitled “Response of apple cultivars in different apple plantation systems to incidence of Woolly apple aphid, *Eriosoma lanigerum* Hausman (Hemiptera: Aphididae)” was conducted in Fruit Experimental Farm, Division of Fruit Science, SKUAST-K, Shalimar during the year, 2023-2024. The extensive surveys were conducted at fortnightly intervals starting from 16th SMW (Standard Meteorological Week) till 50th SMW to assess the incidence and status of Woolly apple aphid (WAA), in three apple orchard plantation system at SKUAST-K, Shalimar i.e. Low, Medium and High density apple plantation. In all the three apple plantation systems, the incidence of WAA commenced from third week of April (16th SMW), which increased gradually till it attained peak infestation in second week of July (28th SMW); thereafter, the aphid infestation continued to decline until second week of December (50th SMW). In low-density apple plantation, the apple variety Maharaji had the least aphid incidence (16.66%) while Cox Orange Pippin showed the highest aphid incidence 54.44 per cent. In medium-density plantation, Silver Spur had the lowest WAA incidence (18.51%), while Gala Mast showed the highest incidence as 53.32 per cent. In high-density apple plantation, Gala Redlum exhibited the highest aphid incidence (57.03%) whereas Red Velox had the least incidence of 26.66 per cent.

Keywords: Apple Plantation System, *Eriosoma lanigerum*, Maharaji, Standard Meteorological Week, Woolly Apple Aphid





ICBC-P 13

Screening of Different Genotypes of Chickpea (*Cicer Arietinum* L.) against Gram Pod Borer *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae) in North Kashmir

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Chick pea (*Cicer arietinum* L.) (Leguminaceae) or Bengal gram is a very important legume crop that belongs to the family Fabaceae, extensively grown throughout the country. The present investigation was carried out to screen total number of (15) chickpea genotypes for their relative resistance against gram pod borer, *Helicoverpa armigera* in order to find the best chickpea genotype suited to Kashmir conditions. The present study was carried at Experimental Farm, Faculty of Agriculture, wadura, Sopore during 2018. Screening of different genotypes of chickpea against *Helicoverpa armigera* revealed that the minimum eggs population of 0.94 eggs/plant was recorded in RV SSG-32, respectively. The maximum eggs population of 4.17 eggs/plant was registered in genotype RV SSG-44. The other genotypes viz., AG BL-G-170003, AG BL-D-170011, SHALIMAR CHICKPEA 1, AG BL-G-170001, AG BL-P-S 170008, AG BL-P-S-170007, AG BL-D-170010, AG BL-G-170002, AG BL-G-170004, AG BL-P-S-170006, AG BL-D-170009, AG BL-P-S-170005, & AG BL-D-170012, recorded eggs population between 1.06 to 3.83 eggs/plant. Also, the minimum larval population of 0.75 larvae/plant was recorded in RV SSG-32, respectively. The maximum larval population of 3.83 larvae/plant was registered in genotype RV SSG-44. The other genotypes viz., AG BL-G-170003, AG BL-D-170011, SHALIMAR CHICKPEA 1, AG BL-G-170001, AG BL-P-S 170008, AG BL-P-S-170007, AG BL-D-170010, AG BL-G-170002, AG BL-G-170004, AG BL-P-S-170006, AG BL-D-170009, AG BL-P-S-170005, & AG BL-D-170012, recorded larvae population between 0.94 to 3.75 larvae/plant. Investigation revealed that very low damages were reported on the chickpea genotype namely RV SSG-32 (7.45%) followed by AG BL-G-170003 (7.52%). The highest damage (63.15%) was found on the cultivar RV SSG-44, it was closely followed by AG BL-D-170012, AG BL-PS-170005, with pod damage of 54.83 & 45.07 per cent respectively. The results obtained from percentage of pod damaged revealed that 4 genotypes viz: RVSSG-32, AG BL-G-170003, AG BL-D-170011 & Shalimar chickpea .1 genotype were resistant;





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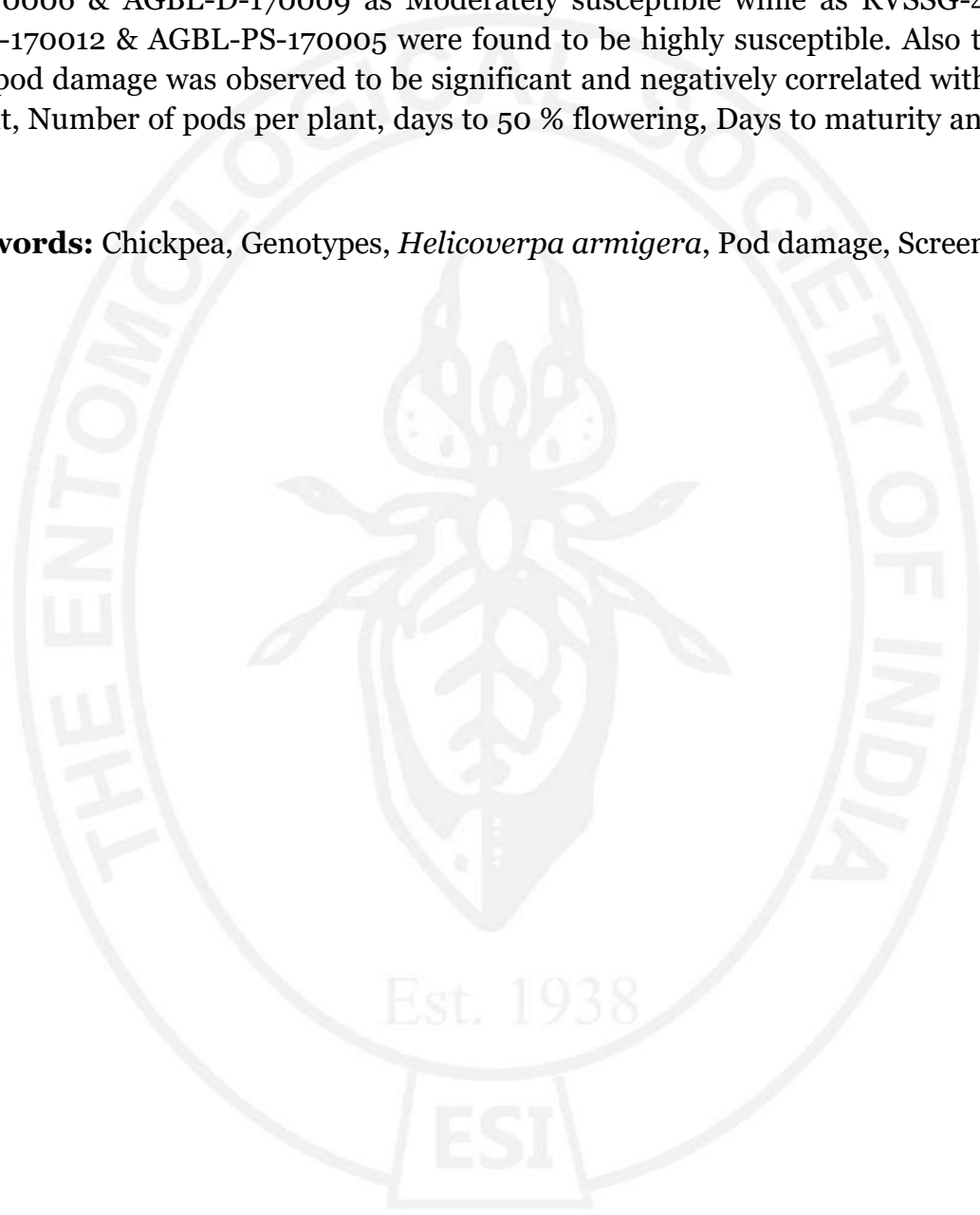
8-9 October, 2025

Theme-II

Insect Conservation, Biodiversity and Climate Change
Impact - Invasive Insect Species: Global Challenges Strategies &
Opportunities, Impact of Climate Change on Insect-Pest Dynamics,
Insect-Plant Interactions in a Changing Climate

cultivars AG BL-G-170001, AGBL-G-170002, AG BL-PS-170007, AG BL-PS-170008 & AG BL-D-170010 were categorized as Least susceptible; AG BL-G-170004, AG BL-PS-170006 & AGBL-D-170009 as Moderately susceptible while as RVSSG-44, AG BL-D-170012 & AGBL-PS-170005 were found to be highly susceptible. Also the per cent pod damage was observed to be significant and negatively correlated with plant height, Number of pods per plant, days to 50 % flowering, Days to maturity and seed yield.

Keywords: Chickpea, Genotypes, *Helicoverpa armigera*, Pod damage, Screening



Poster Presentation



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In collaboration with

The Entomological Society of India, ICAR-IARI Pusa Campus, New Delhi - 110012



ICBC-P 14

Spider Diversity (Arachnida: Araneae) Recorded in Assam Lemon (*Citrus Limon*) Ecosystem of Northeastern India Under Natural Farming System

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Assam lemon is an important Citrus fruit crop of north-east India. Spiders are one of the most abundant predatory groups found in the Assam lemon orchards. They feed on insects as well as other arthropod pests. Keeping in view of their important role in the natural biological control, the current study was carried out to study the spider fauna of the Assam lemon ecosystem present in the Northeastern parts of India under natural farming system. The field surveys were carried out during 2023-25 in the experimental field of Natural farming, College of Horticulture & Farming System Research (CHFSR), Assam Agricultural University, Nalbari. During the course of the survey, spiders belonging to 12 species, 14 genus and 6 different families were recorded from the study areas. The predominant families were Salticidae (38.80%) and Araneidae (25.08%) along with the reported presence of Oxyopidae (12.52%), Hersiliidae (5.2%), Heteropodidae (5.2%), Pisauridae (5.0%), Tetragnathidae (4.2%) and Thomisidae (4.0%). The highest and least population of spiders belonged to the species, *Oxyopes birmanicus* Thorell (Family: Oxyopidae) and *Neoscona* spp. (Family: Araneidae) respectively. The rich faunal diversity of spiders found during the present investigation indicate that spiders could be utilized as potential biocontrol agents in the management of Assam lemon pest complex.

Keywords: Assam lemon, Biocontrol agents, Citrus ecosystem, Natural farming, Spider fauna





Unlocking the Potential of Native isolates of Entomopathogenic Nematodes against Apple stem borer, *Aeolesthes sarta* Solsky (Coleoptera: Cerambycidae)

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Apple stem borer, *Aeolesthes sarta*, is a wood boring pest of apple. In Kashmir valley, the pest has attained serious dimensions as its population has increased manifold in the last few years. Its concealed lifestyle enables it to avoid surface-applied treatments, rendering most conventional insecticides ineffective or environmentally damaging due to increased dosage requirements. Entomopathogenic nematode, *Heterorhabditis bacteriophora* which are natural biological control agent, has emerged as a promising alternative to chemicals in controlling cryptic insect pests. The shade and cryptic conditions also favour the growth and survival of these beneficial nematodes. Moreover, native nematode strains are reported to perform better against native insect pests as compared to exotic or non-exotic strain as the former are adapted to the local soil and environmental conditions. We evaluated two native nematode strains, *H. bacteriophora* PP549990 and *H. casmirica* SKUAST-K 101 isolated from the soils of Kashmir valley against different larval instars of *A. sarta*. Median lethal concentration values of both the nematode exhibited a declining trend with increasing exposure duration. Similarly, the median lethal time was positively correlated with larval size, indicating more susceptibility towards smaller instars. The time consumed to cause mortality to first instar larvae was least followed by second and third instar. Our experimental findings showed that *H. bacteriophora* PP549990 was comparatively better than *H. casmirica* SKUAST-K 101 across all test larval instars and time intervals used in the study.

Keywords: *Aeolesthes sarta*, *Heterorhabditis*, Median lethal concentration, Median lethal time, Nematode





A Preliminary Survey on Tortricid Moths (Lepidoptera: Tortricidae) from North Bengal, India

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Micro-moths represent over three-quarters of the 47 currently recognized lepidopteran superfamilies, of which India has reported nearly 36, including several economically important families. The superfamily Tortricoidea (Family: Tortricidae), is one of the most species-rich groups of microlepidoptera, with more than 11,000 species worldwide. The Indian fauna includes around 515 species under 175 genera, however only 31 species belonging to 27 genera have been documented from West Bengal. Despite its diverse ecosystems, particularly in North Bengal, this region remains largely unexplored for tortricid diversity. In this study, tortricid moths were surveyed from 12 locations across five districts of North Bengal (Alipurduar, Coochbehar, Kalimpong, Jalpaiguri and Dakshin Dinajpur), encompassing habitat ranging from tropical forests to montane landscapes with agri-horticultural ecosystem. About 500 specimens were collected, representing around 40 morphospecies. Among these 19 species have been identified based on diagnostic morphological traits such as labial palpi, leg modifications, wing venation, abdominal and genital structures. DNA barcodes were generated for seven species to complement morphology-based identifications. Notable pest species were documented, including *Archips machlopi*, *Homona coffearia*, *Dudua aprobola*, *Cryptophlebia ombrodelta*, and *Gatesclarkeana erotias*. For each species, diagnostic characters, high quality-colored illustrations, host associations, and distributional records were provided. This study presents the first comprehensive account of tortricid moth diversity from North Bengal, adding 13 species and 12 genera as new state records to the fauna of West Bengal, thereby strengthening the taxonomic knowledge of the family and providing baseline data for future ecological and pest management studies.

Keywords: DNA barcoding, Microlepidoptera, Morphology, Species diversity, West Bengal





Arctiinae Diversity of Himachal Pradesh: A Baseline for Biodiversity Monitoring

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Moths represent a highly diverse group of Lepidoptera, playing vital roles in ecosystem as pollinators, prey species indicators of environment health. In India, the subfamily Arctiinae (Erebidae) comprises 673 species representing 175 genera. To contribute regional data from the Western Himalaya, surveys were conducted from April to July 2025 in the Shivalik Hills (Hamirpur, Bilaspur, Solan) and the Lesser Himalaya (Kangra, Chamba), documenting Arctiinae diversity across subtropical pine forests and mid-altitude temperate habitats, along with their host plant associations. Adult moths from various elevations were sampled using opportunistic daylight captures and nocturnal light-trapping. Thirty-nine species of the subfamily Arctiinae were collected and identified based on wing coloration, maculation patterns, antennal structure and abdominal coloration with characteristic bands. This suggests that habitat and altitudinal factors have a significant impact on the diversity of communities. These records establish a foundational dataset for studying temporal and spatial shifts in Arctiinae diversity under changing climatic and anthropogenic pressures.

Keywords: Arctiinae, Diversity, Himachal Pradesh, Host Plant Associations, Lepidoptera





Biology of the Bean Spider Mite, *Tetranychus ludeni* Zacher on Cowpea

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The biology of *Tetranychus ludeni* Zacher infesting cowpea was conducted at the Department of Entomology, RPCAU, Pusa. The study revealed that both male and female mites undergo several developmental stages, including egg, larva, protonymph, deutonymph, and adult. Additionally, a brief resting phase, referred to as quiescence, was observed during the transition between these stages. Life cycle of adult male was 8.14 ± 2.07 days and for female 8.77 ± 2.15 days. The adult mite had longevity of 5.1 ± 0.21 days for males, 8.6 ± 0.45 days for mated females, and 11.2 ± 0.71 days for unmated females. The fecundity of mated females (101.9 ± 1.52 eggs) was higher compared to unmated females (57.3 ± 1.49 eggs).

Keywords: Biology, Cowpea, Longevity, *Tetranychus ludeni*, Quiescence





Bruchid Resistance Studies in Lentil (*Lens culinaris* Medik.)

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Lentil (*Lens culinaris* Medik.) is an important pulse crop in India, serving as a key protein and iron source for a large segment of the population. The present study assessed the resistance of lentil genotypes panel, sourced from IIPR, NBPGR, and ICARDA, against three bruchid pests: *Callosobruchus analis*, *C. chinensis*, and *C. maculatus*, which are major causes of post-harvest losses in stored legumes. Resistance was evaluated following screening in no-choice environments and genotypes were classified based on seed damage (SD) and a susceptibility index (SI) criteria. Biochemical traits were analyzed in 12 prominent genotypes including check. Among the species, *C. analis* caused the highest seed damage (15.3–28.7 seeds per 30, 36.2–64.4% weight loss) and oviposition rates (85.6–100%), followed by *C. chinensis*, which inflicted variable damage (2.3–30 seeds; 0.94–59.7% weight loss). *C. maculatus* showed significantly lower infestation due to non-preference, likely because of its larger body size and preference for larger seeds. Genotypes ILWL-55, ILWL-39, and IPL-350 consistently exhibited lower susceptibility, particularly to *C. maculatus* and *C. chinensis*, with lower seed damage and SI values. Biochemical analyses showed variation in flavonoids (0.63–1.54 mg/g) and phytic acid (0.78–1.3 g/100g), with phenols, flavonoids, and tannins negatively correlated with bruchid development. Phytic acid was negatively linked to egg density in *C. analis*. In contrast, correlations for *C. maculatus* were inconsistent. Overall, ILWL-55 and ILWL-39 emerged as strong candidates for breeding bruchid-resistant lentil varieties, highlighting the role of seed biochemicals in resistance.

Keywords: Bruchids, *Callosobruchus*, Lentil, No-choice, Resistance





Butterfly Species of the Selected Protected Areas of the Himalayan Terai Region in Uttar Pradesh, India: Diversity, Relative Abundance, and Implications of Vegetation and Climate Change

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The lower elevation tract of land in the northern part of the Indo-Gangetic Plain, along the foot of the Central Himalayas, is referred to as the Terai. In the state of Uttar Pradesh, this area is a strip of six wildlife sanctuaries and two tiger reserves collectively forming a protected area network. The study in the Terai evaluated butterfly diversity, relative density, and host plant affinity at four sample sites. Being an ecotone, where the foothills of the Sub-Himalayas overlap the Gangetic plains, the Terai provides habitats and climatic conditions from both the adjacent regions. This transitional environment is home to a very dense butterfly fauna. The survey recorded 125 species belonging to 60 genera, spread over six families, occurring in forests, grasslands, as well as open forest edges of the protected areas. During the last several decades, however, widespread loss of grasslands and forest types because of intensive land use and related disturbances has compromised habitat quality in Terai. Since most butterfly species are strongly host-plant dependent, either as adult nectar sources or larval food sources, any alteration in vegetation straightaway jeopardizes their existence. Their well-documented sensitivity to climate change further multiplies this threat by changing forest composition and the availability of host plants. Predictions show that lowland Sal forests, a widespread vegetation type of the Terai, are particularly susceptible to such alteration. Therefore, endemics with restricted ranges and low overlap among forest types are most at risk, indicating their high host plant specificity.

Keywords: Butterfly, Terai, Vegetation, Climate, ecotone





Cataloguing of Syrphid flies and their Seasonal Abundance in Jammu Region

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Syrphid flies or hover flies (Diptera: Syrphidae) are among the most significant groups of insect pollinators with approximately 6300 described species worldwide (Bashir *et al.*, 2025). They are known for their ecological services to agroecosystems by pollinating crops and acting as pest predators. Predatory syrphid larvae are natural biological control agents that lower aphid populations in both field and lab conditions, whereas adult syrphids are significant pollinators with high floral visitation rates and pollen carrying ability. This study documents the diversity and ecological patterns of syrphid flies, which are crucial as pollinators and for biological pest control through their aphidophagous larvae. The research was conducted across three distinct geographical locations in the Jammu region: the outer plains, mid-hills and high hills. From 399 collected samples, 15 species belonging to 8 genera were identified. *Episyrphus balteatus* was the most abundant species overall. The outer plains exhibited the highest species diversity according to the Shannon-Weiner index (1.987). Seasonal activity peaked during the 13th standard meteorological week, with significantly higher abundance observed during morning hours compared to evening. The flies showed a high frequency of occurrence on various host plants, with notable activity on *Mangifera indica* and *Daucus carota*. The study concludes that syrphid flies are vital components of the agroecosystems of Jammu. Their documented diversity and seasonal abundance underscore their significant contribution to pollination services and ecological balance, highlighting the importance of their conservation for sustainable agricultural productivity.

Keywords: Conservation, Diversity, Ecological services, Pollinator, Seasonal abundance





Conservation Biological Control for Rugose Spiraling Whitefly, *Aleurodicus rugioperculatus* Martin in Coconut

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Conservation biological control (CBC) is a sustainable approach based on manipulation of habitats to conserve naturally occurring predators, parasitoids and pathogens present in the agro-ecosystem, thereby leading to natural pest suppression. Habitat management strategies are used for enhancing the positive effects of natural enemies on pest suppression and are the basis of conservation biological control. Coconut, *Cocos nucifera* L. is an important plantation crop and livelihood for millions of people. Insect pest dynamism in coconut ecosystem is changed greater extent after invasion of rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* during 2016. RSW prefer to colonize on hybrid and dwarf coconut varieties and attain outbreak situation in many location in India. The most prevalent and effective natural enemies viz., parasitoid *Encarsia guadeloupeae*, the predator *Apertochrysa astur* entomopathogenic fungus, *Cordyceps (=Isaria) fumosorosea* which exhibit maximum natural parasitism, predation and mortality, respectively. To improve the activity of these resident biological control agents, *Banana* and *Canna indica* crop were cultivated as banker plants in coconut garden either intercrop or border crops. Results revealed that these plants recorded maximum (67.36-81.45%) parasitism of *E. guadeloupeae* and 5.89- 6.85 grub/leaf of *A. astur* in habitat manipulation adopted coconut garden than the conventional practices. Further, overall reduction (75.88-80.24%) of RSW was witnessed in this coconut garden and highest yield. The main function of these banker plants are the supporting of natural enemies reproduction and act as refuge crops during unfavorable weather conditions. Therefore, the growers were advised to grow these crops in coconut garden for conservation and augmentation.

Keywords: Coconut, Habitat Manipulation, Intercrops, Natural Enemies, Rugose Spiraling Whitefly





Diversity of Insect Pests Infesting Maize (*Zea mays* L.) in the High-Altitude Ecosystem of Gurez Valley, A Retrospective Analysis

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Maize (*Zea mays* L.), is the third most important food crop in Jammu and Kashmir after rice and wheat, valued for its multifaceted use as food, livestock and poultry feed and in industrial applications. Despite its importance, maize productivity is severely constrained by insect pest infestations, particularly in high-altitude ecosystems. The present study was undertaken during the 2025 cropping season in maize-growing areas of Gurez Valley, Bandipora, to document the diversity of insect pests associated with the crop. Regular field surveys and visual observations were conducted to record pest incidence and damage symptoms across different growth stages. The survey revealed a diverse assemblage of insect pests belonging to Lepidoptera, Hemiptera, Coleoptera, Diptera and Neuroptera. Key pests recorded included maize stem borer (*Chilo partellus*), armyworm (*Spodoptera frugiperda*), cutworm (*Agrotis ipsilon*), aphids (*Rhopalosiphum maidis*), shield bug (*Dolycoris baccarum*), tarnished plant bug (*Lygus* spp.), black and red bug (*Corizus* sp.), stink bug (*Cletus punctiger*), and flea beetles (*Chaetocnema* spp.). In addition, natural enemies such as ladybird beetles, green lacewings and robber flies were observed, indicating a functioning predator-prey complex. Pest abundance and severity varied with crop phenology and altitude. The findings underscore the vulnerability of maize in the Gurez high-altitude ecosystem to multiple pest attacks, with potential implications for crop yield and regional food security.

Keywords: Diversity, Maize, Gurez Valley, High-altitude ecosystem, Insect pests





Diversity, Ecological roles, and Climate-Driven Dynamics of Insect Fauna in Kanha National Park: Insights from A Three-Year Field Study (2021–2024)

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The present study investigates the diversity, abundance, and ecological roles of insect pollinators, pests, predators, and parasitoids in Kanha National Park over three consecutive years (2021–2024). The research provides a comprehensive assessment of species richness, seasonal trends, and functional roles in forest ecosystem health. A total of 332 insect species were recorded, including 23 pollinators, 201 pests, 74 predators, and 34 parasitoids. Among pollinators, Hymenoptera dominated, followed by Lepidoptera and Diptera. An increasing trend in pollinator diversity, as reflected by the Shannon-Wiener Index (H'), suggests improved floral resource availability and effective habitat conservation. Insect pests showed gradual increase in diversity, with Lepidoptera being most abundant (34 butterfly and 124 moth species), followed by Coleoptera, Orthoptera, and Isoptera. The Simpson's Dominance Index (D) declined from 0.08 (2021–22) to 0.06 (2023–24), indicating a more balanced pest population. Major defoliators like *Hyblaea puera* and *Eutectona machaeralis* peaked during monsoon and post-monsoon seasons. Predatory and parasitic insects showed increased abundance, indicating natural pest regulation. Notable species included *Trichogramma raoi* and various predatory beetles. Their diversity index rose from 2.71 to 3.05, highlighting a well-functioning predator–prey system. This study underscores the need for long-term biodiversity monitoring, conservation of native flora, and sustainable pest management practices.

Keywords: Biodiversity, Insect Pollinators, National Park, Natural Enemies, Seasonal Variations





DNA Barcoding as a Tool to Decipher the Lineage Diversity of Cockroaches (Blattodea) in the Peninsular India

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Under the current scenario of global climate change and human-driven extinctions, taxonomists face an urgent race to document earth's biodiversity before it disappears from the wild. Cockroaches (Blattodea) remain a neglected and under-documented insect group, often regarded perceived as pests despite their ecological importance and considerable diversity worldwide. Cockroach diversity in India is represented by 188 species classifies under seven families and 73 genera, with 94% endemism. Yet, less than 20 per cent of the reported species are represented by DNA barcodes in global databases, reflecting a critical gap in molecular data for the unique diversity of India. This study presents the first comprehensive effort to generate DNA barcodes for Indian cockroaches, to aid documentation of this neglected group. Extensive field sampling across the Western Ghats and Deccan Peninsula yielded over 120 DNA barcodes from 150 specimens. Morphological analyses recognized 50 groups, and molecular phylogenetics recovered 55-60 lineages, whereas species delimitation analyses identified between 86 and 99 genetic lineages. These results reveal substantial cryptic diversity, including numerous putative undescribed species. Beyond clarifying species boundaries, this study establishes the first DNA barcode reference library for Indian cockroaches. This library is expected to aid in future Integrative Taxonomic studies to accelerate the pace of species documentation, DNA metabarcoding and environmental DNA (eDNA) studies, supports investigations of trophic interactions and ecological networks, facilitating invasive species monitoring, and evolutionary and biogeographic research. This study bridges the gap of genetic data resource for advancing cockroach systematics, ecology, and conservation in India.

Keywords: Blattodea, Cryptic diversity, DNA barcoding, Endemism, Species delimitation





Effect of Weather Factors on the Abundance of Mustard Aphid (*Lipaphis erysimi* Kalt) and its Predatory Coccinellids

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Seasonal dynamics of mustard aphid (*Lipaphis erysimi* Kalt.), *Cheilomenes sexmaculata* and *Coccinella septempunctata* were studied on rapeseed mustard under field conditions during the *Rabi* seasons of 2023-24 and 2024-25 at Banda University of Agriculture and Technology, Uttar Pradesh (25.5225° N, 80.3427° E). The mustard aphid exhibited a distinct unimodal pattern, peaking in late January (4th to 5th SWM), and coincided with moderate meteorological parameters. The maximum count of aphids, *Cheilomenes sexmaculata* and *C. septempunctata*, in 2023-24 were 43.58 /10 cm central shoot, 4.25 plant⁻¹ and 4.50 plant⁻¹, and in 2024-25 were 51.53/10 cm central shoot, 5.30 plant⁻¹ and 7.56 plant⁻¹, respectively, with comparatively higher counts in 2024-25. A strong significant association between the mustard aphid with *Cheilomenes sexmaculata* ($r = 0.955$ & $r = 0.960$; $p < 0.05$) and *C. septempunctata* ($r = 0.870$ & $r = 0.885$; $p < 0.05$) was observed during the respective years, showing the potential of coccinellids in suppressing aphid populations. Among seasons, the mustard aphid showed a significant correlation only with the minimum temperature ($r = -0.558$) and only in 2023-24. Among coccinellids, *Cheilomenes sexmaculata* showed a significant negative correlation with the minimum temperature ($r = -0.529$) in 2023-24 and rainfall ($r = -0.534$) with a significant positive correlation with maximum relative humidity ($r = 0.516$) in 2024-25. However, *C. septempunctata* correlated significantly only with maximum relative humidity ($r = 0.556$) in 2024-25. The finding highlights the functional response of coccinellid predators and the critical influence of abiotic factors on aphid dynamics under field conditions.

Keywords: *Cheilomenes sexmaculata*, *Coccinella septempunctata*, Mustard aphid, Population dynamics, Weather variables





Feeding efficacy of native green lacewings of Jammu on invasive pest Fall Armyworm *Spodoptera frugiperda* (J.E. Smith, 1797)

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The fall armyworm, *Spodoptera frugiperda* (Noctuidae; Lepidoptera), is a well-known agricultural pest and has become a major invasive pest worldwide over the last decade. Invading Jammu since 2020, *S. frugiperda* has primarily colonized in the sub-tropical areas of the region. Its rapid spread poses a significant threat to maize and other crops, leading to substantial economic losses and raising concerns for regional food security. Current management, which relies mainly on chemical pesticides, is unsustainable, necessitating the development of effective alternative tactics, biological control being one such approach. Green lacewings have been shown to be effective biocontrol agents against a wide range of soft-bodied insect pests, including aphids, whiteflies, thrips, mites, and scale insects, as well as eggs and small larvae of Lepidoptera and Coleoptera (Canard *et al.*, 1984; McEwen *et al.*, 2010). This study evaluated the feeding efficacy of native green lacewings (Neuroptera: Chrysopidae) from Jammu against the early life stages of *S. frugiperda*. Laboratory bioassays were conducted by offering eggs and neonates of *S. frugiperda*. The results demonstrated high predatory potential, with an average consumption of *S. frugiperda* eggs ranging from 255 to 260 per lacewing larva. The consumption of neonates was also considerable, ranging from 58 to 62 neonates. The findings conclusively indicate that the native green lacewings of Jammu are voracious predators of this invasive pest. We conclude that these native lacewing species are promising biocontrol agents for integration into IPM programs against *S. frugiperda*. Their conservation and augmentation in agroecosystems of Jammu are essential for developing sustainable and environmentally safe pest management solutions.

Keywords: Biocontrol agent, Conservation, Fall armyworm, Invasive pest, Native green lacewing





Insect Pest Management Under Changing Scenario of Climate Change in India

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The importance of climate and weather events to the distribution of insects and their population dynamics has long been recognized. Insects are poikilothermic in nature and are directly under the control of temperature for their growth. The duration of insect life cycle is altered under increased temperature and elevated carbon dioxide concentrations resulting in variable number of generations per year. The elevated carbon dioxide concentrations are mediated through enhanced photosynthesis in plants for phytophagous insects' growth and development. Several insect pests, that were important in the past or the minor pests are likely to become more devastating with global warming and climate change. Insect pests cause an estimated annual loss of 13.6 per cent globally and 23.3 per cent in India. Losses due to insect pests are likely to increase as a result of change in crop diversity and climate change. An increase of 0.4°C average surface temperature over past century in India has led to crop insect pests losses increase from 3.0 per cent during the pre-green revolution period to 50 per cent during the post-green revolution period. The changes of insect pests losses has been increased up to 32 per cent. A major portion of the cultivated areas of India covered under rainfed. The rainfed agriculture is directly reciprocal to the climate. So, any changes in the state of climate may cause crop failure due to biotic and abiotic stresses of climatic vagaries. The adaptation, mitigation and natural resource management are basic components of remedial measures taken to combat the adverse impact of climate change. The natural resource management is a holistic approach to minimize the adverse impact of climate change by application of sustainable approach in insect pest management. To combat the adverse impact of climate change on insect pests, its urgent need to adopt climate resilient strategies and initiatives for insect pest management in India. This paper attempt to review the reported studies on climate change management to reduce the risk of strategy for effective insect pest management in India.

Keywords: Climate change, Insect pests, India, Management, Temperature





Insect-Plant Interaction in a Changing Climate

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Climate change profoundly impacts insect behaviour and plant-insect interactions, with significant consequences for ecosystems, agriculture, and biodiversity. Rising temperatures, altered precipitation patterns, and elevated atmospheric CO₂ levels are driving shifts in insect phenology, feeding rates, and reproductive cycles. These changes often lead to temporal mismatches between insect emergence and plant flowering or fruiting, disrupting critical processes like pollination and herbivory, which can reduce crop productivity. Additionally, climate-induced changes in plant physiology, such as alterations in secondary metabolites and nutrient content, influence insect host preferences, herbivore resistance, and pollinator attraction, potentially destabilising ecological relationships. Temperature-based predictive models and phenological observations help forecast insect activity and its effects on plant health, highlighting the need for integrated climatic, biological, and ecological data. Extreme weather events, including heatwaves, droughts, and irregular rainfall, exacerbate these dynamics, often triggering pest outbreaks or pollinator declines. Understanding these complex interactions is essential for developing strategies to mitigate impacts on agricultural productivity, ecosystem stability, and food security. Interdisciplinary approaches combining Climatology, Entomology, and plant science are critical to predict, manage, and adapt to the evolving consequences of climate change on insect-plant interactions.

Keywords: Climate, Ecology, Ecosystem, Insect Phenology, Pollinator.





Plant Quarantine: A Vital Strategy for Managing Invasive Agricultural Pests

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Invasive alien species (IAS) are organisms that spread beyond their natural range and pose threats to native biodiversity, ecosystems, and even the economy. India has been heavily impacted by these species, with nearly 40% of its flora consisting of non-native plants, many of which are invasive. Such invasions often result in certain species turning into pests or driving native species towards extinction. Their significance is evaluated in terms of the damage they cause to human health, livelihoods, biodiversity, and the economy. As a member of both the Convention on Biological Diversity (CBD) and the World Trade Organization (WTO), India is obligated to manage IAS. Article 8(h) of the CBD stresses the need to prevent their introduction, while the WTO's Sanitary and Phytosanitary Agreement seeks to stop the spread of exotic plant and animal pests, some of which can become invasive in new regions. To address these risks, most countries enforce quarantine regulations to limit the movement of commodities that may harbor invasive species. In India, any alien species not yet recorded but with invasive potential is treated as a quarantine pest, requiring a thorough Pest Risk Analysis (PRA) before being allowed entry. The Plant Quarantine (Regulation of Import into India) Order, 2003, which ensures compliance with both CBD and WTO requirements which categorizes agricultural imports into four groups: (a) prohibited species (Schedule IV); (b) restricted species, importable only through designated institutions (Schedule V); (c) restricted species permitted with additional pest-free declarations and treatment certifications (Schedule VI); and (d) plant material meant for consumption or processing, allowed with a standard Phytosanitary Certificate (Schedule VII). It also specifies requirements for over 700 agricultural commodities, more than 1,200 quarantine pests, and 57 invasive weeds. The Ministry of Environment, Forest and Climate Change (MoEF&CC) is the lead agency for India's negotiations under the CBD, while the Ministry of Agriculture and Farmers Welfare oversees quarantine, surveillance, and control measures. However, MoEF&CC still lacks a clear policy or mechanism for IAS management. This gap highlights the urgent need for a unified strategy that integrates existing fragmented regulations, strengthens biosecurity, and aligns with global standards. Additionally, India must invest in research, training, capacity





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Opportunities, Impact of Climate Change on Insect-Pest Dynamics,
Insect-Plant Interactions in a Changing Climate

building, collaboration, and information exchange at both national and regional levels to effectively tackle the growing challenges posed by IAS.

Keywords: CBD, Invasive Alien Species, Phytosanitation, Quarantine, WTO



Rapid Virtual Oral Presentation



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Preliminary Survey for the Species of Dragonflies in District Hamirpur, Himachal Pradesh, India

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A preliminary survey was conducted in district Hamirpur, Himachal Pradesh, to record the species of dragonflies. This survey was conducted at different locations, near streams, field, near forest margins. These dragonflies were photographed and identified using the field guides. Different species of dragonflies recorded were including the *Paragomphus lineatus* (lined hooktail), *Orthetrum pruinosum* (Pink skimmer), *Orthetrum glaucum* (common blue skimmer), *Orthetrum triangulare* (triangle skimmer), *Orthetrum taeniolatum* (Small skimmer), *Trithemis aurora* (Crimson dropwing), *Trithemis festiva* (Indigo dropwing), *Pantala flavescens* (wandering glider), *Bradinopyga geminate* (Indian rockdweller) and *Anax immaculifrons* (magnificent emperor). *Orthetrum pruinosum* and *Orthetrum triangulare* were very common. *Anax immaculifrons* was not very common.

Keywords- Aquatic, Conservation, Diversity, Habitat, Streams





Seasonal Incidence and Bioefficacy of Insecticides against Sapota Bud Borer

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The sapota bud borer, *Anarsia achrasella* Bradley, is a key lepidopteran pest that exerts considerable toxicological stress on reproductive tissues of *Manilkara achras*, leading to significant reductions in crop productivity. Field investigations conducted at Dr. YSR Horticultural University, Venkataramannagudem during 2023–2024 assessed the seasonal incidence of bud borer damage and the comparative efficacy of different insecticidal treatments. The incidence of bud damage exhibited temperature variation, highest at 21.57 per cent during the second fortnight of March, when elevated maximum temperature acted as a toxicological driver of infestation intensity. Correlation analysis demonstrated a strong positive association between bud infestation and temperature, while high rainfall imposed as suppressing pest population. However, Bioefficacy trials indicated that the interactions of synthetic molecules with insect physiology. Among the insecticides, novaluron induced the highest level of reduction in pest, resulting in minimal bud damage of 3.63 percentage. Spinosad, a naturally derived neurotoxicant, produced comparable efficacy with 5.24 per cent damage of bud borer, while emamectin benzoate and flubendiamide demonstrated intermediate toxicological performance. In contrast, botanical derivatives and microbial agents such as *Bacillus thuringiensis* elicited sublethal effects, reducing bud damage but failing to reach the suppressive threshold of newer synthetic molecules. The study emphasizes the importance of integrating insect growth regulators and selective neuroactive compounds into resistance management frameworks to ensure ecotoxicologically safe and sustainable suppression of *Anarsia achrasella* in sapota orchards.

Keywords: *Anarsia achrasella*, Bioefficacy, Bud borer, Sapota, Seasonal incidence





Seasonal Incidence of Major Insect Pests of Okra Crop and their Relationship with Weather Parameters in Eastern Uttar Pradesh

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The present study was conducted to investigate the seasonal incidence of major insect pests of okra (*Abelmoschus esculentus* L.) and their correlation with key weather parameters during the Kharif seasons of 2021–22 and 2022–23. The field experiment was carried out using the okra variety *Arka Anamika*, sown on 20th June 2021, with a plot size of 10 m × 10 m and spacing of 60 cm × 30 cm. Weekly observations were recorded from sowing to harvest, focusing on major pests including shoot and fruit borer (*Earias vittella*), jassid (*Amrasca biguttula biguttula*), whitefly (*Bemisia tabaci*), and red cotton bug (*Dysdercus cingulatus*). The results revealed distinct seasonal patterns for each pest, influenced strongly by environmental factors such as maximum and minimum temperature, relative humidity, and rainfall. *E. vittella* caused peak shoot and fruit damage during mid-season, with higher relative humidity and moderate temperatures favoring its buildup. Jassid populations increased under warm and dry conditions, while whitefly incidence was highest during periods of moderate temperature, high humidity, and intermittent rainfall. Red cotton bug populations peaked under warm, low-humidity conditions with minimal rainfall. Correlation analyses confirmed that relative humidity and rainfall positively influenced *E. vittella* incidence, while jassid and red cotton bug outbreaks were more responsive to high temperatures and low moisture conditions.

Keywords: Okra, Population, Seasonal Incidence, Temperature, Weather





Spatial and Temporal Dynamics of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guen.) Infestation in Key Brinjal-Growing Areas of Eastern Uttar Pradesh

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The present research works the survey for the extent of losses on farmer's fields grown under different agricultural practices was carried out to check the infestation of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guen.) The experiments were conducted at the farmer's fields in different blocks of Deoria and Gorakhpur districts of Uttar Pradesh and Agricultural Research Farm of B.R.D.P.G. College, Deoria, Uttar Pradesh during Kharif 2020 and 2021. The survey for the extent of losses in brinjal caused by brinjal shoot and fruit borer on farmer's fields recorded the minimum percentage of shoot infestation in the field of Ghanshyam Prasad (block: Bhaluani, village: Bairia Tiwari) with 18.17% shoot infestation, and the maximum percentage of shoot infestation was observed in the field of Ramprasad Mishra (block: Rampur Karkhana, village: Kamdhenvan) with 45.13% shoot infestation. However, the maximum percentage of fruit infestation (58.56%) was found in the field of Hari Shankar (block: Patardeva, village: Kanthipatti), while the minimum fruit infestation (22.56%) was recorded in the field of Krishn Raj Singh (block: Bhaluani, village: Babhani) in Deoria district. In Gorakhpur district the damage of brinjal shoot and fruit borer, minimum percentage of shoot infestation (21.67% shoot damage) was recorded in the field of Ganga Ram (block: Belghat, village: Dhabia), while the maximum percentage of shoot damage was observed in the field of Krishna Murari (block Gogha, village Rawat Par) with 45.12% shoot damage. However, the minimum percentage of fruit damage (32.89% fruit damage) was recorded in the field of Shyam Kishor (block Kauriram, village Bastupar), while the maximum fruit damage was observed in the field of Prabhu Nath (block Gola, village Bhawanipur), with 56.46% fruit damage.

Keywords: Fruit damage, Infestation, *Leucinodes orbonalis*, Shoot damage, Survey





Taxonomic Contributions to the Subfamily Elaterinae (Coleoptera: Elateridae) from Northeastern Region of India

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The family Elateridae Leach, 1815, is the ninth largest beetle family (Coleoptera), comprising nearly 11,000 described species in 18 subfamilies, 37 tribes, and about 600 genera worldwide. In India, it is represented by over 838 species belonging to 113 genera and eight subfamilies. Commonly known as click beetles, shipjacks, or spring beetles, members of this family are notable for their characteristic jumping ability, producing an audible “click.” Their larvae, called wireworms, inhabit decomposing wood, termite nests, soil, and organic litter. More than 100 species are recognized as serious agricultural pests, attacking crops such as sugarcane, maize, groundnut, wheat, sorghum, potato, onion, ginger, chilli, sugar beet, and carrot, causing failed emergence, wilting, stunted growth, and plant mortality. In recent years, they have become significant pests of various crops in Karnataka. The subfamily Elaterinae, the largest within Elateridae, includes about 200 valid genera worldwide, of which only 47 are recorded from India. Despite their agricultural and ecological importance, the taxonomy of Indian Elaterinae remains poorly explored, particularly in the biodiversity rich northeastern region. In this study, 146 specimens were collected from Arunachal Pradesh, Manipur, and Meghalaya. Sixteen species were identified using diagnostic morphological traits of the antennae, prosternal apophysis, metacoxal plates, abdominal structures, and genitalia. These represent the tribes Synaptini, Melanotini, Elaterini, Dicroepidiini, and Megapenthini, and the genera *Glyphonyx*, *Melanotus*, *Mulsanteus*, *Neopsephus*, *Nipponoelater*, *Prokraerus*, and *Xanthopenthes*. Three species are described as new to science: *Glyphonyx kyrdemkulaiensis* sp. nov., *Glyphonyx ribhoiensis* sp. nov., and *Neopsephus umiamensis* sp. nov., while five others are newly recorded from India. These findings provide valuable baseline data for future taxonomic research on Indian Elaterinae.

Keywords: Distribution, Diversity, New records, new species, Taxonomy.





Thermal Stress-Induced Modulation of Metabolic Enzymes in *Aedes Aegypti* and *Aedes Albopictus*

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Rising global temperatures are silently reshaping the physiology of disease vectors, altering their survival and transmission potential. This study explores the effects of thermal stress on metabolic enzyme activity in third instar larvae of *Aedes aegypti* and *Aedes albopictus*. Larvae were exposed to a temperature gradient (10 Degree Celsius to 40 Degree Celsius) for 3 hours, with 30 Degree Celsius as control. Biochemical assays evaluated carbohydrate metabolism (glucose, trehalose), proteolytic enzymes (Cathepsin D, serine protease), transaminase, antioxidant enzymes (Catalase, Superoxide Dismutase), and total protein content. Lethal Time 50 analysis revealed 37.243 Degree Celsius as a critical thermal limit. *Aedes albopictus* showed enhanced oxidative defense and stable trehalose levels, while *Aedes aegypti* demonstrated greater modulation in proteolytic and protein content responses. Catalase and Superoxide Dismutase peaked at 25 Degree Celsius but declined at extremes. Overall, species-specific enzymatic responses indicate differential thermo tolerance, with implications for vector survival, distribution, and climate-adapted control strategies.

Keywords: Lethal Time 50, *Aedes aegypti*, *Aedes albopictus*, Catalase, Superoxide Dismutase, Protein





Variation in Consumption and Assimilation of Host Plants by Fall Armyworm (*Spodoptera frugiperda* J.E. Smith)

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A laboratory experiment was conducted to study the host driven differences on the nutritional physiology and digestive enzyme responses of Fall Armyworm. The host plants selected were maize, wheat, cotton, soybean and cowpea. Standard protocols were followed to study the parameters like Efficiency of conversion of ingested food, Efficiency of conversion of digested food, Relative Consumption Rate, Relative Growth Rate, Production Index, Consumption Index, Approximate digestibility, Reference ratio, Maintenance Cost and Respiration. Similarly, different gut enzymes like Protease, Amylase, Trypsin and Chymotrypsin of fifth instar larvae of *S. frugiperda* was compared with the nutritional parameters of the host following standard methodologies. Maize-fed larvae achieved the highest efficiencies of conversion of ingested food (25.6%) and digested food (42.1%), whereas cotton-fed larvae recorded only 12.3% and 21.5%, respectively. Relative consumption rate and relative growth rate were also maximum on maize (3.2 g/g/day; 1.6 g/g/day respectively), indicating superior utilization of food resources. Cotton-fed larvae showed high approximate digestibility (78.5%) but with low biomass conversion, reflecting metabolic inefficiency. Enzyme assays further supported these patterns: amylase activity peaked in cotton-fed larvae (4.8 U/mg protein), correlating with high soluble sugar content, while protease and trypsin activities were highest in soybean-fed larvae (6.2 and 3.9 U/mg protein, respectively), matching their higher protein levels. Cowpea-fed larvae recorded maximum chymotrypsin activity (3.2 U/mg protein). These biochemical findings highlight why maize, wheat, and soybean are more suitable hosts for Fall Armyworm population growth, while cotton exerts a suppressive effect.

Keywords: Assimilation, Consumption, Gut enzymes, Host plants, *Spodoptera frugiperda*





Species Diversity Indices in Maize Crops

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A study was conducted in the Lovely Professional University Research farm, Punjab, to study the species diversity of insect pests and their natural enemies in maize. During the study, 17 species of insect pests and 13 species of predators were recorded. Furthermore, Simpson's, Shannon-Wiener, Margalef, and Brillouin indices were used to statistically describe the pest and predator communities. Simpson's index was higher in Hemiptera, Menhinick's index was the largest in Coleoptera with higher richness, Pielou's index showed the highest evenness in Orthoptera and for the Shannon-Wiener index both Hemiptera and Coleoptera showed higher values with more richness and evenness for both years 2024 and 2025. Among the predators, Coleopterans recorded the highest Menhinick's index and Margalef's index with higher richness, and Pielou's index recorded the highest for Odonata and Hymenoptera with higher evenness for both years 2024 and 2025 respectively.

Keywords : Biodiversity, Diversity indexes, Insect Pest, Maize, Predators





An Assessment of Coleopteran Family-Level Diversity in Sanjay Gandhi National Park, Mumbai

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The present study documents a total of 48 Coleoptera families recorded at seven sampling stations across Sanjay Gandhi National Park (SGNP) during the survey period from July 2022 to June 2023. This National park despite being surrounded by the metropolitan city of Mumbai shows significant high richness which is consistently reflected by higher values of Species Richness, Margalef, Menhinick, and Chao indices, indicating that the sampling stations harbor a similarly diverse community. Such diversity may be due to heterogeneous vegetation (deciduous and semi-evergreen patches), and diverse microhabitats that create multiple ecological niches and support the coexistence of a wide range of families. Shannon index values (3.47 to 3.74) indicate high family-level diversity within the national park. Present study proposes some spatial distributional specificity; 23 families were recorded at all the seven sites; 24 families were recorded at two to six sites where as Hybosoridae was recorded only from Yeoor. Jaccard similarity for spatial distribution ranged from (0.62) between Yeoor and Gandhi Tekdi to (0.84) between Gandhi Tekdi and Kashi and Gandhi Tekdi and Hathi Gate suggesting similar habitat conditions and overlapping beetle communities. Similar study carried out in the same national park between 2013-2015 reported presence of 34 families. The present study added 14 families making it to total of 48 which emphasizes the importance of SGNP.

Keywords: Coleoptera, Family Diversity, Hybosoridae, Microhabitat, Sanjay Gandhi National Park





Soil Microarthropod Communities: Habitat Distribution and Preferences in Northern Districts of West Bengal

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A study was conducted in northern districts of West Bengal to identify the type of habitats preferred by the soil microarthropods. Four different types of habitats viz., soil, litter, manure pit and moss were studied. The number of microarthropods were collected and identified, at least up to genus-level and their number was counted. Analysis revealed clear habitat differentiation among mesofauna communities. The taxa-habitat network was highly connected, dominated by generalist taxa that occupy multiple habitats, suggesting resilience to habitat loss. Most taxa, including laelapids, oribatids, acarids, and collembolans, were generalists, while a few, such as pseudoscorpions, were habitat specialists. Litter supported the most distinct assemblages, including specialist taxa, whereas soil hosted a higher proportion of generalists, linking communities across habitats. Oribatids were the most dominant taxa across all habitats. The study indicates that soil microarthropod communities are structured by habitat. These patterns emphasize that both habitat diversity and species functional roles are critical for ecosystem resilience, biodiversity conservation, and the sustained delivery of soil ecosystem services. Soil mesofauna can serve as bioindicators of soil health, inform conservation strategies for habitat heterogeneity, and guide sustainable land management by linking biodiversity to ecosystem services such as nutrient cycling and carbon storage.

Keywords: Biodiversity, Ecosystem resilience, Habitat heterogeneity, Soil ecosystem services, Soil mesofauna





Host Diversity and Parasitic Potential of *Diaeretiella rapae* (M'Intosh) under organic farming systems in Jharkhand

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Beneficial insects play significant role in delivering the ecosystem services, particularly regulation of insect pests through parasitization. This service is remarkably more crucial in organic and natural farming, where biological control is one of the key approaches of pest management. *Diaeretiella rapae* (M'Intosh) is one of the important nymphal- adult endoparasitoid of aphid with high potential to suppress the infestation. However, information on its host range and parasitic potential under organic crop cultivation, especially in Jharkhand, is limiting. The present study was conducted at Ramakrishna Mission Vivekananda Educational and Research Institute and Divyayan Krishi Vigyan Kendra, Morabadi, Ranchi during rabi seasons of 2024 and 2025. Weekly surveillance was undertaken to record the activity of *Diaeretiella rapae*, document its host diversity and assess its parasitic potential against mustard aphid, *Lipaphis erysimi* (Kaltenbach) and cabbage aphid, *Brevicoryne brassicae* (Linnaeus). The parasitic activity was observed across eight different crops viz., brinjal, tomato, cabbage, cauliflower, broccoli, knol-khol, mustard, and radish under organic field conditions with parasitoid parasitising the key aphid species, including, *Aphis gossypii* (infesting brinjal and tomato), *Brevicoryne brassicae* (infesting cabbage, cauliflower, knol- khol, broccoli), and *Lipaphis erysimi* (infesting mustard and radish). Average parasitism exceeded 40 per cent on mustard aphid and 30 per cent on cabbage aphid. These findings indicate the pivotal role of *D. rapae* in the natural suppression of aphid both in brassica and solanaceous organic ecosystems in Ranchi. The conservation of the parasitoid can enhance the biological control of pest naturally and reduce the insecticide reliance in conventional (chemical) farming.

Keywords: Aphid, *Brevicoryne brassicae*, *Diaeretiella rapae*, Jharkhand, *Lipaphis erysimi*, Organic farming, Parasitoid





Diversity of Fruit flies (Diptera: Tephritidae) in Selected Mega Markets of India

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Fruit flies (Diptera: Tephritidae) pose a significant threat to horticultural crops, causing substantial production losses and disrupting market trade. While most studies have focused on their importance in fields, horticultural commodities also spend considerable time in transit and storage. Therefore, understanding the diversity of fruit flies in markets is crucial for effective pest management and regulation. This study aimed to investigate the occurrence and diversity of fruit flies in selected mega-markets of India using molecular and morphological approaches from September to December 2024. Two mega-markets were selected from each of the following regions: Delhi (Keshavpur and Azadpur), Uttar Pradesh (Sahibabad and Lalbagh), Hyderabad (Batasingaram and Kothapet fruit markets), and Bangalore (Yelahanka market and KR Market). Fruit flies were captured at fortnightly intervals using para-pheromone traps (methyl eugenol and cue lure) and bait traps (yeast extract). Infested fruits were also collected and reared from each market. A total of 3,955, 3,179, 1,122, and 304 flies were collected from the Delhi, Uttar Pradesh, Bangalore, and Hyderabad markets, respectively. Results showed that species diversity and abundance varied across the selected markets. Seven species were recorded and identified, namely *Bactrocera dorsalis*, *B. correcta*, *B. nigrofemoralis*, *B. zonata*, *Zeugodacus cucurbitae*, *Z. tau*, and *Z. scutellaris*. Species identification was carried out through morphological examination and confirmed by DNA barcoding. The predominant species recorded from the Delhi and Uttar Pradesh markets were *Z. cucurbitae* (55.19% and 65.27%, respectively), followed by *B. dorsalis* (35.75% and 24.91%, respectively) and *B. zonata* (7.61% and 8.65%, respectively). A low abundance of *Z. tau*, *B. correcta*, *B. nigrofemoralis* and *Z. scutellaris* was observed. In the Bangalore markets, *Z. cucurbitae* (38.68%) was most abundant, followed by *B. dorsalis* (24.59%) and *B. nigrofemoralis* (19.34%), with a lower abundance of *Z. tau*, *B. zonata*, and *B. correcta*. In Hyderabad markets, *B. dorsalis* (52.96%) was the most abundant, followed by *Z. cucurbitae* (39.47%) and *B. zonata* (6.92%). Neither *Z. tau* nor *B. nigrofemoralis* was found in Hyderabad markets. Notably, *Z. scutellaris* (0.15%) was exclusively recorded in Uttar Pradesh markets among all those surveyed. Fruit samples collected from each market were reared in the laboratory, and adult emergence confirmed that the species collected in the traps originated from the respective market regions. This research provides valuable insights into mega-markets as potential sources of infestation and highlights the variation in species diversity. It represents the first documentation of fruit fly species diversity in Indian markets and will help integrate markets into area-wide pest management practices.

Keywords: DNA barcoding, Fruit fly, Mega-markets, Para-pheromones, Species diversity





Tarsonemid Mites Associated with Different Agri-horticultural Plants in Eastern India

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Tarsonemid mites (Acari: Tarsonemidae) represent one of the largest groups within the cohort Heterostigmata, with many species of considerable economic importance as phytophagous pests. Species such as *Polyphagotarsonemus latus* and *Steneotarsonemus spinki* are serious pests causing heavy damage to vegetables, fruits, ornamentals, and cereals. Their small size, cryptic habits, and rapid population build-up under favourable climatic conditions make them difficult to detect and manage, often leading to significant yield losses. Despite their impact, information on the diversity and distribution of tarsonemid mites remains limited. Only 47 species belonging to 10 genera have been documented to date from India, and among them, 31 are exclusively found in West Bengal. The present investigation was conducted to document tarsonemid mites associated with various agricultural and horticultural plants in Eastern India. Surveys revealed the occurrence of both economically important pests and several species newly described from this region. Notable records include *Bongotarsonemus unicornus* on *Prunus avium* in Darjeeling, *Ceratotarsonemus bengalicus* on *Citrus reticulata* in Rishikhola, and *Daidalotarsonemus tambulae* on *Piper betle* in Maslandapur. Similarly, *Floridotarsonemus kanthali* on jackfruit, *Fungitarsonemus clavatus* on mango, and *Metatarsonemus badurkani* on multiple hosts such as *Ziziphus jujubae* and *Lagerstroemia speciosa* indicate their wide host affinity. Additionally, *Steneotarsonemus indianensis* on *Phragmites australis* and *Tarsonemus bengalicus* on bamboo highlight the growing taxonomic richness of this family in the region. These findings provide baseline information on tarsonemid diversity in Eastern India and highlight the need for regular monitoring, accurate identification, and their integration into IPM strategies to safeguard agri-horticultural systems.

Keywords: Agri-horticultural crops, Eastern India, Host-mite association, Mite taxonomy, Tarsonemidae





Population Dynamics of *Noorda moringae* and *Noorda blitealis* in Relation to Weather Parameters in Moringa

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Moringa oleifera, an increasingly popular and nutritionally rich crop, faces significant yield loss due to infestations by the budworm *Noorda moringae* and leaf-eating caterpillar *Noorda blitealis*. In the present study, population dynamics of both pests was monitored under field conditions in Coimbatore district, Tamil Nadu, from November 2023 to July 2024. Observations were recorded at fortnightly intervals on larval population and bud infestation, and correlated with weather parameters to identify critical pest periods. The results revealed that *N. moringae* infestation peaked at 28.86 per cent during the 17th standard meteorological week (SMW), coinciding with active flowering, and declined to 0 by the 26th SMW as pods developed. Similarly, *N. blitealis* showed maximum larval population (5.02 larvae per branch) during the 15th SMW, with complete absence during the 46th SMW when rainfall was highest (19.03 mm). Correlation analysis showed that maximum temperature had a significant positive relationship with pest abundance. A 1°C increase in Tmax led to a 0.56% increase in *N. moringae* bud infestation and a 0.12 larvae/branch increase for *N. blitealis*. These findings highlight the value of population dynamics monitoring as a basis for timely and efficient pest management decisions in moringa cultivation. By understanding pest dynamics in relation to weather variables, growers can anticipate outbreaks and make informed decisions. This data-driven strategy enhances the effectiveness of pest control measures, minimizes unnecessary chemical use, and promotes sustainable crop production.

Keywords: Budworm, Infestation dynamics, Leaf-eating caterpillar, Moringa, Weather correlation





Indian Gelechiidae (Gelechioidea: Lepidoptera): Taxonomic and Molecular Updates

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The family Gelechiidae is one of the most species-rich groups of micromoths in India and includes several serious pest species such as *Approaerema modicella* (Deventer, 1904), *Pectinophora gossypiella* (Saunders, 1844), *Phthorimaea absoluta* Meyrick, 1917, *Phthorimaea operculella* (Zeller, 1873) and *Sitotroga cerealella* (Olivier, 1789). Despite their diversity and economic importance, the taxonomy of Indian Gelechiidae has remained fragmented across disparate publications and outdated descriptions. In this study, we critically reviewed and consolidated all available records to produce the most comprehensive taxonomic catalogue to date, documenting approximately 351 species under 80 genera across seven subfamilies and providing type information, distribution, host plants and diagnostic illustrations. Building upon this compilation, taxonomic investigations were conducted on 62 representative species, focusing on classical morphological traits such as external morphology, wing venation and male and female genitalia. These efforts led to the description of four new species namely, *Gelechia adi* sp. nov., *G. bilobuncusa* sp. nov., *Istrianis ladakhensis* sp. nov. and *Tricerophora* sp.) and the documentation of four new distributional records for India namely, *Anarsia kepensis* Park, 2016, *A. tricornis* Meyrick, 1913, *Hypatima rhomboidella* (Linnaeus, 1758) and *Helcystogramma flavifuscum* Li & Zhen, 2011. For economically important taxa, morphological diagnoses were combined with mitochondrial COI DNA barcoding and the development of an updated identification key. This integrative approach refined species boundaries, clarified synonymies, provided high-resolution images and delivered the first molecular reference sequences for several Indian species like *Eustalodes achrasella* (Bradley, 1981), *Palumbina glaucitis* (Meyrick, 1907), *Mesophleps* sp. Together, these advances present a consolidated and authoritative picture of the current state of Gelechiidae taxonomy in India and offer a roadmap for future research aimed at achieving a stable and comprehensive classification of this diverse and economically important family.

Keywords: Crop pests, DNA barcoding, Indian fauna, new species, Taxonomic catalogue





Seasonal Plasticity of Wing and Wing Spot in *Drosophila rajasekari*: A Geometric Morphometric Approach

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Phenotypic plasticity is the ability of a genotype to produce different phenotypes in response to environmental change. This study examined seasonal plasticity in whole wing and wing spot morphology of *D. rajasekari* males to test whether whole wing and wing spot respond in parallel to environmental variation. Male wings collected during monsoon, post-monsoon, and summer were analyzed using Geometric Morphometric Analysis (GMA). Shape variation was analyzed using Canonical Variate Analysis (CVA) and Procrustes ANOVA, while developmental stability was assessed through Fluctuating Asymmetry (FA). In addition, centroid size variation was examined, and correlations between whole wing and wing spot size was evaluated. The results revealed that seasonal changes in whole wing and wing spot was not parallel, indicating independent responses. CVA revealed partial seasonal separation; Procrustes ANOVA showed significant seasonal effects on size and shape in both traits, with strong FA. FA was consistently greater in wing spots, especially in monsoon, suggesting increased sensitivity of wing spot pigmentation to developmental and environmental stress. Centroid size also showed differing trends: wings were largest in monsoon and smallest in summer, while wing spots peaked during monsoon, declined in post-monsoon, and increased again in summer. Correlations between wing and spot size were positive in all seasons, strongest in post-monsoon.

Keywords: Canonical Variate Analysis, Fluctuating Asymmetry, Geometric Morphometric Analysis, Phenotypic Plasticity, Procrustes ANOVA





Biology and Morphometrics of Hadda Beetle, *Henosepilachna vigintioctopunctata* (F.) on Bittergourd (*Momordica charantia* L.)

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The life cycle traits and morphometric studies of *Henosepilachna vigintioctopunctata* (F.) were conducted in the laboratory conditions at BUAT, Banda. There were 10 sets for biological study experiments and each set replicated thrice, and four sets for morphometric observations and each set was replicated five times. The mean egg period was 3.54 days and their size varied from 1.08 to 1.12 mm in length and 0.36 to 0.45 mm in breadth. The average fecundity, eggs per cluster (No.) and percentage of egg hatching were 173.60, 44.90 and 85.47, respectively. The average durations of first, second, third and fourth instar larvae were 4.09, 3.69, 4.11, 4.04 days, respectively, and total larval period was 19.48 days. The length and breadth of corresponding stages were 1.76 and 0.58 mm, 2.89 and 1.02 mm, 4.86 and 2.05 mm, 5.47 and 2.93 mm, respectively. The pre-pupal duration was 1.30 days; however, pupal period was 5.58 days. The average length and breadth of pre-pupa and pupa were 66.66 and 4.80 mm, 5.11 and 3.07 mm, respectively. The average length and breadth of female and male adults 6.72 and 4.99, 6.01 and 4.67 mm, respectively. The average durations of pre mating and mating period (in minutes), pre oviposition, oviposition and post oviposition period of female were 1.40, 10.40, 4.81, 7.79 and 5.69 days, respectively. The average life span of female and male was 19.81 and 9.12 days, respectively. The sex ratio of male and female were 1:1.2.

Keyword: Bittergourd, Fecundity, *Henosepilachna vigintioctopunctata*, Life cycle, Morphometrics





Parasitizing Potential of Larval Parasitoid *Cotesia plutellae* on Diamondback moth, *Plutella xylostella* Infesting Kale in Sopore, Kashmir

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A mated female of *Cotesia plutellae* was found to parasitize an average of 59.0 ± 4.45 3rd instar larvae of diamondback moth, during its ovipositional period of 9.6 ± 0.54 days at the rate of 5.9 ± 0.35 larvae day⁻¹. Rate of parasitism was found to vary from 1st day till 10th day. A maximum of 13.20 larvae were parasitized on 1st day which gradually declined on successive days and was observed minimum on 10th day. Difference in day wise larval parasitism when compared with one way ANOVA was found statistically significant ($F = 153.62^{**}$; d.f. = 9, 36; $p = < 0.001$). Replication wise comparison was also found statistically significant ($F = 3.32^*$; d.f. = 4, 36; $p = 0.02$) which indicated intraspecific variation in parasitizing potential. The present study revealed a female *C. plutellae* killed an average of 58.34% larvae during its first three days. Parasitizing potential was statistically identical for first two days which declined on third and fourth day but was statistically identical from D5 to D7. Parasitizing potential depended on number of mature egg loads in ovary of a female and its allocation on daily basis in the form of larval parasitism which declined gradually with the age of female. For first three days maturity of eggs was faster hence maximum percentage of larvae were killed as compared to subsequent days. Average longevity of female *C. plutellae* was worked out as 14.38 ± 1.21 days whereas 13.17 ± 1.21 days for male including post ovipositional period as 4-5 days.

Keywords: *Cotesia plutellae*, Diamond back moth, Longevity, Parasitizing potential, Third instar larvae





Microhabitat Drivers of Butterfly Beta-Diversity in Urban Green Spaces: A Study of Parks in Chandigarh, India

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Urban parks are increasingly recognized as vital refuges for biodiversity within expanding cities. Butterflies, being sensitive indicators of habitat quality, respond strongly to microhabitat variation, making them ideal for assessing the ecological value of urban green spaces. We conducted a year-long survey (March 2024–February 2025) across major parks in Chandigarh, India, using replicated Pollard transects and microhabitat assessments to examine how fine-scale habitat features influence butterfly diversity. In total, we recorded 32 species representing five families and 270 individual butterflies. Richness and abundance were lowest during the peak summer months and highest in the post-monsoon season, reflecting resource phenology. Partitioning beta diversity revealed that species turnover (70–85%) contributed far more than nestedness (15–30%), indicating that different parks supported distinct assemblages rather than nested subsets of a regional pool. Generalized linear models and ordination analyses highlighted flower abundance, unmanaged herbaceous patches, and shrub cover as the strongest predictors of species richness and community turnover, while park area and canopy cover played secondary roles. These findings suggest that conserving urban butterfly diversity requires maintaining a mosaic of microhabitats across multiple parks, rather than concentrating efforts in a single large site. Practical management actions, such as reducing mowing intensity, retaining wildflower margins, enhancing native nectar and host plantings, and maintaining puddling sites, will help sustain diverse butterfly populations while balancing recreational functions of urban parks.

Keywords: Butterflies, Beta diversity, Microhabitat, Chandigarh, Pollard transects, Species turnover, Urban parks





Life History and Morphometrics of Common Mormon (*Papilio polytes* L.) on Curry Plant

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The life history of the common mormon butterfly (*Papilio polytes* L.) was studied on the curry plant *Murraya koenigi* (L.) at BUAT, Banda. The first generation emerged adults were kept for pairing (10 pairs) in rearing cages (20×15×13.5cm) and the biological parameters (n=30) and morphometrics were observed. The results revealed that average pre- oviposition, oviposition and post-oviposition period were 1.06, 5.46 and 1.12 days, respectively. A single female laid 19.16 eggs which hatched in 3.49 days. The mean duration of 1st, 2nd, 3rd, 4th and 5th larval instars were 3.79, 2.98, 2.72, 3.84 and 4.64 days, respectively, with the average duration of total larval period was 18.04 days. The pre-pupal duration was 1.28 days; however, pupal period was 9.91 days. The average duration of adult longevity of male and female was 5.49 and 6.95 days, respectively. The total duration of male and female life cycle was recorded as 35.97 and 38.15 days, respectively. Morphometric studies on *P. polytes* revealed that the eggs measured 0.93 mm in diameter. Average body length and width of 1st, 2nd, 3rd, 4th and 5th instar larvae were 4.46 and 1.21, 7.77 and 2.45, 13.87 and 3.48, 23.48 and 4.91, 35.36 and 7.01 mm, respectively. The average length and width of pupa was 26.41, 8.01 mm, respectively. The average body length, width and wing span were measured as 23.76, 5.58 and 81.85 mm in male, while 26.27, 7.48 and 94.94 mm in female, respectively.

Keywords: Curry leaf, Fecundity, Life cycle, Morphometrics, *Papilio polytes*.





Temporal Dynamics of Chalcididae Wasps in Central India: Implications for Insect Conservation and Climate Change

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Parasitoid wasps of the family Chalcididae (Hymenoptera: Chalcidoidea) are vital regulators of pest populations and serve as important indicators of ecosystem health. However, their diversity and response to environmental changes remain poorly documented in central India. To address this gap, surveys were conducted across more than 20 sites in three agroclimatic zones of Chhattisgarh, yielding 70 species from 11 genera and four subfamilies, based on over 350 specimens. Diversity indices revealed higher species richness in natural ecosystems compared to agroecosystems, though both habitats showed significant declines between 2019–2020 and 2021–2023. Increasing dominance of generalist species, such as *Dirhinus himalayanus* and *Antrocephalus validicornis*, indicates habitat degradation and community homogenization. These shifts coincide with recent climatic variability, including erratic rainfall and rising temperatures, suggesting that climate change is influencing parasitoid communities alongside land-use pressures. The findings highlight the importance of conserving insect diversity under changing climates and emphasize the role of parasitoid wasps as bioindicators of ecosystem resilience. Long-term monitoring of these natural enemies can provide insights into biodiversity responses to climate stress, while also strengthening their application in integrated pest management and sustainable agriculture.

Keywords: Biodiversity, Chalcididae, Chhattisgarh, Climate change, Insect conservation





Response of Kharif Food Legumes to Eriophyid mite (*Aceria cajani*) in Vindhya Plateau of Madhya Pradesh

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Kharif Food legumes (Pegion pea, green gram, Black gram, Cluster bean, Cow pea, Soybean and Ground nut) are provides edible pods/ fruits/ seeds from plant belongs to fabaceae family. They are highly nutritious as excellent source of plant-based protein, oil, dietary fibers, minerals and vitamins. Kharif Food Legumes also play a crucial role in sustainable agriculture through their symbiotic bacteria Rhizobium in roots nodules that convert atmospheric nitrogen into a form that plant consume, this process enriches the soil or increase soil fertility and reducing the need for synthetic fertilizer. So that cultivation of these food legumes is cost effective to the farmers. These food legumes residue /plant parts are also used as good forage for cattle because it is enriched protein, fiber, vitamins and minerals. The eriophyid mite *Acerina cajani* it is highly specific host *ie.* Pegionpea however mite dose not directly infested to the crop by infesting but it acts as a vector of sterility mosaic virus (SMV). The virus which is primary cause of crop damage, results in severe stunting, mosaic leaf patterns or yellowing of leaves and check the plant growth from flowering and producing pods. So that it reduces productivity of crops drastically. A study was undertaken during kharif season of 2024-25 at instructional farm of College of Agriculture, Ganj Basoda and farmer's fields nearby the College. During the study period three locations were selected to record observations. From each location 100 plants per each kharif food legumes were randomly selected and tagged. Out of these infested plants were calculated and presented in percentage. The maximum 35.09 per cent infested plant were found in pegionpea whereas minimum 1.02 percent plant infestation were noted in the field of soybean. Rest of the kharif food legumes were found intermittently. None of the kharif food legumes was found to be not infested.

Keywords: Pigeon pea, green gram, Black gram, Cluster bean, Cow pea, Soybean and Ground nut, Eriophyid mite, *Acerina cajani*, percent plant infestation





Unraveling the Life Cycle of *Spodoptera litura*: A Global Pest Driving Ecological and Agricultural Challenges in a Changing Climate

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Spodoptera litura is a polyphagous pest of global importance that consumes over a wide range of host plants, including crops like vegetables, cotton, soybeans, and maize. Strong ecological resilience and a highly adaptive life cycle are credited with its success. Its effects have been more severe in recent decades due to climate change, which has increased outbreak frequency, expanded geographic spread, and accelerated developmental rates. The objectives of this study were to summarize the state of knowledge regarding the biology and ecology of *S. litura*, analyze its life cycle in light of climate change, and pinpoint crucial areas for sustainable management. Cabbage (*Brassica oleracea* var. *capitata*) was used as the host plant to evaluate its suitability for rearing the insect in the laboratory. Special emphasis was placed on the vulnerabilities of each life cycle stage (egg, larva, pupa, adult) and their interactions with changing environmental conditions. The results show that the eggs are extremely sensitive to temperature and humidity, the larvae are flexible and feed a lot, the pupae can diapause in soil to survive stress, and the adults are very fertile and have a high capacity for dispersal. Conventional management is less successful as a result of climate change, which speeds up life cycle progression, promotes geographic expansion, and exacerbates insecticide resistance. Unraveling the life cycle of *S. litura* highlights key vulnerabilities that can inform climate-smart integrated pest management (IPM) to reduce risks, protect crop yields, and preserve ecological stability, sustainable solutions that combine biological management, host-plant resistance, pheromone-based monitoring, and predictive modeling are crucial.

Keywords: Climate change, Integrated pest management (IPM), Life cycle, Polyphagous pest, *Spodoptera litura*



Theme III

**Insect Behaviour and Genomics –
Semiochemicals, Applications of
Omics in Entomology.**





Vector Components in the Epidemics of Plant Viruses, Phytoplasma and Other Diseases

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IPM is one of the corner stone of successful agriculture and horticulture. The philosophy of IPM is all management practices combined contributing to pest management in ecologically and economically sustainable ways. While this is true for IPM, integrated resistance management or IRM is need of the hour. IPM of the arthropod vectors which transmits several plant diseases is an altogether different compared to the regular IPM. Many species of aphids, leafhoppers, /planthoppers, whitefly, thrips, mealybugs, psyllids, a few species of mites, nematodes are major vectors. The association between plant vectors and insect pathogens is an evolutionary one. While most of the aphids, leafhoppers, /planthoppers, whitefly, thrips, mealybugs, psyllids, mites, and nematodes can be direct pests causing extensive damage on different crops, very few selected species have attained the potential to transmit the plant pathogens. Aphids There are specific viruses which are transmitted only by leafhoppers, thrips, whitefly, aphids, mealybugs, mites nematodes. It is very important to understand here that aphids transmit only plant viruses, whereas thrips transmit tospoviruses or tomato-spotted virus group. In fact, the famous thrips taxonomist Dr Lawrence Mound stated that if there is a tospovirus, you can safely assume that a species of thrips involved as vector. Whitefly, especially *Bemesia tabaci* transmit mostly DNA Viruses. Leafhopper transmits a few viruses and can also transmit phytoplasma. Mealybugs transmit certain specific diseases, so also mites.

Tobacco mosaic virus, which mechanically can be contaminated even by merely touching infected plants can never be insect transmitted. Thus, it is very wrong to assume that the vectors are just flying syringes. Vector transmission can be largely classified into persistent, semi-persistent and non-persistent. In case of non-persistent transmission, acquisition of the virus takes place within a few seconds to 1-2 minutes. There is no latent period and within 1-2 minutes, if the vector can find another suitable host, it will transmit the disease. If it does not, the virus is lost. Some of the most common non-persistently aphid transmitted viral diseases include the papaya ring spot virus, watermelon mosaic, bean mosaic others. Most NP transmitted viruses can also be transmitted by application of infected sap to the leaf surface. Management of non-persistent transmission viruses is extremely difficult as





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application of insecticides for vector control often has little effect. In case of semi-persistent virus, such as Cauliflower mosaic virus which is also transmitted by a few species of aphids, acquisition takes a reasonably long time and the transmission too. But these viruses, we call typically having bimodal transmission, where they can transmit as in a non-persistent and also in a persistent manner. A few species of whitefly too can transmit pathogens in a SP mode. There will be two peaks of transmission. But some of the diseases such as potato leaf roll virus, banana bunchy top, and citrus tristeza are transmitted by certain species of aphids, where the acquisition and transmission takes a very long time. Most of the species are colonizing aphids and management differs. Thus, understanding the mode of transmission is critical in management. Some viruses have peculiar relationships with their insect vectors. In thrips transmission of tospoviruses, only very young nymphs can acquire the virus, but nymphs cannot transmit the virus. The virus passes through the nymph, passes through the haemolymph, through the midgut epithelial barrier, multiplies in the salivary glands and the thrips is able to transmit as adult. So, adults cannot acquire the disease, but can transmit the viruses, whereas nymphs can acquire the virus, but cannot transmit the virus. So, this is the kind of. Even among species of thrips, not all species are vectors. Only selected species are vectors, such as *Thrips palmi*, *Frankliella occidentalis*, and a few other species. Likewise, in case of aphids, *Aphis gossypii*, *A. craccivora* and *Myzus persicae* are some of the most important ones. In fact, *Aphis gossypii* can transmit most of the diseases and also it has the potential to transmit the diseases in non-persistent, semi-persistent and persistent mode of transmission.

Whitefly-transmitted viral diseases are some of the most dreaded diseases that India and South Asia are facing. Tomato leaf curl virus, chilli leaf curl virus, cucurbit leafcurl, papaya leaf curl virus cotton leaf curl virus etc., are a few diseases which are whitefly transmitted. Fortunately, only the species of *B. tabaci*, among the hundreds of species, is the most efficient. At this stage, it is not clear as to why only *B. tabaci* is the superbug which can transmit many of the begomoviruses in comparison to other species of whiteflies. Furthermore, the whitefly itself is undergoing tremendous changes. Earlier it was thought to be *B. tabaci*, then we called it *Bemisia argentifolii*, then type B virus, type B of *B. tabaci*, then now we call it as the different genomic groups. This is very important to understand because we have to understand which of the genomic group is most efficient in transmission of the disease. Leafhoppers are basically phloem feeders and especially in field crops transmit several viruses. Psyllids and leafhoppers transmit phytoplasma, which remain one of the key challenges in preventing spread of diseases such as Citrus greening, sandal spike, and





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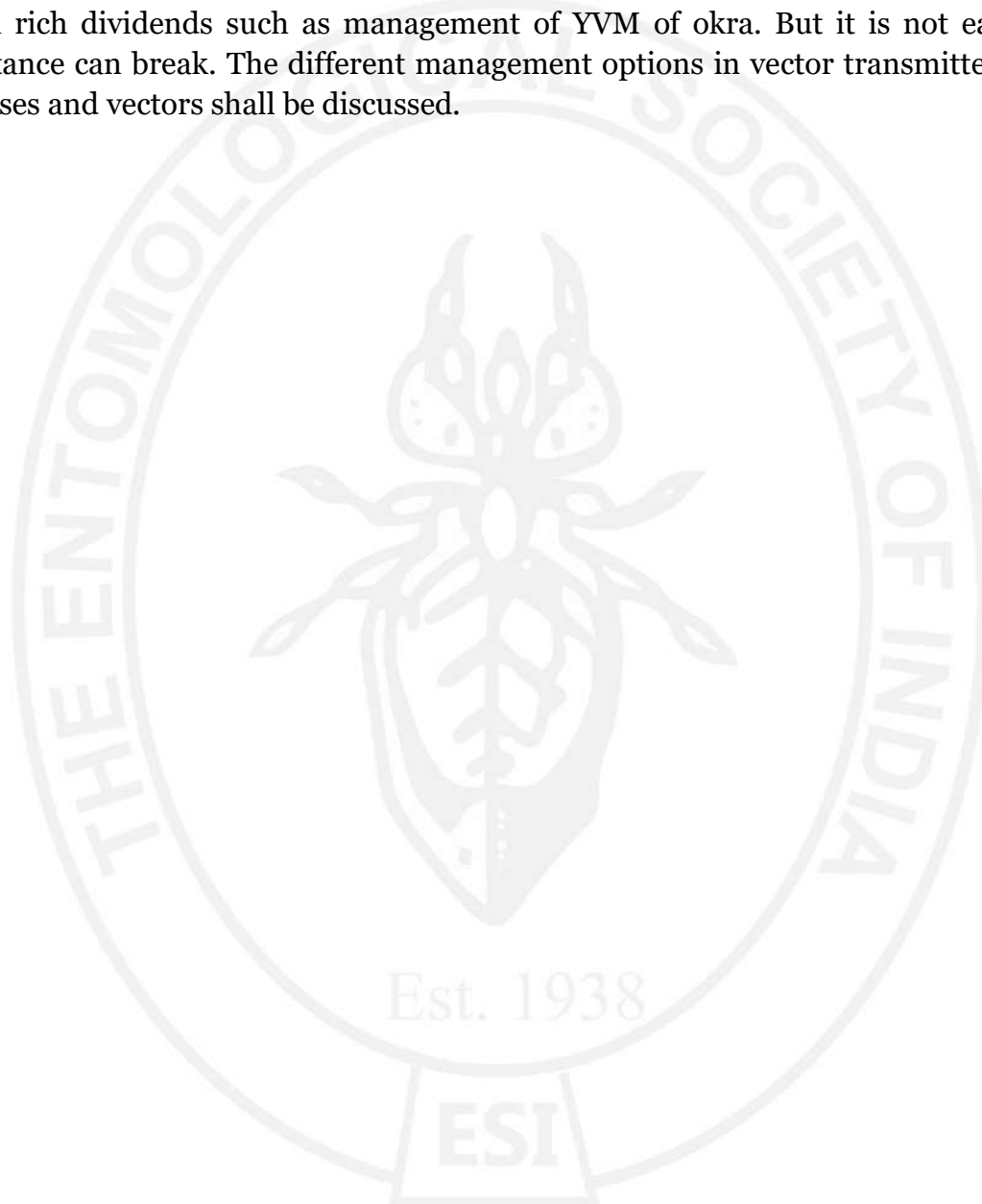
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many ornamental diseases. The loss by sesame phyllody can be as high as 60%. Managing plant vectors and pathogens transmitted by them is highly challenging. Use of genes from crop wild relatives and introgression to cultivable species has given rich dividends such as management of YVM of okra. But it is not easy and resistance can break. The different management options in vector transmitted plant diseases and vectors shall be discussed.



Lead Presentation



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Omics Based Approaches in Entomology: Emerging tools for Pest Management

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Introduction

Genomics is the study of genetic information organization within genomes, encompassing its structure, function, and evolution, as well as its interrelationships. It involves identifying, characterizing, and cloning complete genomes with the ultimate goal of comprehending an organism's phenomics. Genomic analysis spans genome sequencing, gene identification, transcript and protein analysis, and elucidation of metabolic pathways. Therefore, genomics not only deals with genetic information generation but also with how organisms employ this information. Genomics is categorized into three main types: structural genomics, functional genomics, and comparative genomics. Structural genomics aims to create high-resolution genetic and physical maps and determine an organism's complete genome sequence or transcriptome. Functional genomics involves comprehensive characterization of all genes within a genome, including transcriptomics for gene expression analysis and proteomics for protein characterization. It also encompasses the study of gene interactions with proteins and other molecules. Comparative genomics involves comparing the genome sequences of target organisms with those of model organisms, offering valuable insights into genome functional annotation.

Importance of Genomics

Genomics plays a pivotal role in:

- Locating the positions and orientations of genes on chromosomes.
- Identifying transcribed regions of genes, including introns and exons.
- Describing promoter, enhancer, and repressor regions, along with general and specific transcription elements.
- Identifying the roles of common motifs in genes.
- Revealing the functions of other DNA sequences like miRNAs.
- Enhancing our understanding of the sequence of bases, unlocking the blueprint of an organism's development.





- Enabling precise genetic manipulation for improved yield and resilience under adverse environmental conditions.

Insect Genomes Projects

Rapid advances in the use of computational biological tools have aided in exploration of genomes of several organisms including insects. Symbiosis. Several global research initiatives like, Manhattan Project on Entomology - I5K (an attempt to cover genomics of 5000 insects) have given new impetus to insect genomics considering the impact of insect pests in agriculture and public health which have a direct bearing on the welfare of mankind. Insects are the largest group of animals replete with genomics databases. As on date whole genome data is available for 138 insects, transcriptomes of 116 insects, gene sets of 61 insects, 36 gene families of 60 insects, 7,544 miRNAs of 69 insects, 96,925 piRNAs from two insects, 22,536 pathways of 78 insects, 679,881 untranslated regions (UTR) of 84 insects and 160,905 coding sequences (CDS) of 74 insects. Unravelling such a big data of genomic information of inputs require sophisticated bioinformatics analytics. Molecular approaches coupled with bioinformatics analyses offer scope for gene mining the data bases for identifying novel target sites for next generation insecticides and bio rational pesticides.

Genomics in Entomology

Genomics applications in entomology include:

- Identifying pest species.
- Identifying genes involved in plant-insect interactions.
- Discovering novel targets for insecticides.
- Investigating resistance mechanisms to xenobiotics.
- Understanding genes responsible for insect vector activity in plant diseases.
- Assessing invasive pest management efficacy.
- Analysing pest demographics and reconstructing invasion routes.

Genomic approaches have been instrumental in gene discovery, identification of pesticide targets, and understanding insect responses to various factors. The emerging problems of invasive pests, resurgence of sucking pest complex in various field crops, xenobiotic resistance in crop pests to insecticides and vector transmission of plant pathogens could be better tackled with focused research thrust by strategic use of biotechnological tools. Insect molecular biological approaches offer better understanding of molecular basis of insect nutrition, host defense and behavioural



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physiology of pests and natural enemies. They provide strategic research support to the existing entomological research programmes to resolve conflicts in taxonomic identity of crop pests, handling xenobiotic resistance in transgenic crop systems, developing natural enemies with improved tolerance to biotic and abiotic stresses. The integration of genomics with traditional integrated pest management (IPM) approaches has led to the emergence of IPM-omics. This research paves the way for future endeavours involving pest species, with the overarching goal of incorporating genomics databases into IPM and insect resistance management (IRM) programs to mitigate crop damage caused by pests. While challenges persist in utilizing this technology, ongoing advancements and global networking among scientific communities promise widespread recognition of insect genomics for effective pest management and improved agricultural productivity.

Lead Presentation



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Role of Acoustic Signal in the Study of Mating Behavior of a High-Altitude Cricket Species *Hyphinomos svenhedini* Ramme, 1950 (Orthoptera: Tettigoniidae)

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Orthopterans, such as crickets and Katydids, are known for their ability to produce acoustic signals through the friction interaction between different parts of their bodies. Crickets and Katydids produce sound through wing stridulation, while grasshoppers produce sound by rubbing the hind femur on specific areas of their wings. Acoustic signals are crucial in animal communication and reproductive isolation between species before mating. Male crickets produce calls, specific to a species, to attract females from a distance. These signals are generated by the swing mechanism located in the front. Female individuals show a silent behavior, then respond by recognizing and approaching male calls of their own species, known as phonotaxis. The species-specific nature of acoustic signals makes them reliable means of detecting and characterizing cryptic species and conducting a wide range of acoustic monitoring to assess biodiversity in a specific geographical region. This study focuses on the study of acoustic signals emitted by the diurnally active cricket, *Hyphinomos svenhedini*, from alpine zones of high-altitude mountain cricket in mating behavior. The study further highlights a series of events involved in the courtship and copulatory behaviour of this species.





Silent Signals, Sustainable Solutions: The Rise of Semio-chemicals in Indian Farming

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Semio-chemical-based pest management strategies have emerged as a cornerstone of sustainable agriculture in India, addressing escalating ecological concerns linked to the overuse of synthetic pesticides. These strategies harness naturally occurring chemical cues—such as pheromones, kairomones, and allelochemicals—to manipulate pest behavior and offer targeted, residue-free alternatives. Over the past three decades, research in India has led to the identification and synthesis of more than 40 insect sex pheromones, enabling the deployment of monitoring systems, mass trapping, and mating disruption across major crops. Advances in analytical techniques—gas chromatography-mass spectrometry, electroantennography, and wind tunnel assays—have facilitated precise pheromone blend identification and performance optimization. Further, innovations such as lure-and-infect designs, push-pull strategies, and integration with entomopathogenic fungi have extended efficacy to challenging scenarios, including invasive pests like the fall armyworm. Efforts are underway to develop biodegradable and nanostructured dispensers, and to integrate traps with digital decision-support tools for enhanced field longevity and precision. However, widespread adoption faces challenges including variability in field performance due to agroclimatic heterogeneity, limited farmer awareness, high initial costs, and regulatory barriers. Additionally, the semio-chemical profiles of several economically significant Indian pests remain poorly characterized, emphasizing the need for ongoing research and extension. With continued investment and interdisciplinary collaboration, semio-chemical strategies have the potential to transform Indian pest management toward more resilient and environmentally sound agricultural systems.





Kairomone-Guided Behaviour: Enhancing *Trichogramma pretiosum* for Bio-Intelligent Fall Armyworm Management

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The behavioural ecology of egg parasitoids is strongly influenced by semiochemicals emitted by their hosts, shaping host-finding efficiency and biological control potential. The invasive insect pest, Fall Armyworm (*Spodoptera frugiperda*) threatens global maize production, and its sustainable management requires innovations beyond conventional pesticides. This study investigates the role of host-derived kairomones in guiding *Trichogramma pretiosum*, a promising egg parasitoid, as part of bio-intelligent pest management strategies. Hexane extracts derived from *Corcyra cephalonica* and *S. frugiperda* were tested using a custom-designed four-armed olfactometer and validated in polyhouse assays. Results revealed that specific kairomone extracts from *C. cephalonica* eggs (10%) and *S. frugiperda* female moth extract (1%) significantly improved parasitoid activity index, parasitization rates, and adult emergence. GC-MS profiling identified key hydrocarbons, such as tetracontane, dodecane, and octane, as dominant compounds, suggesting their role as semiochemical cues driving parasitoid foraging behavior. The integration of kairomones into biocontrol frameworks offers a lab-to-field innovation, where egg parasitoids can be guided more efficiently towards pests' egg masses, thereby improving the consistency and reliability of biological control. Such an approach reduces reliance on synthetic pesticides, empowers eco-friendly Integrated Pest Management (IPM), and holds promise for developing field-deployable kairomone formulations. This study demonstrates a paradigm shift from conventional biocontrol to semiochemical-assisted bio-intelligent pest management, opening pathways for commercial applications in sustainable agriculture.

Keywords: *Corcyra cephalonica*, Kairomones, Semiochemical, *Spodoptera frugiperda*, *Trichogramma pretiosum*





Molecular Characterization of Major Sucking Pests Associated with Chrysanthemum and Carnation under Protected Cultivation

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Chrysanthemum and carnations are globally important ornamental crops valued for their aesthetic and commercial significance but remain highly vulnerable to sucking insect pests under protected cultivation. During 2023–2024, a molecular study was conducted to characterize key pest species infesting carnations and chrysanthemums. Samples of thrips, aphids, whiteflies, and mites were collected from polyhouses and preserved in 70% alcohol. Genomic DNA was extracted using the CTAB method. Molecular characterization revealed three thrips species (*Frankliniella occidentalis*, *F. schultzei*, *T. tabaci*), two aphid species (*Myzus persicae*, *Aphis gossypii*), and one mite (*Tetranychus urticae*) on carnation. In chrysanthemum, four aphids (*Macrosiphoniella sanborni*, *Aphis gossypii*, *Aphis fabae*, *M. persicae*), two thrips (*F. schultzei*, *Thrips tabaci*), and one whitefly (*Trialeurodes vaporariorum*) were identified. Phylogenetic analysis, 3D protein modeling, Ramachandran plot evaluation, and amino acid composition further confirmed species delineation. These findings provide molecular evidence of major sucking pests threatening chrysanthemum and carnation cultivation under protected conditions.

Keywords: Carnation, Chrysanthemum, Molecular identification, Phylogenetic analysis, 3D Protein structure





IBG -03

Predatory Potential of *Hippodamia Variegata* (Goeze) against Woolly Apple Aphid, *Eriosoma Lanigerum* (Hausamann) Infesting Apple

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The woolly apple aphid, *Eriosoma lanigerum* (Hausamann), is a major pest of apple that poses a global threat to apple orchard productivity. This aphid establishes dense colonies enveloped in a white waxy, filamentous covering, commonly found on trunks, branches, young shoots and roots of apple trees. Heavy infestations result in the formation of hypertrophic galls on roots and branches, which adversely affect tree vigour and overall growth. Unlike foliar feeding aphids, *E. lanigerum* primarily colonizes woody tissues, leading to deformities, bark blistering, splitting and gall like swellings. At present, management largely depends on insecticidal applications, associated with environmental risks. In this context, the present study was undertaken to assess the predatory potential of *Hippodamia variegata* (Goeze) against *E. lanigerum* under laboratory conditions. This ladybird beetle is well known for its ability to feed and devour a large number of sap sucking insects. In the present study, the net predation of 399 to 894 woolly apple aphids of different stages by various stages of *H. variegata* was recorded. *H. variegata* was able to feed and complete its lifecycle successfully on all the life stages of aphid proving its ability to suppress *E. lanigerum* population Hence, *H variegata* can be utilized in IPM programmes as a potential predator for the management of woolly apple aphid, *Eriosoma lanigerum*.

Keywords: Apple, *Hippodamia variegata*, Predatory potential, Woolly apple aphid





The Diverse Roles of Insulin Signaling in Insect Behaviour

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Nutritional state is a universal factor that influences behavioral expression in animals, including insects. Adult insects must gather sufficient energy to support activities such as somatic maintenance, mate searching, egg development, nest construction, oviposition, and parental care. To achieve this, individuals combine complex information about their own nutritional status with environmental cues, such as resource and mate availability, to make prudent decisions about energy acquisition and expenditure. Insulin/insulin-like growth factor signaling (IIS) is one of the most well-recognized pathways that contributes to the organization and expression of energy-dependent behaviors. IIS plays a central role in regulating diverse insect behaviors. This intricate pathway, known as the Insect Insulin Signaling Pathway (ISP), integrates nutritional and hormonal signals to maintain energy balance and coordinate physiological processes critical for survival and reproduction. ILPs influence feeding behaviors by modulating hunger and satiety, especially during key life stages such as reproduction and moulting, while also promoting growth and development through energy mobilization. In females, insulin signaling facilitates vitellogenesis, a crucial process for egg production, thereby linking nutritional status to reproductive success. Beyond metabolic regulation, the ISP allows insects to adapt to environmental stressors, like temperature changes and food scarcity, by integrating neuropeptides and neurotransmitters. In social insects, insulin signaling underpins caste differentiation, shaping developmental pathways and colony roles based on larval nutritional status. Despite significant advances in understanding these processes, the complex interactions between insulin signaling, other hormonal pathways, and ecological dynamics remain a frontier of entomological research.

Keywords: Hormones, Insulin, Integrated pest management, Metabolism, Nutrition





IBG -05

Effect of Aphid-tending Ant, *Formica rufa* on predatory potential of Ladybird Beetle, *Hippodamia variegata* (Goeze) (Coleoptera: Coccinellidae): using *Aphis pomi* De Geer (Hemiptera: Aphididae) as a prey

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We investigated the impact of ant–aphid mutualism between the green apple aphid, *Aphis pomi*, and the red wood ant, *Formica rufa*, on the predatory potential of the ladybird beetle, *Hippodamia variegata*, under controlled laboratory conditions (temperature 23–27 °C, relative humidity 60–70%). Experiments were conducted to assess the predatory efficiency of different larval instars and adults of *H. variegata* in aphid colonies either tended or untended by *F. rufa*. Results revealed that the presence of ants significantly suppressed the predation rate of *H. variegata*. Female adults exhibited the greatest reduction in predatory potential (20.2%), followed by male adults (18.6%), fourth-instar larvae (16%), and third-instar larvae (10%). Early larval stages were less affected, with reductions of 6.4% and 5.2% recorded for second and first instar larvae, respectively. These findings highlight that *H. variegata* experiences considerable interference from *F. rufa* during foraging, leading to diminished efficiency as a biological control agent in ant-tended aphid colonies. The study confirms that *H. variegata* is a non-myrmecophilous coccinellid and does not benefit from the mutualistic association between *A. pomi* and *F. rufa*. Understanding such interspecific interactions is crucial for evaluating the effectiveness of natural enemies in aphid management programs. This investigation provides new insights into the behavioral ecology of predatory coccinellids and underscores the need to consider ant–aphid mutualism when designing integrated pest management strategies for apple ecosystems.

Keywords: Aphid–ant mutualism, *Aphis pomi*, *Formica rufa*, *Hippodamia variegata*, Biological control





Effect of Blue Light on the Locomotor Activity Rhythm and Antioxidative Enzyme in the Female Cricket, *Gryllus bimaculatus*

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Circadian rhythms are endogenous, completing a full cycle every 24 hours, and they regulate key behavioral and physiological processes in living organisms. In insects, these rhythms control locomotor activity, eclosion, and antioxidant defences. Light is a well-established zeitgeber that synchronizes internal clocks to the external 24-hour day-night cycle by acting through the optic lobes, which serve as the central circadian pacemaker in insects. This study investigated the effect of blue light exposure on the circadian locomotor activity rhythm and the dynamics of key antioxidative enzymes, catalase (CAT) and superoxide dismutase (SOD) in the female cricket, *Gryllus bimaculatus*. The variations in illumination patterns and light intensity differentially influencing cricket behavior and biochemical responses were examined. The results demonstrated that exposure to blue light significantly altered locomotor activity patterns compared to white light, confirming its strong role in modulating circadian behavioral rhythms. In contrast, CAT and SOD activities exhibited non-significant trends toward modulation under blue light, suggesting a possible, but less pronounced, influence on antioxidant defences. These findings highlight the differential impact of light quality on both locomotor and biochemical circadian outputs in the female cricket, underscoring the complex interaction between environmental light cues and circadian regulation.

Keywords: Antioxidant enzyme, Circadian Rhythm, *Gryllus bimaculatus*, Locomotor Activity





Effect of Olfaction for Food Preference in Melon Fruit Fly, *Zeugodacus Cucurbitae*

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Melon flies employ sophisticated sensory mechanisms combining visual recognition and tactile assessment to locate optimal breeding sites, evaluating fruit characteristics including morphological structure, physical dimensions, aromatic profiles, and pigmentation through integrated olfactory systems for identifying suitable larval development environments. The polyphagous agricultural pest *Zeugodacus cucurbitae* specifically targets cucurbitaceous crops, causing substantial economic damage through widespread global agricultural impacts, with established research demonstrating that mature specimens utilize coordinated visual-olfactory navigation for host identification. This investigation analysed behavioural responses of sexually mature specimens toward visual and chemical host-derived stimuli during foraging, implementing comparative protocols examining two genetic variants through individual and combined population assessments using equivalent sex ratios, quantifying preference behaviours across *Momordica charantia*, *Lagenaria siceraria*, and *Cucurbita pepo*, with pheromone validation studies exposing subjects to methyl eugenol and opposite-sex excretory materials. Results revealed consistent *Lagenaria siceraria* avoidance regardless of specimen characteristics with statistical significance, while isolated conditions demonstrated *Cucurbita pepo* preference excluding genetically modified males, though combined populations favoured *Momordica charantia*, with methyl eugenol attraction observed except in modified males. These findings establish that sexual dimorphism and genetic variation significantly influence sensory mechanisms governing host selection, and despite agricultural transitions toward perennial cucurbit cultivation ensuring continuous host availability across geographic regions, observed infestation intensity variations between crop species indicate underlying attraction mechanisms differentially influencing pest colonization patterns, suggesting specific factors stimulate species-specific crop attraction despite abundant host plant availability throughout agricultural systems.

Keywords: Cucurbit Fruits, Golden Brown Eye Mutant, Methyl eugenol, *Olfactory Stimuli*, *Zeugodacus cucurbitae*





Optimizing Fruit Fly Detection in High-Density Apple Orchards: Traps and Lures

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Fruit flies pose threat to apple production in temperate regions causing direct yield loss and deteriorating fruit quality. The present study was carried out during 2024 in high-density apple orchards at two different locations i.e., Fruit Experimental Farm, FOH, SKUAST-K Shalimar, Srinagar and Farmers orchard, Bandipora. The work focused on the developing effective monitoring tools for accessing the populations of fruit flies and susceptibility of several high-density apple genotypes to fruit fly infestation in temperate orchard ecosystem. Monitoring entailed the use of three trap type viz Delta traps, Pherobac traps and Bottle traps, each baited with four lures: Fly lure, Wax lure, Fly lure + Protein bait and Triple blend lure. Observations were taken from 23rd SMW to 40th SMW and the first catch was recorded during 23rd-24th SMW with fruit fly catch 15.6 fruit flies/trap at Bandipora and 15.3 fruit flies/trap at Srinagar. The outcome showed that the Delta traps, especially when used in combination with the Triple blend lure, captured the most fruit flies viz 132.0 Fruit flies/trap at Bandipora and 92.2 fruit flies/trap at Srinagar. The population activity reached its peak during 35th-36th SMW at both locations (195.0 Fruit flies/trap at Bandipora and 140.0 flies/trap at Srinagar), in parallel with favourable climatic conditions of high humidity and moderate temperatures. Following that, a slow reduction was noted coinciding with lower temperatures and fly activity. Conversely, Bottle traps recorded the lowest fruit fly catches (53.1 fruit flies/trap at Bandipora and 31.8 Fruit flies/trap at Srinagar), particularly under rainy conditions, signifies the inadequacy in design of the trap noted. Among the lures, the Triple blend exhibited highest attractancy (100.6 fruit flies/trap at Bandipora and 61.3 fruit flies/trap at Srinagar), followed by Fly lure + Protein bait (81.6 fruit flies/trap at Bandipora and 51.0 fruit flies/trap at Srinagar), with Fly lure alone being least effective (52.6 fruit flies/trap at Bandipora and 36.0 fruit flies/trap at Srinagar). The interaction effects between lure and trap type were significant, emphasizing the need to optimize both traps and lures for effective surveillance. Findings from this study provide practical insights for integrated pest management strategies and contribute to sustainable apple production in high-density orchard systems.

Keywords: Fruit fly, Traps and Lures, High-density Orchard, Monitoring, Triple blend





Screening of Cucurbits Germplasm for Their Relative Resistance/Susceptibility to Fruit Flies, *Bactrocera* spp. Infestation in (Diptera: Tephritidae) in Kashmir

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The present studies on “Screening of cucurbits germplasm their relative resistance/susceptibility to fruit flies, *Bactrocera* spp. infestation in Kashmir” was carried at Experimental Farm, Faculty of Horticulture, SKUAST, Shalimar during 2021-22. The larval infestation of *Bactrocera* species (*B. cucurbitae*, *B. dorsalis*, *B. scutellaris*) in different cucurbit crops started from second week of August (34th SMW), which gradually increased in successive weeks till first fortnight of September (37thSMW). In different cucurbit crops, the larval population was in the range of 16.66 - 22.55 larvae per fruit; where as the fruit infestation ranged from 47.91 to 55.44 per cent on weight basis; and from 37.75 to 37.99 per cent on number basis. Based on the extent of infestation, the screened cucurbit germplasm was categorized into Resistant and Moderately Resistant, Several cucurbit germplasm showed promising levels of tolerance, with reduced larval infestation and fruit damage, and are thus considered potential germplasm for further breeding programs aimed at developing fruit fly-resistant cultivars. The findings of this study hold significant implications for sustainable cucurbit production in Kashmir conditions. The identification and deployment of resistant germplasm can play an important role in integrated pest management (IPM) strategies, by reducing the use of chemical pesticides, lowering production costs, and minimizing ecological disruption. Moreover, the incorporation of resistant lines into varietal development programs could pave the way for long-term solutions to fruit fly management in cucurbit crops. The study demonstrates the critical role of varietal screening and germplasm evaluation for varietal improvement programme in mitigating the threat posed by *Bactrocera* spp.; and emphasizes the need for utilization of resistant germplasm in pest management and crop improvement frameworks.

Keywords: Screening, germplasm, *Bactrocera* species, resistance, cucurbits





A Study on the Sensory Apparatus of Mouthparts of a Gall Inducer, *Phacopteron lentiginosum* Buckton (Hemiptera: Aphalaridae)

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Phacopteron lentiginosum induces pouch shaped galls on the leaves of *Garuga pinnata*, a medicinal plant. The mouthpart morphology of the fifth instar nymphs was examined using light and scanning electron microscopy. The mouthpart consists of a subtriangular labrum, a two-segmented labium with a labial groove and a stylet fascicle of paired mandibles and maxillae. The stylets, originating from the posterior anteclypeus, pass through the labial segments and are held in the labial groove by clamps. Before extension, they fold into a loop within the stylet holding organ. During feeding, the stylets penetrate plant tissues, reach the plant phloem and ingest plant sap. The labium bears eight types of sensilla, including two types of sensilla trichodea, four types of sensilla basiconica, sensilla companiformia and poriform sensilla. Mandibular and maxillary stylets interlock to form food and salivary canals, with serrated mandibular tips aiding tissue penetration. These structural features highlight specific adaptations for concealed feeding within gall tissues.

Keywords: Gall, Gall Inducer, Mouthparts, Scanning Electron Microscopy, Sensilla





Biochemical Basis of Resistance in Potato Cultivars Against Potato Tuber Moth (*Phthorimaea operculella* Zeller)

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Potato (*Solanum tuberosum*) is a significant cash crop across the world. Potato tuber moth (PTM), *Phthorimaea operculella* Zeller, a pest affecting both in field and storage conditions resulting in considerable economic losses. As the chemical pesticides causes great health hazard, use of insect resistance cultivars could reduce indiscriminate use of insecticides. A total of fifteen potato cultivars (nine landraces and six commercial) were screened based on ovipositional and feeding preferences in both foliage and tuber parts. Biochemical factors associated with the expression of resistance to this pest in potato were estimated and considered as a source of resistance. The landrace cultivars Phan San Minit, Lah Ksain and Lah Saw Smit had a lower number of eggs and were slightly infested (less mines). Expression of resistance was associated with high amount of glycoalkaloids (α -solanine and α -chaconine) and phenolic compounds (chlorogenic acid, caffeic acid and flavonoids). The susceptible cultivars Kufri Jyoti and Kufri Megha had greater number of eggs on them and were severely infested (more mines). Susceptibility was associated with less amount of glycoalkaloids and phenolic compounds. Whereas, total soluble sugars (TSS) had less effect on PTM behaviour. Resistance cultivars of potato with these factors may be used as sources of resistance in future breeding programs to enhance the resistance to *P. operculella* in commercially cultivated potato cultivars.

Keywords: Glycoalkaloids, Phenolic compounds, Potato tuber moth, Resistance, Screening





Genetic Diversity of Rice Yellow STEM Borer, *Scirpophaga incertulas* (Walker) from Different Locations of India Based on Mitochondrial *COX1* Gene

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Rice yellow stem borer (YSB), *Scirpophaga incertulas* (Walker), is one of the most destructive insect pests of rice across diverse rice ecosystem. The pest infests rice crop both at the seedling and maturity stages, causing severe yield losses. Host Plant Resistance (HPR) is the economical, sustainable, and eco-friendly component of integrated pest management (IPM). Understanding the population genetics and genetic diversity can facilitate the identification of tolerant donors for resistance breeding. In this study, the genetic diversity of YSB from different locations of India was analysed using the mitochondrial *Cytochrome c oxidase subunit I (COX1)* gene, and these were compared with YSB populations from other countries. Phylogenetic analysis revealed two major clades among the global YSB populations. Nucleotide sequence analysis identified 61 mutations and 57 variable sites (polymorphic sites) in the *COX1* sequences, with Indian populations showing a higher number of variable sites. Furthermore, haplotype analysis uncovered presence of 38 haplotypes, with haplotype 24 (Indonesia) and haplotype 32 (Andhra Pradesh, India) being the most dominant. The overall haplotype diversity (Hd) and the nucleotide diversity were 0.964 and 0.02185, respectively, while for Indian populations they were 0.952 and 0.01248. Neutrality test statistics yielded significant negative values: Tajima's D (-1.55427), Fu and Li's D (-3.7440), and Fu and Li's F (-3.33247), while for Indian populations the respective values were -2.2285, -3.89795, and -3.65195. Significant and negative values indicate viable expansion in the population size and geographic range of the YSB population with no evidence of genetic bottlenecks in India. Therefore, mitochondrial *COX1* gene-based genetic diversity analysis reveals substantial genetic variation among the YSB populations across countries as well as within India. This study represents the first kind of report summarising the genetic variation of YSB populations using mitochondrial *COX1* gene.

Keywords: *COX1*, Genetic diversity, HPR, *Scirpophaga incertulas*, Yellow Stem Borer





Biology of Pulse Beetle, *Callosobruchus maculatus* (F.) on Different Hosts

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A laboratory study was conducted to investigate the developmental biology of the pulse beetle, *Callosobruchus maculatus* (F.) on seven different seeds of pulses viz., mung bean, cowpea, Kabuli chickpea, desi chickpea, red gram, lentil and black gram under controlled conditions of 30 ± 2 °C and 75 ± 5 % relative humidity. 50 g of each test seeds kept in plastic jar in five replications and five pairs of *C. maculatus* were released in each jar. Egg deposition was the highest on mung bean (346.20 ± 4.50) and lowest on lentil (179.40 ± 2.37), with over 90% of eggs laid within the first four days. The oviposition period ranged from 4.60 ± 0.11 to 5.60 ± 0.11 days, incubation from 3.40 ± 0.11 to 5.60 ± 0.11 days, larval period from 14.80 ± 0.09 to 17.00 ± 0.14 days, and pupal period from 5.00 ± 0.20 to 6.60 ± 0.11 days, resulting in total developmental periods of 26.40 ± 0.11 to 32.80 ± 0.17 days. Adult emergence was highest on mung bean (43.60 %) and lowest on red gram (22.40 %). Male and female longevity ranged from 7.40 ± 0.18 to 8.80 ± 0.09 days and 10.40 ± 0.11 to 13.60 ± 0.11 days, respectively. The loss of seed weight was highest in mung bean (19.00 %) and lowest in lentil (8.50 %). These findings indicate that mung beans and cowpea are highly suitable and preferred hosts for *C. maculatus* due to shorter developmental biology, however, pulses such as lentil and black gram are less favourable.

Keywords: *Callosobruchus maculatus*, Developmental biology, Lentil, Pulse beetle, Redgram





Comparative Study on the Effectiveness of Male Annihilation Technique against Fruit Flies in Cucurbitaceous Crops in Kashmir and Kerala

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This research work evaluates the response of Tephritid fruit flies to different cue lure trap treatments and designs at field sites in FoA Wadura and Palakkad, Kerala. Traps charged with 1 ml of lure recorded highest catch in both locations with 8.05 ± 0.59 flies/trap/week in Kashmir and 11.32 ± 0.64 and 7.35 ± 1.76 flies/trap/week for *Zeugodacus cucurbitae* and *Zeugodacus tau* in Kerala. Freshly charged traps found more effective than weathered traps with weekly charging producing highest catches (4.9 ± 1.12 in Kashmir and 30.9 ± 1.7 and 11.5 ± 1.96 flies/trap/week for *Zeugodacus cucurbitae* and *Zeugodacus tau* in Kerala). Yellow colour performed best irrespective of the type of species, location (19.200 ± 1.1 and 5.0 ± 0.8 flies/ trap/ week for *Zeugodacus cucurbitae* and *Zeugodacus tau* respectively in Kerala, 10.425 ± 0.65 flies/trap/week in Kashmir). Trap shape also affected performance. Delta traps caught the highest number of fruit flies in water melon field at Wadura (Kashmir) (10.10 ± 2.1 flies/trap/week) and in Palakkad Bottle traps (10.35 ± 0.15 flies/trap/week) were found highly effective in snake gourd field and spheres showed the lowest trap catch in both cases. The attractiveness of fruit flies towards the fruit mimicking colour and shaped traps was observed through these treatments.

Keywords: Cucurbitaceous crops, Fruit flies, Kashmir, Kerala, Male annihilation





Glucosinolate cues shape Diamondback Moth behaviour in Cauliflower

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Diamondback moth (*Plutella xylostella* L.) is one of the most economically damaging pests of cruciferous crops, causing significant yield losses in cauliflower (*Brassica oleracea* var. *botrytis* L.). Its host selection, oviposition, and feeding behaviour are strongly mediated by glucosinolates, a class of sulfur-rich secondary metabolites that serve both as defense compounds and as semiochemical cues. To elucidate the biochemical basis of *P. xylostella* host choice, a comprehensive investigation was conducted on 96 diverse cauliflower genotypes at the 45-days old seedling stage, when plants are most susceptible to infestation. Individual glucosinolates were quantified using high-performance liquid chromatography (HPLC), revealing substantial genotypic variation across aliphatic, indolic, and aromatic classes. Behavioural bioassays and feeding damage assessments under controlled and net house conditions demonstrated strong correlations between specific glucosinolate profiles and insect response. Genotypes higher in sinigrin and glucoraphanin were more attractive and sustained higher levels of herbivory, whereas those containing higher glucoiberin, glucobrassicin, and long-chain methylthioalkyl GSLs exhibited significantly reduced damage, indicating their potential roles in non-preference. These results highlight the dual function of glucosinolates as both attractants and repellents and underscore their ecological importance in shaping insect behaviour. The study provides valuable insights into the chemical ecology of host–insect interactions and offers a framework for deploying glucosinolate profiling as a biochemical marker in resistance breeding and integrated pest management strategies for sustainable crop protection.

Keywords: *Brassica oleracea*, Glucosinolates, *Plutella xylostella*, Resistance breeding, Semiochemicals





Isolation and Functional Characterization of Core Gut Symbionts from Indian Honey Bee Species, *Apis cerana* and *Apis mellifera* (Apidae, Hymenoptera)

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Honey bees (*Apis cerana* and *Apis mellifera*) are keystone pollinators in agriculture and natural ecosystems and their health is strongly influenced by a specialized gut microbiome that contributes to nutrition, immunity and defence against pathogens. While metagenomic studies have provided insights into the composition of this microbiome, culture-based approaches remain crucial to experimentally validate microbial functions, particularly in Indian contexts. However, isolating core gut bacteria is challenging, as many of them require strictly anaerobic or microaerophilic conditions, making their isolation under laboratory conditions particularly difficult. In the present study, we successfully isolated core gut bacteria from Indian populations of *A. cerana* and *A. mellifera* for the first time. A total of 55 bacterial isolates were obtained using optimized growth conditions, of which 37 were identified as core symbionts, including the key genera *Gilliamella*, *Snodgrassella*, *Bifidobacterium* and *Frischella*. The successful isolation of these taxa demonstrates that even fastidious and oxygen-sensitive symbionts can be recovered through carefully controlled cultivation strategies, bridging the gap between culture-independent surveys and experimental validation. To assess their functional contributions, enzymatic screening of the isolates was carried out with a focus on carbohydrate digestion by cellulolytic, hemicellulolytic and pectinolytic activities. This is the first ever study from the Indian honey bee populations focusing on the core gut bacterial isolation along with the functional validations, providing a concrete base for future studies.

Keywords: *Apis cerana*, *Apis mellifera*, Enzymatic Activity, Gut Bacteria, Isolation, Probiotics





New Taxonomic Combination and Phylogenetic Insights of the genus *Chrysozephyrus* (= *Hypaurotis*) Shirôzu & Yamamoto, 1956 (Lycaenidae: Lepidoptera: Theclinae) for Indian species

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The ecological diversity and functional roles of butterflies are crucial indicators of biodiversity changes. The urgent need to document and quantify butterfly diversity is hindered by challenges in identification due to their complex life cycles, polymorphisms and regional variations. Butterflies serve as vital bioindicators due to their ecological diversity. Within the tribe Theclini of subfamily Theclinae, the genus *Chrysozephyrus* Shirozu & Yamamoto, 1956 exhibits significant morphological similarities. To confirm species differentiation, a comprehensive analysis involving genitalic dissection and photography was conducted for *C. syla* and *C. birupa* in both sexes. Additionally, COI gene sequences were generated and submitted to NCBI, marking the first global DNA barcoding and phylogenetic study for these species. Phylogenetic analysis identified five major clades, with closely related species forming distinct groups. Nucleotide composition analysis revealed a strong A + T bias, particularly at the third codon position, consistent with insect mitochondrial genomes. Genetic variability assessments supported low intergeneric distances of several taxa. These findings refine Theclini taxonomy and emphasize the importance of integrating morphological and molecular approaches in butterfly phylogenetics.

Keywords: *Chrysozephyrus*, CoI, DNA Barcoding, Phylogenetic analysis, Taxonomy





Phylogenetic Analysis of Tribe Neptini (Lepidoptera: Nymphalidae: Limenitidinae) on the basis of CoI Gene

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Butterflies of the tribe *Neptini* (Lepidoptera: Nymphalidae: Limenitidinae) represent an ecologically significant group with complex taxonomy and wide distribution across the Oriental and Palearctic regions. Morphological similarity among species often complicates accurate identification, making molecular approaches valuable for resolving phylogenetic relationships. The present study employed mitochondrial cytochrome oxidase I (COI) gene sequences to reconstruct phylogeny and evaluate genetic divergence within Neptini. Eight species of *Neptis* and *Pantoporia* were sampled from Himachal Pradesh and Uttarakhand, India, and additional sequences representing global taxa were retrieved from NCBI. DNA extraction, amplification using Folmer's primers, and sequencing were conducted, and analyses were performed in MEGA v12. Nucleotide composition revealed a strong A+T bias (68.7%), particularly pronounced at the third codon position. Sequence alignment showed 343 conserved sites and 236 variable sites, with 211 parsimony-informative positions. Interspecific divergence within studied species ranged from 5.0 per cent to 11.4 per cent. Phylogenetic reconstructions using Maximum Likelihood (ML) method produced 11 clades, with moderate to high bootstrap support. The tree placed *Phaedyma aspasia* within *Neptis* and recovered *Lebadea martha* as a sister group, while *Pantoporia* species were variably nested within *Neptis*, suggesting paraphyly. These findings support the reliability of COI barcoding for species delimitation in *Neptini* and highlight incongruences in current classification. The study emphasizes the necessity of integrating morphological and molecular evidence to clarify evolutionary relationships and provides a DNA reference framework useful for taxonomy, ecology, and conservation planning.

Keywords: CoI, DNA, Neptini, Paraphyly, Phylogeny



Theme IV

Cutting Edge Technologies of Pest Management - Biotechnology and Nanotechnology Approaches on Pest Management, Advances in Pesticide Chemistries, Bio-Pesticides and Microbial Pesticides Towards Green Technologies, Postharvest Storage Pest Management.





Recent Trends in Pesticide Usage in Apple Ecosystem of Kashmir and New Opportunities from Medicinal Plant Chemistries

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Synthetic pesticides prepared directly on the basis of petrochemical derivatives have posed a great threat to both man and the environment. Besides several side effects, most of the pests have developed resistance to commonly available synthetic pesticides. The toxic chemicals have accumulated in many organisms and environment. A vast majority of beneficial organisms/arthropods, pollinators and natural enemies have observed decline due to the application of synthetic pesticides. Also to develop a new synthetic molecule requires high cost and a long period of research. Jammu and Kashmir has not been any exception to this rule. We have been using pesticides on apple for a very long time. Eight to ten sprays are annually used on apple during its growing season. This has surely taken its toll in terms of pest resistance, resurgence, loss of natural enemies, environmental deletion and human health due to pesticide residues. Many health concerns have been implicated to use of pesticides in the apple ecosystem particularly to pesticide applicators. As we are aware that plants synthesize many biochemical molecules during their growth and development. Many of these biochemical molecules play a significant role in the plant defense system against various biotic stresses particularly diseases and pests. Among the plant species useful for human survival, the medicinal and aromatic plants synthesize high amount of strongly potent active compounds which are used against the pests. Earlier reports and our present research output indicate availability of many potential plant molecules useful to commercialize for biopesticides as antifeedants, repellents, ovipositors etc. We have found many plant species like *Accorus calamus*, *Artemisia annua*, *Matricaria chamomilla*, *Sassurea costus* having a potential to be used for apple pest management. These phytochemical molecules particularly the essential oils extracted have a huge potential as storage pest protectants. The natural plant product molecules from these medicinal plants open new opportunities to manage various pests of apple in Kashmir.





Functional Significance of Endosymbiotic Gut Bacteria in Insects

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Insects are among the most diverse and ecologically dominant organisms on earth, thriving in a wide range of environments and exploiting a variety of food sources. The dominance of insects and their ability to adapt to diverse and extreme environments and to occupy every available niche on earth could be attributed to their association with endosymbiotic gut bacteria—microorganisms that live within the insect gut, forming intimate and often obligate mutualistic relationships with their hosts. Symbiosis has been identified as a common phenomenon in many insects and their association in fruit flies has been studied in depth which have been explored not only to study the host ecology but also for their management (Sood and Nath, 2002; Sood and Prabhakar, 2009 & Prabhakar et al., 2009). Many studies have proven the multifaceted role of these gut bacteria like nutrition, physiology, immunity, and even the evolution of their insect partners. Many insects feed on nutrient-deficient diets, such as plant sap (aphids), wood (termites), blood (mosquitoes), or keratin (cloth moths). These diets often lack essential amino acids, vitamins, and cofactors necessary for insect survival and reproduction. Endosymbiotic bacteria help fill these nutritional gaps by synthesizing essential nutrients that the insect cannot produce on its own. For example, *Buchnera aphidicola*, an obligate symbiont in aphids, provides essential amino acids absent in phloem sap (Douglas, 2009). Another critical role of these microbes is digestion and detoxification. Insects like termites rely on complex gut microbial communities to degrade cellulose and lignin in wood. These microbes produce enzymes such as cellulases and xylanases, enabling the insect to access energy-rich sugars (Brune, 2014). Similarly, some gut symbionts help detoxify plant secondary metabolites or xenobiotics, enhancing the host's ability to feed on chemically defended plants or resist insecticides (Kikuchi et al., 2012). Endosymbiotic bacteria also influence the immune system and disease resistance of their insect hosts by modulating immune signaling pathways or producing antimicrobial compounds, (Zhukova & Sapountzis, 2021). Furthermore, some symbionts, like *Wolbachia*, can manipulate insect reproduction through mechanisms such as cytoplasmic incompatibility, feminization, or parthenogenesis, thereby influencing population dynamics and potentially aiding in biological control efforts (Werren et al., 2008). From an evolutionary perspective, many endosymbionts have co-evolved with their hosts over millions of years, resulting in genome reduction and host specialization underscoring the essential nature of these symbionts to insect





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Theme-IV

Cutting Edge Technologies of Pest Management - Biotechnology and Nanotechnology Approaches on Pest Management, Advances in Pesticide Chemistries, Bio-Pesticides and Microbial Pesticides Towards Green Technologies, Postharvest Storage Pest Management

biology. Use of antibiotics for the destruction of gut symbionts has been explored earlier for the pest management with limited success, however with more in depth understanding of these endosymbiotic gut bacteria recently and their role in insect ecology and evolution offers many other practical applications. Targeting symbiotic pathways may provide novel strategies for pest management, while conserving beneficial symbioses could support pollinator health and ecosystem services (Crotti et al., 2012). Modulation of gut symbionts *via* CRISPR/ Cas9, RNAi mediated paratransgenesis, paratransgenesis, exploitation of chemical inventories of the microbiome to develop novel bio-pesticides, microbial semiochemicals, combination of bio-pesticides with nanotechnology, autocidal program, and the combining of IIT and SIT to increase the insect mortality are other future options. Hence continued research into these symbioses holds promise for both basic biological insights and applied environmental solutions for pest management.

Lead Presentation



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In collaboration with

The Entomological Society of India, ICAR-IARI Pusa Campus, New Delhi - 110012



Comparative Evaluation of Temperate, Subtropical and Tropical Isolates of Nucleopolyhedrovirus against Tomato Fruit Borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae)

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The tomato fruit borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is a serious insect pest owing to its polyphagous nature, migrating long distances, greater capacity to develop resistance against insecticides and persistence in cropping areas. The comparative evaluation of temperate, sub-tropical and tropical *H. armigera* NPV (HearNPV) isolates was carried out to determine the potential of local and exotic HearNPV isolates for the management of *H. armigera* in Kashmir, India, having a temperate climate. Mortality of 2nd instar *H. armigera* larvae with three different HearNPV isolates at different concentrations ranged between 13.40 - 73.25 per cent, with significant differences between the concentrations in each isolate under laboratory conditions. The median lethal concentration (LC₅₀) values of HearNPV-IND-K, HearNPV-IND-J, HearNPV-IND-B isolates against 2nd instar *H. armigera* larvae were 4.62×10^3 , 5.99×10^4 and 7.24×10^4 OBs/larva at 10th day post inoculation, with significant differences among the isolates. In time response bioassays, the cumulative mortality (%) caused by median lethal concentration (LC₅₀) of HearNPV-IND-K, HearNPV-IND-J and HearNPV-IND-B isolates over a period of 10 days was 50.33, 49.00 and 49.00 per cent, respectively. Their median survival time (ST₅₀) values against 2nd instar *H. armigera* larvae were 8.10, 8.94 and 9.50 days, respectively, with significant differences among the isolates. The results revealed that the LC₅₀ and ST₅₀ values of HearNPV-IND K isolate was significantly lower than HearNPV-IND-J and HearNPV-IND-B isolates. The cumulative mortality of *H. armigera* larvae with HearNPV-IND-K, HearNPV-IND-J and HearNPV-IND-B isolates at different concentrations ranged between 22.00-68.32, 20.54-55.17, 11.66-44.33 per cent, respectively, on tomato crop under field conditions. The highest mortality rate of 68.32 per cent was observed at the local isolate (HearNPV-IND-K). It's concluded that the local isolate had the potential for the development of species-specific and environmentally safe biocontrol agent for organic farming and its





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incorporation into Integrated Pest Management (IPM) program may reduce the use of chemical insecticides in Kashmir.

Keywords: Baculoviruses, *Helicoverpa armigera*, LC_{50} , Nucleopolyhedrovirus, ST_{50} , Tomato



Oral Presentation



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Contact toxicity of some insecticides against Red flour beetle, *Tribolium castaneum*

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Red flour beetle, *Tribolium castaneum* is a very destructive pest of several commodities in storage. The management of this pest in storage godowns is mainly rely on prophylactic treatment by synthetic insecticides (Deltamethin and malathion) and curative treatment using phosphine fumigant. The continuous and indiscriminate use of these insecticides has led to resistance development in multiple populations, not only in India but worldwide, highlighting the urgent need to find effective alternative insecticides. In the present study, the toxicities of five newer insecticides were assessed and compared with Deltamethrin across different surface types, and the joint toxicity of the most effective alternative insecticide with deltamethrin was also evaluated. All insecticides were found most effective on glass surfaces followed by tile surfaces. Among insecticides, Spinetoram was found to be the most effective alternate insecticide with lethal doses (LC₅₀) of 250.07, 240.23 and 232.63 mg/m² on glass surface, 233.17, 221.48 and 215.58 mg/m² on tile surface and 323.55, 314.72 and 309.77 mg/m² on jute surface for 24, 48 and 72h exposure period, respectively, followed by Chlorfenapyr with 167.55, 160.52 and 158.23 mg/m² on glass surface, 252.50, 243.22 and 236.55 mg/m² on tile surface and 254.08, 243.12 and 240.90 mg/m² on jute surface for 24, 48 and 72h respectively. Spinetoram was 1.68- 2.60 fold and chlorfenapyr was 1.42-1.89 fold more toxic than deltamethrin. The joint toxicities of deltamethrin and spinetoram at different proportions revealed that combinations 9:1 and 4:1 were synergistic whereas other combinations were antagonistic. The study concluded that spinetoram and chlorfenapyr can be explored as alternatives to deltamethrin against red flour beetle *T. castaneum* and spinetoram can be used in combination with deltamethrin to enhance the efficacy.

Keywords: Alternate insecticides, Contact toxicity, Joint toxicity, Red flour beetle, Relative toxicity





Field Evaluation of Novel Insecticides for Sucking Pest Management in Cucurbitaceous Vegetables in Kashmir

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Sucking pests such as aphids (*Aphis gossypii*), thrips (*Thrips palmi*), and whiteflies (*Bemisia tabaci*) are among the most destructive constraints in cucurbit cultivation, causing direct feeding damage and transmitting viral diseases. A field study was undertaken to evaluate the efficacy of novel insecticidal molecules against these pests on bottle gourd (*Lagenaria siceraria*) and ridge gourd (*Luffa acutangula*). Nine treatments were tested, including Chlorantraniliprole 18.5% EC @ 0.0046% + Carbofuran 3 CG @ 3.25 g/m², Chlorantraniliprole 18.5% EC @ 0.0092%, Cyantraniliprole 10.26% OD @ 0.018% + Carbofuran 3 CG @ 3.25 g/m², Cyantraniliprole 10.26% OD @ 0.036%, Flubendiamide 8.33% + Deltamethrin 5.56% SC @ 0.007% + Carbofuran 3 CG @ 3.25 g/m², Flubendiamide 8.33% + Deltamethrin 5.56% SC @ 0.014%, Chlorpyrifos 20 EC @ 0.02%, Imidacloprid 17.8 SL @ 0.005%, and untreated control. Treatments were applied twice and the pooled data were analyzed. Chlorantraniliprole 18.5% EC @ 0.0046% + Carbofuran 3 CG was most effective against aphids, reducing their populations by 83.96% in bottle gourd and 82.00% in ridge gourd. Thrips were most effectively suppressed by Cyantraniliprole 10.26% OD @ 0.018% + Carbofuran 3 CG, which achieved 82.57% and 83.28% reduction, while the same treatment provided superior control of whiteflies with reductions of 86.05% and 85.70% in bottle gourd and ridge gourd, respectively. None of the novel molecules exhibited phytotoxic symptoms and they were comparatively less detrimental to natural enemies than conventional standards. These findings suggest that cyantraniliprole-based combinations represent a highly effective and safer alternative for the integrated management of sucking pests in cucurbitaceous vegetables, with potential to reduce reliance on older chemistries and delay resistance development.

Keywords: Cyantraniliprole, Chlorantraniliprole, Cucurbits, Novel insecticides, Sucking pests





Harnessing Biorational Tools for Sustainable Crop Protection in the Himalayan Region

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The North-Western Himalayas harbor diverse insect pests that damage fruit and forest ecosystems, while also offering rich bioresources for sustainable pest management. This study integrates three complementary biorational approaches viz. baculovirus-based biopesticides, plant-derived insecticidal compounds and entomopathogenic fungi as eco-friendly alternatives to chemical insecticides. Nucleopolyhedroviruses (NPVs) isolated from *Lymantria obfuscata* and *Malacosoma indicum* showed strong host specificity and virulence. Molecular analyses revealed close relatedness of *L. obfuscata* NPV with *L. dispar* NPV and *M. indicum* NPV with *M. californicum* NPV. The Baderwah isolate proved most pathogenic to *L. obfuscata*, while the Mahor isolate was most effective against *M. indicum*. Optimized *in vivo* production using third instars yielded quality inoculum and field application (@ 1×10^{12} POBs/acre) suppressed larval densities by 25–63%, with residual effects in the following season. In parallel, five medicinal plants viz. *Artemisia absinthium*, *Acorus calamus*, *Digitalis purpurea*, *Plectranthus rugosus*, and *Achillea millefolium* were screened against *Corcyra cephalonica*, *Sitophilus oryzae*, and *Helicoverpa armigera*. Among these *A. absinthium* exhibited the strongest activity, validated through High Resolution Liquid Chromatography-Mass Spectrometry (HR-LCMS) and molecular docking. Kaempferol, diosmetin, and related compounds bound strongly to acetylcholinesterase of *H. armigera*, with kaempferol showing the greatest inhibitory potential. Complementing these approaches, local *Beauveria bassiana* isolates caused higher mortality in *Holotrichia longipennis* (67.45%) than commercial strains, while *Metarhizium anisopliae* (NBAIR strain) effectively reduced apple root borer incidence when applied with enriched Farm Yard Manure. Collectively, these findings highlight the potential of integrating baculoviruses, phytochemicals, and entomopathogenic fungi into biorational pest management as field-applicable alternatives that minimize reliance on synthetic insecticides and foster sustainable crop protection.

Keywords: Commercial strains, Entomopathogens, Medicinal plants, NPV, Sustainable Pest Management





Management of Melon Fruit Fly on Cucumber with Reference to Terminal Residues and Dissipation Behaviour of Deltamethrin and Flubendiamide

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A field study was carried out during *Kharif*, 2024 at the Department of Entomology, CCS HAU, Hisar to evaluate management strategies against the melon fruit fly, *Zeugodacus cucurbitae* (Coquillett), on cucumber and to assess terminal residue of deltamethrin and flubendiamide. Treatments were applied at fruit initiation stage and repeated after 15 days, with weekly observations. Significant variation was observed among treatments in reducing fruit infestation. The lowest infestation was recorded with Flubendiamide 8.33% + Deltamethrin 5.56% w/w SC (8.95%), followed by Malathion 50% EC + jaggery (9.94%), both statistically at par and superior to other treatments. Residue analysis was performed using Gas Chromatography (deltamethrin) and High-Performance Liquid Chromatography (flubendiamide). The formulation was tested at recommended (250 mL/ha) and double (500 mL/ha) doses, with fruit samples collected at 0, 1, 2, 3, 5, 7 and 10 days post-application. At the recommended dose, deltamethrin residues declined from 0.522 to 0.060 mg/kg by day 7 (88.51% dissipation; half-life 2.4 days), while at double dose, residues dissipated from 1.220 to 0.090 mg/kg (93.44%; half-life 2.9 days). Flubendiamide at the recommended dose decreased from 0.730 to 0.060 mg/kg (91.78%; half-life 1.9 days), and at double dose from 1.090 to 0.090 mg/kg (91.74%; half-life 2.7 days). By day 10, residues were below the LOQ. These findings suggest that Flubendiamide + Deltamethrin and Malathion + jaggery are the most effective management options, while residue dissipation patterns confirm their safety when applied as per recommendations.

Keywords: Cucumber, Deltamethrin, Flubendiamide, Management, Melon fruit fly, Residue analysis





Mapping the impact of Bowman-Birk protease Inhibitor on *Achaea janata* larvae via LC-MS/MS proteomics, Mitochondrial Pathway profiling, and cellular imaging

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Achaea janata is one of the devastating insects of the castor plant, especially for India, as India is the leading global supplier of castor oil, widely used in industrial manufacturing across major countries like the USA and China. Hence, management of *A. janata* is essential for protecting the castor crop. The role of plant protease inhibitors (PIs) in impairing the growth and development of Lepidoptera larvae by inhibiting their midgut digestive proteases is well known. However, the information on insect midgut proteome in response to PIs and its impact on the insect's metabolic pathways and cellular architecture is limited. Therefore, in the present study, we employed a multi-model approach to understand the effects of Bowman-Birk Inhibitor (RsBBI) purified from mature seeds of *Rhynchosia sublobata*, on the midgut tissue of *A. janata* larvae. After the in vivo feeding assay with RsBBI, a significant weight reduction and an increased mortality rate were observed. LC-MS/MS proteomic analysis of the insect midgut revealed substantial numbers of differentially expressed proteins in RsBBI-fed larvae. Histology and Transmission electron microscopy revealed the changes in the midgut cell morphology and pronounced tissue degeneration. The confocal study revealed RsBBI localization within midgut cells, coinciding with elevated ROS levels and disrupted antioxidant enzyme activity. Spectrophotometric analysis of ATP and ADP levels, confirmed the impaired energy metabolism, further supported by reduced mitochondrial membrane potential, significant reduction in ETC complexes' activity, and altered cristae morphology. Collectively, these findings provide the mechanistic insight into RsBBI cytotoxicity and highlight its potential relevance for *A. janata* control strategies.

Keywords: *Achaea Janata*, Bowman-Birk Inhibitor, Confocal study, Proteome analysis, Protease inhibitors.





Method Validation and Quantification of 27 Pesticides in Fruits and Vegetables on GC-MS/MS

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A targeted multi-residue analytical method was developed and validated for the quantification of 27 pesticides (Chlorpyrifos, Chlorpyrifos-Methyl, Cypermethrin, Ethion, Quinalphos, Profenophos, Fenprothrin, Bifenthrin, Deltamethrin, λ -Cyhalothrin, Fenvalerate, Alpha BHC, Gamma BHC, (Lindane), Beta BHC, Heptachlor, Delta BHC, Aldrin, Dieldrin, Endrin, Endrin aldehyde, Endosulfan Sulphate, Endosulfan I, Endosulfan II, Heptachlor epoxide Isomer B, 4, 4-DDE, 4, 4-DDD, 4, 4-DDT) in fruit and vegetable matrices using Gas Chromatography–Tandem Mass Spectrometry (GC-MS/MS). Sample preparation was done by modified QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) protocol, followed by clean-up with dispersive-SPE. Method validation, conducted in accordance with the European Commission's SANTE guidelines, evaluating linearity, selectivity, accuracy (trueness), precision (repeatability and within-laboratory reproducibility), limit of Detection (LOD), limits of quantification (LOQ), matrix effects, and measurement of uncertainty. All analytes exhibited satisfactory linearity ($R^2 \geq 0.99$) over the calibration range of 0.01-1.0 mg/kg. Recoveries at three spiking levels (0.05, 0.075, 0.10 mg/kg) were within the acceptable range of 70–120%, with precision (RSD) consistently below 20%. LOQs achieved were sufficient to ensure compliance with regulatory maximum residue limits (MRLs). Matrix effects were evaluated and controlled via matrix-matched calibration and was recorded to be within the acceptable range of $\pm 20\%$. The method demonstrated high selectivity, robustness, and suitability for routine residue monitoring in compliance with regulatory standards.

Keywords: Fruits and Vegetables, GC-MS/MS, Method Validation, Pesticide Residues, QuEChERS





Ovicidal and Larvicidal Effects of Petroleum Spray Oils on Green Apple Aphid (*Aphis pomi* De Geer) in Apple Orchards

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The green apple aphid (*Aphis pomi* De Geer) is one of the first pests to colonize apple orchards in spring, often reaching damaging levels in major production areas of India such as Jammu and Kashmir. Petroleum spray oils (PSOs), routinely applied at delayed dormancy to manage San José scale and European red mite, have not been systematically evaluated for their impact on *A. pomi*. This study investigated the ovicidal and larvicidal potential of a 2 per cent PSO formulation through laboratory and field trials conducted in 2023 and 2024. Applications made at the delayed dormant/green tip stage significantly suppressed egg hatch, reducing cumulative emergence to below 10 per cent in both assays. Survival analysis confirmed a markedly higher mortality risk in treated eggs compared with controls. Direct toxicity tests on emerged nymphs recorded high levels of mortality, reaching nearly 70 per cent under field conditions and over 99 per cent in laboratory dip bioassays by five days after exposure. Residual toxicity assays demonstrated that aphid mortality continued to increase after contact with treated surfaces, exceeding 60 per cent within two days. Field evaluations further revealed that PSO sprays lowered bud infestation by aphids to nearly one-fourth of the untreated level, with the strongest suppression achieved when PSO was combined with imidacloprid. These findings provide the first detailed evidence of ovicidal and larvicidal activity of PSOs against *A. pomi*. The results highlight the value of PSO not only as a standalone measure but also as a compatible component of early-season integrated pest management strategies in apple orchards.

Keywords: Green Apple Aphid, Horticultural Mineral Oil, Larvicidal Efficacy, Ovicidal Activity, Residual Toxicity





Persistence Behaviour of Fenpyroximate, its Metabolite M1 and Risk Assessment on Apple in Kashmir

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Fenpyroximate, an excellent acaricide is widely used for the control of European red mite *Panonychus ulmi* on apple in Kashmir and is recommended throughout the growing season of the apple fruit. In the present study the degradation pattern of fenpyroximate and its Z isomer (M1) were studied on apple using high performance liquid chromatography with diode array detection. Fenpyroximate (Sedna 5 SC) was applied @ 50 g ai ha⁻¹ on apple one month prior to harvesting of the fruit. Samples of apple were collected at 0, 1, 3, 7, 10, 15 and 30 days after application of the treatment. The average initial deposit of fenpyroximate and M1 were found to be 1.12 and 0.209 µg g⁻¹ respectively on apple. The residues of fenpyroximate and M1 dissipated to 0.094 and 0.025 µg g⁻¹ at 15-day post treatment with half-life periods of 4.30 and 5.77 days respectively. The residues of fenpyroximate and M1 dissipated to below limit of quantification of 0.020 and 0.022 µg g⁻¹ respectively after 30-day post treatment. For the safety of consumers, a waiting period of 10.11 days (based on total residues) needs to be observed for fenpyroximate treated apples. Maximum permissible intake (MPI) of 0.6 µg g⁻¹ of fenpyroximate is higher than theoretical maximum residue contribution (TMRC) value of 0.013 µg g⁻¹ at 0 day, suggesting fenpyroximate is unlikely to cause health hazards on apple in Kashmir.

Keywords: Apple, Degradation, Fenpyroximate, Half-life, M1





Seasonal Incidence and Bio-Efficacy of Botanical, Entomopathogen and Newer Insecticides against *Thrips florum* on Gerbera in Kashmir

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The current investigation was conducted in the experimental block of the Division of Floriculture & Landscaping Architecture, Faculty of Horticulture (FOH), Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Shalimar during 2020-2021 under polyhouse condition. The peak thrip infestation level was noticed in the month of July (2.69 thrips/leaf and 11.28 thrips/flower) at a mean maximum temperature of 37.1°C. Correlation studies revealed a highly significant positive correlation between thrip population and temperature while a highly significant negative correlation with RH. Further, while testing the efficacy of various insecticides against thrips, highest efficacy was observed in fipronil 5%SC @1ml/L followed by acetamiprid 20%SP @0.5g/L. However, chlorfenapyr 10% SC @1ml/L proved to be least efficient in suppressing thrip infestation.

Keywords: Botanical, Entomopathogens, Gerbera, Insecticides, Management





Validation of Integrated Pest Management Module for Khasi Mandarin (*Citrus Reticulata* Blanco) Under Northeast India's Climatic Conditions

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Khasi mandarin is one of the most important commercial fruits of North-Eastern India. Its cultivation has been hindered due to various insect pests and disease problems. Trunk borer, citrus butterfly, leaf miner, blackfly, whitefly, psylla, fruit fly are the major insect pests of Khasi mandarin causing 40-60 per cent damage. Efforts were made to evaluate the IPM module and Farmers' Practice (FP) based on the earlier field studies for the management of insect pests in Khasi mandarin under the climatic conditions of North-Eastern India. The experiment was conducted in farmers orchard in Tinsukia district of Assam during 2021–2023. In the IPM strategy, installation of yellow sticky traps @ 20/ha, NSKE @ 5 %, and novaluron 10EC @0.005% reduced the sucking insect populations. Likewise, application of biopesticide *Beauveria bassiana* @4 X 10⁶cfu/ml (0.1%) reduced the lemon butterfly population and smearing the tree trunk with a slurry of 50 ml novaluron 10EC, 2 kg lime in 10 litres of water along with gum up to a height of 1 m from the ground level during February to March effectively control the trunk borer population. Among the two management modules, IPM proved to be the promising one with better net returns. The validated IPM strategies can be adopted by Khasi mandarin growers as an economically viable and sustainable option for the management of insect pests. Studies validate the efficacy of these integrated approaches, with findings showing superior outcomes in terms of economic returns, pest control, and the promotion of beneficial insects.

Keywords: IPM, Insect pests, Khasi mandarin, North-Eastern India, NSKE





Virulence of *Metarhizium anisopliae* Strain TMBMA1 against Cotton Pink Bollworm: Biochemical and Molecular Insights

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The pink bollworm (*Pectinophora gossypiella*; PBW) is one of the most destructive pests of cotton, severely impacting both yield and fiber quality. The emergence of resistance to *Bt* cotton in PBW populations has further increased the dependence on insecticide applications has led to the various environmental concerns intensifying the need for safer and more sustainable pest management strategies. Present study evaluated the virulence of *Metarhizium anisopliae* (strains TMBMA1) against various life stages of PBW, along with an assessment of extracellular enzyme activity and the expression of pathogenesis-related (PR) genes in TMBMA1. The strain TMBMA1 has strong ovicidal, larvicidal and pupicidal potential. Egg hatchability was significantly reduced, with 88.71 per cent increased mortality over control at the highest concentration. Larvae were the most susceptible stage, with TMBMA1 causing up to 97.92 per cent mortality in 3rd instar larvae at 1×10^{10} CFU/ml, and an LC₅₀ of $1 \times 10^{6.9}$ CFU/ml. Strain TMBMA1 also exhibited strong pupicidal activity, reducing pupal emergence from 85.42 per cent in the control to just 4.17 per cent at the highest concentration, representing a 95.11 per cent increase in mortality. Enzymatic assays revealed significantly elevated levels of exochitinase and protease activity when TMBMA1 spores were incubated with PBW cuticle, indicating their role in cuticle degradation and pathogenesis. The qRT-PCR analysis further confirmed the virulence potential, showing strong upregulation of PR genes, particularly *CHI2* and sustained expression of *CHI3* after inoculation of EPF. These findings highlight the potential of *M. anisopliae* strain TMBMA1 as a promising biocontrol agent for integrated management of pink bollworm in cotton.

Keywords: EPF, Exochitinases, Gene expression, *Metarhizium anisopliae*, PBW, Virulence





Comparative Assessment of Management Approaches for Apple Fruit Borer in Kashmir Orchards

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The Apple Fruit Borer (AFB) emerged as a destructive pest in some pockets of Northern Kashmir, causing significant fruit fall and yield loss in apple orchards. A two-year field study (2023–2024) was conducted in District Baramulla to quantify its impact and evaluate management strategies under field conditions. The pest infestation in untreated control plots resulted in 44.24% fruit fall, leading to a proportional increase in premature fruit drop. In contrast, Integrated Pest Management (IPM) achieved the lowest fruit damage (8.04%), with a reduction in AFB damage (88.60%), followed by Chlorantraniliprole 18.5% SC, having (17.29%) fruit damage and (71.66%) reduction in AFB. Other treatments, such as Chlorpyrifos 50 % EC + Cypermethrin 5% EC, Chlorpyrifos 20 % EC, Chlorantraniliprole 18.5% SC, Quinalphos 25 EC, and Bisexual Pheromone Traps, showed moderate efficacy, whereas the untreated check sustained the highest damage. Overwintering larval survival was also significantly reduced (by IPM practice, confirming their role in breaking the pest cycle. Phytotoxicity evaluation revealed that none of the chemical insecticides used in the IPM caused harmful effects on leaf injury, wilting, necrosis, vein clearing, epinasty and hyponasty. Analysis of variance confirmed statistically significant differences ($p < 0.05$) among treatments for all evaluated parameters. The study establishes IPM that includes Orchard sanitation + Bisexual Pheromone traps + Chlorpyrifos 50 % EC + Cypermethrin 5% EC) + Quinalphos 25 EC as the most effective, safe, and reliable method for AFB management, providing a strong basis for their integration into an IPM module for sustainable apple cultivation in Kashmir.

Keywords: Apple Fruit Borer, Damage, Integrated Pest Management, Kashmir, Phytotoxicity





Comparative Degradation Dynamics of Hexythiazox and Propargite in Traditional and High-Density Apple Orchard Systems of Kashmir

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Unregulated pesticide use in horticulture poses significant risks to environmental and human health due to residue accumulation in food crops. This study investigates the dissipation pattern of two acaricides viz, Hexythiazox and Propargite, in apple fruits under different orchard systems in Kashmir. Field experiments were conducted on the E.L. Star apple cultivar in a High-Density Plantation (HDP) at SKUAST-K, Shalimar, and a traditional orchard in Khal Mulla, Ganderbal. Both pesticides were applied at recommended and double the recommended concentrations, one month before harvest. Fruit samples were collected at 0, 1, 3, 5, 7, 10, 15, 20, 25, and 30 days after application and analysed using Liquid Chromatography-Mass Spectrometry (LC-MS). At the recommended dose (0.002%), Hexythiazox showed initial residues of 1.12 ppm (HDP) and 1.91 ppm (traditional), with 97 per cent dissipation within 15–25 days and half-lives of 2.77 and 5.30 days, respectively. At 0.004%, residues increased to 2.22 and 2.49 ppm, with extended half-lives (4.62 and 9.63 days) and a pre-harvest interval (PHI) of up to 17.13 days. Propargite at 0.05% resulted in initial residues of 1.63 and 1.87 ppm, dissipating by over 96 per cent within 15–25 days, with short PHIs (0.85–1.09 days). At 0.1%, residues reached 2.09 ppm, with slightly longer half-lives and PHIs (up to 2.30 days). The study concludes that both pesticides dissipate within safe limits before harvest when used appropriately, but doubling concentrations extends persistence, necessitating longer pre-harvest intervals to ensure food safety.

Keywords: Apple, Degradation, Half-life, Hexythiazox, HDP orchard, MRL, Pesticide residue, Propargite, Traditional orchard, QuEChERS, Waiting period





Development and Evaluation of IPM Module for Effective Aphid Management in High-Density Apple Orchards of Kashmir

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Aphids are among the most damaging pests in apple orchards, particularly under high-density plantation (HDP) systems where dense canopies promote their proliferation. The excessive use of chemical pesticides has led to environmental concerns, resistance development, and disruption of beneficial fauna. The present study was conducted during 2021 and 2022 at the Wadura campus of SKUAST-Kashmir to evaluate the efficacy of six Integrated Pest Management (IPM) modules against aphids infesting apple cultivar Gala Redlum under HDP conditions. The objective was to develop a sustainable, eco-friendly strategy by comparing modules comprising chemical, biological, and cultural interventions. Each module was applied at specific phenological stages of the crop and evaluated through replicated field trials. Aphid population was recorded before and after treatment at regular intervals, and percent mortality was calculated using Abbott's formula. The results revealed that all modules significantly reduced aphid populations compared to the control. Module-V, primarily composed of chemical insecticides, showed the highest mean mortality (82.03%), while Module-IV, which emphasized biopesticides and minimal chemical input, recorded 78.14 per cent mortality. Modules incorporating neem-based formulations, *Lecanicillium lecanii*, and yellow sticky traps were particularly effective in reducing aphid loads. Although chemical-based Module-V showed slightly better efficacy, Module-IV was identified as more environmentally sustainable. The results demonstrate that biopesticide-based IPM modules can serve as effective alternatives to conventional chemical control strategies. It is concluded that Module-IV offers a balanced, eco-friendly, and effective approach for managing aphids in high-density apple orchards, with potential for long-term adoption in sustainable horticulture.

Keywords: Aphids, Apple, Bio-intensive module, High-Density Plantation, Integrated Pest Management





Effect of Bio-Nano Zinc Formulations on the Growth and Performance of Mulberry Silkworm (*Bombyx mori* L.)

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An experiment was carried out at College of Temperate Sericulture, SKUAST-K, Mirgund during, Spring 2025 to know the efficacy of bio-nano zinc formulations on growth, economic and reproductive parameters of silkworm *Bombyx mori* L. pure race (HTP₅). The study resulted in significant improvement in all the studied traits of silkworm fed with nettle based bio-nano zinc treated mulberry leaves at 1st, 3rd and 5th days of fifth instar. The experiment consisted of seven treatment combinations (10, 20, 30, 40, 50 ppm of bio-nano zinc formulations, aqueous control and absolute control) with three replications each consisted of 100 larvae under CRD. Significantly higher larval weight of fifth instar (35.16 g /10 larvae), shorter fifth instar larval duration (6.51 days), better silk gland weight (1.330 g), silk gland tissue somatic index (0.338) and ERR (98.135 %) were registered by the silkworm batch fed with treated mulberry leaves at 40 ppm concentration. Among the cocoon parameters significantly higher single cocoon weight (2.083 g) was achieved at 40 ppm which was at par as recorded at 50 ppm (1.990 g). However, significantly higher single shell weight (0.430 g) and shell ratio (21.607 %) were recorded at 50 ppm respectively. Cocoon yield by number (9813.51 / 10,000 worms) and by weight (15.27 kg /10,000 worms), along with pupation rate (95.46 %) were found significantly higher at 40 ppm. Among the reeling parameters significantly higher average filament length (1003.00 m), raw silk percentage (17.76 %), Renditta (5.79), non-breakable filament length (969.00 m) were registered by 40 ppm, however finer denier (2.35) was recorded at 50 ppm. Among the reproductive parameters significantly higher fecundity (578.00), fertility (99.40 %) and hatchability (97.49 %) were recorded at 40 ppm. The study revealed that maximum traits were found significantly higher at 40 ppm concentration of the bio-nano zinc formulation treated batch. The outcome of the experiment suggests that 40 and 50 ppm bio-nano zinc formulations have contributed to maximum traits and thus can be used for improvement in productivity of sericulture.

Keywords: Bio-nano zinc, *Bombyx mori*, Dietary exposure, Formulations, Mulberry.





Effect of Bio-Rational Insecticides on the Natural Enemies Ladybird Beetle (*Coccinella Septempunctata* Linn.) in Mustard Crop

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Mustard, an important oilseed crop, is cultivated globally, with major producers including Canada, India, China, and Russia. India stands as the second-largest producer, contributing 12 per cent to global mustard production. Despite its large-scale oilseed cultivation, India remains a significant importer of edible oils, with rapeseed-mustard accounting for over 30 per cent of domestic edible oil production. In India, the mustard crop faces numerous pest challenges, with more than 43 species of insect pests identified. Natural enemies, including predators, parasitoids, and pathogens, play a crucial role in biological pest control, reducing the need for chemical pesticides. The ladybird beetle, *Coccinella septempunctata*, is particularly important for aphid control in mustard fields, though its effectiveness can be limited by pest infestations. Biorational insecticides, such as *Bacillus thuringiensis*, azadirachtin, and spinosad, offer a promising alternative to synthetic pesticides, minimizing harm to beneficial organisms and the environment. This study focuses on the impact of bio-rational insecticides on the population dynamics of *C. septempunctata* and aphid infestation in mustard crops. The experiment was conducted at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, India, using a Randomized Complete Block Design (RCBD) with popular mustard varieties such as Giriraj. Observations revealed that the population of *C. septempunctata* varied significantly across different insecticide treatments, with NSKE 10% showing the highest reduction in aphid populations and predator numbers. The study highlights the importance of using biorational insecticides that have minimal adverse effects on natural enemies, such as *C. septempunctata*, while controlling aphid populations.

Keywords: Aphids, Biorational insecticides, *Coccinella septempunctata*, Mustard, Natural enemies, NSKE.





Effect of Zinc Nanoparticles on *Varroa destructor* and Bacterial Disease in *Apis mellifera*

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Honeybees (*Apis mellifera*) are vital pollinators in agricultural and natural ecosystems but are severely threatened by pests like *Varroa destructor* and bacterial infections such as American and European foulbrood caused by *Paenibacillus larvae* and *Melissococcus plutonius* respectively. Conventional chemical and antibiotic treatments have several drawbacks, necessitating eco-friendly alternatives. This study evaluates the efficacy of green synthesized zinc (Zn) nanoparticles, produced using *Mentha spicata* leaf extract, against major honeybee health threats. The nanoparticles were assessed through in vitro bioassays for their acaricidal and antibacterial properties. In vitro results revealed that Nano-Zn exhibited the highest efficacy against *Varroa* mites with LT_{50} of 6.88 h and LC_{50} of 23.66%. In vivo, mite mortality was significantly higher in Nano-Zn ($20.00 \pm 7.29\%$) compared to control ($5.88 \pm 2.02\%$). Against foulbrood pathogens, Nano-Zn displayed the largest inhibition zones on nutrient agar plates (42.8 mm for *P. larvae* and 41.6 mm for *M. plutonius*) at 100 per cent concentration, while plant extract, water, and metal salts had negligible effects. Toxicity bioassays on honeybees indicated that Nano-Zn was among the safest nanoparticles tested, especially under contact exposure (spray method), with minimal adverse effects. Colony performance demonstrated that Nano-Zn enhanced brood area (1138.88 cm^2), honey store area (975.31 cm^2), and pollen store area (247.47 cm^2), showing its potential to improve colony strength and productivity. Overall, the findings highlight that biosynthesized zinc nanoparticles offer a highly promising eco-friendly alternative for managing *Varroa* mites and foulbrood diseases in honey bees, with minimal toxicity risks at optimized doses.

Keywords: Antibacterial, Bee Health, Foulbrood Disease, Honeybee, *Varroa* Mite





Enhancing Vegetable Productivity through Effective Insect Pest Management: Insights from a Bio-efficacy Study under Temperate Conditions of Kashmir

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Vegetables constitute a major portion of the human diet worldwide and play a crucial role in nutrition, especially as sources of phytonutraceuticals, minerals, dietary fiber and phytochemicals. However, insect pests are among the major biotic constraints to successful vegetable production in India, as they not only inflict direct damage to host crops but also act as vectors for several viral diseases. Among vegetables, crucifers are the major winter crop, which include cabbage, cauliflower, mustard, broccoli and radish. Due to their intensive cultivation, crucifers are more susceptible to pest infestations, which reduces their overall productivity. Therefore, a study was carried out under laboratory conditions at SKUAST-K to identify the most effective insecticides and concentrations for controlling the key insect pests of cruciferous vegetables under temperate conditions of Kashmir. Results showed that against Cabbage aphid (*Brevicoryne brassicae*), Spinetoram 11.70 SC @ 0.044 per cent gave the highest mean percent reduction (87.08%) over control. Flubendiamide 39.35 SC @ 0.016% recorded the highest reductions of 85.83 per cent and 86.67 per cent in Diamondback Moth (*Plutella xylostella*) and Cabbage Butterfly (*Pieris brassicae*), respectively. Against Crucifer Flea Beetle (*Phyllotreta cruciferae*), Tetraniliprole 18.18 SC @ 0.04 per cent achieved the highest reduction of (84.40%), while Imidacloprid 17.8 SL @ 0.02% was most effective against onion thrips (*Thrips tabaci*), with 83.93% reduction. These findings highlight the bioefficacy of specific insecticides under local temperate conditions and provide a basis for developing integrated pest management strategies for cruciferous vegetables in Kashmir.

Keywords: Bio-efficacy, Cruciferous vegetables, Insect pests, Insecticides, Kashmir.





Establishment of Economic Injury Level of Two Spotted Spider Mite (*Tetranychus urticae* Koch) on Apple as a Sustainable Management Strategy in Kashmir

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Two Spotted Spider Mite (TSSM) *Tetranychus urticae* Koch has become a serious pest of Apple in Kashmir due to changing climatic conditions. The pest sucks sap from the leaves, resulting in bronzing and a reduction in photosynthetic activity. In the present study, the impact of four levels of the *T. urticae* population on the yield and red colour of the Apple peel was observed during three years. The number of mites per leaf in each set of observations was expressed as population densities denoted by cumulative mite days (CMDs). The apple trees having 1150, 1218, and 1087 cumulative mite days (CMDs) during the study period was observed to have a cumulative yield loss of 12 kg/tree. Average fruit weight did not appear to have any significant effect at the observed CMD; however, fruit colour was affected. The observed economic injury level values were 59.3, 68.2, and 49.6 CMDs during the study period. The results suggest that economic injury level values are season-specific, and initiation of pest management practices directed against TSSM is dependent upon the phenological stage of the Apple tree and not uniform throughout the growing period.

Key words: CMDs, Economic injury level, Fruit health, Pest management, TSSM





Feeding and Reproductive Performance of *Coccinella undecimpunctata* L. on two Different Apple Aphids for Sustainable Pest Management

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Biological control a cornerstone of integrated pest management (IPM), offers sustainable alternatives to chemical pesticides. Among the predatory beetles, ladybird beetles (Coleoptera: Coccinellidae) are efficient natural enemies of aphids and other soft-bodied pests. This species-rich and ecologically diverse group has substantial agricultural and horticultural significance, and inhabits nearly all types of terrestrial biomes. The eleven-spotted ladybird, *Coccinella undecimpunctata* L., is widely distributed and characterized by high reproductive potential, voracious feeding habits, and strong synchrony with prey populations, making it a promising candidate for pest suppression in apple orchards. The study observed that the feeding preference of *C. undecimpunctata* during development followed the order *Aphis pomi* > *Aphis spiraecola*. Adult females laid significantly more eggs (634 ± 67.4) when reared on *Aphis pomi* in comparison to *Aphis spiraecola* (402 ± 45.25). The mean durations of 1st, 2nd, 3rd and 4th larval instars was 4.5 ± 0.70 , 3.4 ± 0.69 , 4.9 ± 0.87 and 3.9 ± 0.87 days, respectively on *Aphis pomi*, compared to 2.9 ± 0.73 , 2.7 ± 0.67 , 4.9 ± 0.87 and 3.9 ± 0.87 days on *Aphis spiraecola*. The total larval duration lasted an average of 16.7 ± 1.05 and 12.2 ± 1.31 days on *Aphis pomi* and *Aphis spiraecola*, respectively. Adult female longevity exceeded that of males, with mean values of 48.8 ± 2.97 and 39.5 ± 2.27 days, respectively, depending on the host prey. These results support the inclusion of *C. undecimpunctata* in sustainable pest management strategies, highlighting its potential as a promising biological control agent against apple aphids.

Keywords: Aphids, Biological control, Pest, Sustainable management.





Insect Pest Complex of Apple (*Malus domestica* Borkh.) Under High Density Orchard Ecosystem with Special Reference to Formulation of Pesticide Spray Schedule

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High-density plantation (HDP) orchards in Kashmir present unique challenges for insect pest management due to altered canopy structure and microclimate. A field study was undertaken in high density apple orchard ecosystem to document Insect Pest and Natural Enemy complex viz-a-viz to develop a rational spray schedule. The results of the study revealed that the pest complex was dominated by San Jose scale (*Quadraspidiotus perniciosus*), European red mite (*Panonychus ulmi*), green apple aphid (*Aphis pomi*), and woolly apple aphid (*Eriosoma lanigerum*). A rich guild of natural enemies was recorded, including *Chilocorus infernalis* (scale feeder), aphidophagous coccinellids (*Coccinella septempunctata*, *Hormonia eucharis*, *Hippodamia variegata*), syrphid (*Episyrphus balteatus*), lacewings (*Chrysoperla* spp.), spiders (*Lycosa* spp., *Araneus* spp.), and the predatory mite destroyer *Stethorus punctillum*. Predator activity peaked during 29th to 33rd SMW, coinciding with aphid and mite outbreaks, underscoring their role in natural regulation. Bio-efficacy trials revealed that horticultural mineral oil at delayed dormancy effectively suppressed SJS (75%) without affecting natural enemies. Thiacloprid (21.7 SC) consistently outperformed other insecticides, recording >90% suppression of SJS, aphids, and WAA, with comparatively lower impact on predators (30–36% mortality). Organophosphates (Dimethoate, Quinalphos, Chlorpyrifos) achieved 80–88% pest control but caused higher predator mortality (40–45%). Acaricides such as Fenpyroximate, Propargite, and Fenazaquin controlled ERM (73–79%) but moderately reduced *Stethorus* populations. The integration of HMO at dormancy, thiacloprid at critical phenological stages, and selective acaricides constitutes a robust spray schedule that balances pest suppression with conservation of natural enemies, offering a sustainable IPM strategy for high-density apple production.

Keywords: Apple, Bio-efficacy, High-density orchards, Insect pests, Integrated Pest Management (IPM), Natural enemies, Predators, Suppression





Integrated Management of Thrips (*Scirtothrips dorsalis*) in Rose using Chemical and Biological Insecticides

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Roses are susceptible to a wide range of insect pests from the early stages of growth. Among them, thrips (*Scirtothrips dorsalis* Hood) are considered one of the most damaging, causing 28–95% crop losses. Even low infestations can lead to significant economic losses, as their feeding results in petal discoloration, leaf deformation and reduced aesthetic value of the blooms. Thrips are small, fast-reproducing insects that hide in tight spaces, making chemical control difficult. The present investigation explores the use of eco-friendly biopesticides and plant-based extracts. These alternatives are target-specific, biodegradable and leave minimal residues, offering a safer approach to thrips management in rose cultivation. The trials were laid out at College of Agriculture, Nandurbar, Maharashtra, in the summers of 2023, 2024 and 2025 in a RBD using rose variety 'Top Secret'. There were eight treatments including untreated control, each replicated three times. There were 24 plots with had size of 3.6 x 3 m each, row to row and plant to plant distance was maintained at 90 cm by 60 cm, respectively. Standard agronomic practices were followed. Treatments were applied when thrips population reached the ETL of 8-10 thrips per flower, using an electric-operated knapsack sprayer. Observations were recorded one day before sprayings (pre-count) and at 3, 5 and 7 days after spraying. Among the insecticides evaluated against thrips infesting rose, spinosad 45 SC, fipronil 5 SC, imidacloprid 17.8 SL and dimethoate 30 EC were found to be highly effective in reducing thrips population. These treatments were statistically at par and significantly superior to untreated control. The insecticides in the decreasing order of their efficacy were spinosad 45 SC > fipronil 5 SC > imidacloprid 17.8 SL > dimethoate 30 EC > clothianidin 50 WDG > *Beauveria bassiana* > Azadirachtin 1 EC. The findings of present studies indicated that spinosad 45 SC and fipronil 5 SC proved better for the management of thrips.

Keywords: Azadirachtin, *Beauveria bassiana*, Rose, *Scirtothrips dorsalis*, Thrips





Isolation and Molecular Characterization of Entomopathogenic Nematode, *Heterorhabditis* sp. from the Kashmir Valley

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The occurrence of entomopathogenic nematodes (EPNs) in arable soil samples from Kashmir valley was investigated using insect-bait (White's trap) technique. Isolates were tested for infectivity using the larvae of rice moth, *Corcyra cephalonica* and greater wax moth, *Galleria mellonella*. The study revealed a new strain *Heterorhabditis casmirica* SKUAST-K 101 in soil samples that were randomly collected from agri-horticultural areas of Baramulla district of Kashmir valley at two different intervals i.e., June-July and August-September. Surveys were conducted to determine the diversity and frequency of endemic entomopathogenic nematodes and a total 200 soil samples were collected from the twenty locations of Baramulla district viz., Bumai, Nadihal, Wadura, Seelo, Palhalan, Kriri, Watargam, Zalura, Tujar sharif, Magam, Aloosa, Bramri, Bulbul Abad, Dab Bal, Bata Pora, Auwoora, Farkan, Galgal, Gulgam and Dudi. Among these selected sites entomopathogenic nematode (EPN) was recovered from soil sample collected from Seelo village of Baramulla district during the month of August-September and June-July, respectively. EPNs recovered were identified as *Heterorhabditis casmirica* on all the three basis i. Morphological ii. Morphometric and iii. Molecular. The specimen was allotted name as *H. casmirica* SKUAST-K 101.

Keywords: Agri-horticultural areas, Entomopathogenic nematodes (EPNs), Morphological, Morphometric and Molecular, White trap





Nano-Enabled Management Strategies for Varroa Mite and Foulbrood Disease in *Apis mellifera*

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Honey bees (*Apis mellifera*) are key pollinators in agricultural and natural ecosystems but are threatened by pests like Varroa destructor and bacterial infections such as American and European foulbrood caused by *Paenibacillus larvae* and *Melissococcus plutonius* respectively. Conventional chemical and antibiotic treatments have limitations. Therefore, eco-friendly alternatives are urgently required. This study investigates the efficacy of green synthesized copper (Cu), zinc (Zn), and Sulphur (S), nanoparticles against major threats, produced using *Mentha spicata* leaf extract. The nanoparticles were evaluated through in vitro bioassays for their acaricidal and antibacterial properties. In vitro results revealed, Nano-Zn showed the highest efficacy against Varroa mites with the lowest LT₅₀ (6.88 h) and LC₅₀ (23.66%), followed by Nano-Cu (LT₅₀: 16.80 h; LC₅₀: 27.11%) and Nano-S (LT₅₀: 18.32 h; LC₅₀: 41.07%). In vivo, mite mortality was significantly higher in Nano-Zn (20.00 ± 7.29%) and Nano-Cu (18.33 ± 5.29%) compared to control (5.88 ± 2.02%). In vitro efficacy of nanoparticles against foulbrood pathogens, Nano-Zn displayed the largest inhibition zones in nutrient agar plate (42.8 mm for *P. larvae* and 41.6 mm for *M. plutonius*), followed by Nano-Cu (32.8 mm for *P. larvae*, 25.2 mm for *M. plutonius*), whereas Nano-S showed moderate activity (15 mm for *P. larvae*, 16.4 mm for *M. plutonius*) at 100 per cent dose. Plant extract, water, and metal salts had negligible effects. Toxicity bioassays on honeybees indicated that Nano-Cu was most toxic in oral feeding (LT₅₀: 1.56 days, LC₅₀: 29.51%), while Nano-S was least toxic (LT₅₀: 2.90 days, LC₅₀: 57.13%). But contact exposure using spray method, showed negligible effects, with Nano-Zn and Nano-S at 75% being safest. Colony performance showed that Nano-Zn enhanced brood area (1138.88 cm²), honey store area (975.31 cm²), and pollen store area (247.47 cm²), following Nano-S and control, while Nano-Cu reduced colony growth parameters. Overall, the findings demonstrate that biosynthesized nanoparticles, particularly zinc, offer promising eco-friendly alternatives for managing Varroa mites and foulbrood diseases, with minimal toxicity risks at optimized doses.

Keywords: Antibacterial, Apiculture, Foulbrood Disease, Green Synthesis, Honey Bee, Nanoparticles, Varroa Mite.





New Generation Pesticide Formulations Used to Manage Pest Infestation on Apple Fruit in Hilly Areas

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Apple orchards in hilly regions face serious challenges from pests such as codling moth (*Cydia pomonella*), aphids, mites, and leaf rollers. Harsh climatic conditions, variable temperatures, and limited access often increase pest pressure and complicate control methods. Classical chemical insecticides can result in resistance, impact non-target organisms, and pose problems with pesticide residues. Recently, new pesticide formulations and biological control techniques have showed promise in resolving these difficulties sustainably. Field trials conducted in mountain areas have evaluated microbial insecticides which effectively reduced codling moth larvae in apple orchards in Afghanistan. The performance was comparable to that of synthetic insecticides while having a reduced environmental impact. Innovative and systemic insecticides, including chlorantraniliprole, indoxacarb, have been evaluated in temperate orchards, showing effective management of codling moth and leafrollers with acceptable intervals for residue dissipation. Particle-film formulations have also reduced fruit infestation by reducing egg-laying and larval penetration in apple orchards under field conditions. Indigenous entomopathogenic nematodes have been evaluated in Ladakh hilly apple-growing regions to focus on diapausing larvae, achieving significant reductions in overwintering populations. A trial of Integrated Pest Management in Jammu & Kashmir utilized pheromone traps, cultural practices for sanitation, and targeted chemical applications decreased fruit damage caused by codling moth. The main focus is placed on optimizing timing, adapting formulations to micro-climates, integrating non-chemical methods, and ensuring farmer adoption to sustainably manage pest infestation.

Keywords: Climate, Environment Safety, Integrated Pest Management (IPM), Pest Management, Systemic Insecticides





Pest Management on Walnut and their Impact on Commercial Value in India

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Walnut (*Juglans regia L.*) cultivation holds significant economic value in India, particularly in the northern states such as Jammu & Kashmir, Himachal Pradesh, and Uttarakhand. However, the productivity and commercial quality of walnuts are frequently compromised by pest infestations, which include key pests like the codling moth (*Cydia pomonella*), walnut aphid (*Chromaphis juglandicola*), and bark beetles. These pests not only reduce yield but also deteriorate nut quality, leading to decreased marketability and export potential. Ineffective or delayed pest control further amplifies post-harvest losses and reduces the shelf life of the produce. Integrated Pest Management (IPM) strategies have emerged as a sustainable and economically viable solution to tackle pest-related challenges in walnut orchards. Techniques such as pheromone traps, biological control using natural predators, and regulated use of selective insecticides have shown promising results in minimizing pest impact while maintaining ecological balance. Recent studies and field practices suggest that farmers adopting IPM see improved nut quality, higher yields, and better prices in both domestic and international markets. In the Indian context, raising awareness about pest management techniques and providing access to modern tools and training are critical for enhancing walnut production. The adoption of effective pest management directly correlates with increased commercial value through improved grading, better packaging potential, and enhanced export competitiveness. Thus, strategic pest management is essential for the long-term sustainability and profitability of the walnut industry in India.

Keywords: Codling moth, Integrated Pest Management (IPM), Pheromone trap, Predator, Walnut aphid





Role of Extracted Fava Bean (*Vicia faba*) Proteins in Insect Pest Management

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This study investigates the potential of fava bean (*Vicia faba*) protein isolates as a sustainable and non-toxic alternative for insect pest management. Fava beans are known to contain a variety of bioactive compounds, including vicilin and convicilin, which are storage proteins that have demonstrated insecticidal properties in previous in vitro studies. The current research focuses on the efficacy of a crude protein extract from fava beans against two common agricultural pests: the cotton bollworm (*Helicoverpa armigera*) and the green peach aphid (*Myzus persicae*). A solvent extraction method was used to isolate the protein, and its concentration was standardized for application in two forms: a direct foliar spray and a soil drench. In controlled laboratory experiments, both application methods resulted in significant mortality rates and reduced feeding behavior in both insect species compared to control groups treated with water. Specifically, the foliar spray demonstrated a 75 per cent mortality rate for *Helicoverpa armigera* larvae within 48 hours and a 90 per cent reduction in *Myzus persicae* population growth over one week. The soil drench showed a slower but sustained effect, suggesting systemic uptake of the protein by the host plant, rendering it less palatable to the pests. Gas chromatography-mass spectrometry (GC-MS) analysis of the extracted protein confirmed the presence of specific protein fractions hypothesized to be responsible for the insecticidal effect. These findings suggest that fava bean protein has considerable potential as a bio-pesticide, offering a promising, environmentally friendly strategy for integrated pest management and reducing reliance on synthetic chemical insecticides.

Keywords: Fava Bean, GC-MS, *H. armigera*, *M. persicae*, Non- toxic





Role of Essential Oils of Plant Origin in Pest Management

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Essential oils contain a wide range of bioactive constituents that make them effective in pest management. Essential oils include monoterpenes (limonene) act as fumigants, repellents and neurotoxins by disrupting insect neurotransmission. Sesquiterpenes (caryophyllene) act as feeding deterrents and growth regulators, interfering with insect development. Phenolic compounds (eugenol) exhibit strong insecticidal properties by damaging cell membranes and inhibiting acetylcholinesterase, while aldehydes (citral) act as oviposition deterrents and respiratory disruptors. Essential Oils can be applied as pesticides as they are or as their active components “Active ingredient” or as co-adjuvants in pesticide formulations. They play an important role in plant defence system against microorganisms, insects, herbivores and allelopathic interactions. The use of nature-oriented as bio-pesticide (Essential Oils) to control insect are called “Green pesticides” (natural materials that can reduce the pest population and increase food production.) The chemical composition of Essential Oils is lipophilic, which can enter into insect and cause biochemical dysfunction and mortality. Essential oils with insecticidal activities can be inhaled, ingested or skin absorbed by insects. Essential Oils as biopesticides are considered safe, environment-and-eco-friendly, compatible with biological control programs and have low mammal’s toxicity.

Keywords: Biopesticide, Eco-friendly, Essential Oils, Green pesticide, Non-toxic





Integrated Field Evaluation of Novel Insecticidal and Biocontrol Strategies for the Sustainable Management of *Helicoverpa armigera* (Hubner) in Chickpea (*Cicer arietinum* L.)

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The gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), is a major pest of chickpea (*Cicer arietinum* L.), causing substantial yield losses and economic damage in pulse-based agroecosystems. Effective and sustainable management of this pest is critical for improving chickpea productivity while minimizing environmental impacts. The present field investigation, conducted during the rabi season of 2021 at the Central Research Farm of Sam Higginbottom University of Agriculture, Technology and Sciences (Prayagraj, India), aimed to compare the bioefficacy and cost-effectiveness of selected chemical insecticides and biopesticides against *H. armigera*. The trial was laid out in a randomized block design with seven treatments and an untreated control. Larval populations were monitored pre- and post-application (3, 7, and 14 days), and yield data were used to compute the benefit–cost ratio (BCR). Among the tested treatments, Spinosad 45% SC exhibited highest performance, significantly reducing larval density (mean: 1.08 larvae per 5 plants), enhancing yield (23.52 q ha⁻¹), and achieving the highest BCR (1:3.98). Spinetoram 11.7% EC and Chlorantraniliprole 18.5% SC were also highly effective. Conversely, microbial formulations such as *Bacillus thuringiensis*, *Beauveria bassiana*, and *Metarhizium anisopliae* demonstrated moderate efficacy. These findings underscore the potential of integrating highly efficacious insecticides with compatible biocontrol agents within an integrated pest management (IPM) framework to achieve sustainable and economically viable chickpea production systems.

Keywords: *Helicoverpa armigera*, Integrated pest management, Bio-efficacy, Spinosad, Cost-benefit ratio





Metabolic Profiling and Insecticidal Activities of *Rosmarinus officinalis* L. for the Management of Sucking Insect Pests

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Sucking insects are major threat to agricultural/horticultural crops. Indiscriminate application of chemical insecticides for the control of pests leads to resistance, risk to non-target organisms, environmental issues and consumer health issues, etc. Therefore, botanical insecticides are an alternative to synthetics for the control of sucking pests. In the present investigation, chemical constituents, metabolic profile, and insecticidal activities of *Rosmarinus officinalis* L. (Lamiaceae) ethanolic aqueous extract (EAE), fractions, and compounds were screened against *Aphis craccivora* Koch (Hemiptera: Aphididae) and *Planococcus lilacinus* Cockrell (Hemiptera: Pseudococcidae). GC and GC-MS analysis showed that linolenic acid (24.97%), 1,8-cineole (14.26%), myrcene (10.67%), hexadecenoic acid (9.91%), and camphene (7.12%) were the major constituents in the n-hexane fraction. UHPLC-ESI-QTOF-IMS analysis of EAE showed the presence of palmitoleic acid, 4-ethoxy ethyl benzoate and 7-methylrosmanol as major metabolites. Among the extracts and fractions, EAE was found more effective against *A. craccivora* after 96 h, followed by the n-hexane fraction. In *P. lilacinus*, the n-hexane fraction displayed highest toxicity, followed by ethyl acetate and n-butanol fractions. Furthermore, EAE significantly inhibited in vivo enzymes in *A. craccivora* and *P. lilacinus* after 24 and 48 h. SEM study revealed that notable aberrations in the structure of the peritoneum, setae, and thoracic legs of *A. craccivora* after ingestion of EAE. Under greenhouse conditions, a higher dose of *R. officinalis* EAE resulted in a higher reduction of *A. craccivora* on the leaves and twigs of cowpea after 3, 5, and 7 days of the second spray. This validates its potential use in formulating sustainable pest control methods.

Keywords: Compounds, Enzyme inhibition, GC/GC-MS, Rosemary, UHPLC-ESI-QTOF-MS





A Novel Sulfamoyl based Fluoro Substituted Benzamide Heterocycles as Insecticides for the Management of the Notorious Pest *Plutella xylostella* L. (Lepidoptera:Plutellidae)

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The diamondback moth (DBM), *Plutella xylostella* L., is a major insect pest of cruciferous vegetables, causing severe damage to crops such as cabbage, cauliflower, broccoli, and mustard. Yield losses range from 50–80% in the absence of effective management practices. Chemical insecticides remain the primary method of DBM control; however, their excessive and indiscriminate use has led to widespread resistance, rendering many conventional insecticides ineffective. Therefore, the identification of new chemical entities (NCEs) with novel modes of action is crucial for sustainable management of this pest. The present study focused on the synthesis and evaluation of NCEs belonging to the benzoyl sulfonamide group for their insecticidal activity against DBM. A total of eight NCEs were synthesized and tested, among which two compounds, AK-9 and AK-10, exhibited promising insecticidal efficacy. The LC₅₀ values of AK-9 and AK-10 against DBM were 52.75 ppm and 43.65 ppm, respectively. Furthermore, assessment of their impact on the developmental biology of DBM revealed that individuals treated with AK-9 completed their life cycle in 19.63 days, followed closely by AK-10 at 19.7 days, compared to 25.02 days in the untreated control. These findings demonstrate that benzoyl sulfonamide derivatives possess strong insecticidal potential and can be explored further as novel tools for the effective management of *P. xylostella*.

Keywords: Benzoyl Sulphonamide, Insecticides, Management, New Chemical Entities, *Plutella xylostella*





Assessment of Insecticide Susceptibility in the Brown Planthopper, *Nilaparvata lugens* (Stål)

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Brown planthopper (BPH), *Nilaparvata lugens* (Stål) (Hemiptera: Delphacidae), is a destructive pest of rice found in almost all the rice-growing regions across the India. Its destructive feeding habits and ability to transmit the virus causes severe damage and significant yield loss to the crop. Chemical control is a major method for managing the pest in field. Due to the erratic and indiscriminate application of the chemical insecticides over the years has led to the development of resistance in BPH to the different insecticides. Despite of global resistance studies, mechanisms in North Indian populations remain poorly understood. This study established baseline susceptibility profiles for *N. lugens* populations from Haryana, Uttar Pradesh and Delhi against seven insecticides while characterizing resistance determinants. Bioassays studies revealed significant inter-regional variation, with Haryana populations showing highest LC_{50} values against organophosphates and neonicotinoids. Newly introduced mesoionic insecticides (triflumezopyrim and flupyrimin) demonstrated high toxicity across all populations, confirming minimal cross-resistance with conventional chemistries. Biochemical analyses revealed elevated acetylcholinesterase, Glutathione-S-transferases, and cytochrome P450 monooxygenase activities in Haryana populations, correlating with reduced susceptibility. All enzymes showed increased activity with higher concentrations and extended exposure. Gene expression profiling revealed marked upregulation of detoxification genes, especially CYP6ER1 and CYP6AY1, with distinct patterns under different exposures. Results confirm P450's role in resistance development while highlighting mesoionic compounds' resistance-bypassing properties. This research provides the first comprehensive account of *N. lugens* resistance dynamics in northern India, emphasizing urgent need for proactive management and demonstrating mesoionic insecticides' potential as sustainable alternatives for rice protection.

Keywords: Bioassay, Delphacidae, Insecticide resistance, Integrated pest management (IPM), LC_{50}





Bioassay of Fungal Mediated NanoSiO₂ on Red Flour Beetle *Tribolium castaneum* (Coleoptera: Tenebrionidae) Infesting Wheat Flour

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Cereal grains are vital to global food security, accounting for over 60% of caloric intake in developing nations. The stored-grain insect pests, infestation of red flour beetle *Tribolium castaneum* (Herbst), cause substantial pre and post-harvest losses in both quality and quantity, with India alone losing 12–16 million metric tons annually. The persistent reliance on synthetic insecticides has led to significant pesticide resistance in red flour beetle, necessitating sustainable alternatives. In the present study, fungus-mediated silica nanoparticles (nano SiO₂) synthesized from *Fusarium oxysporum*, *F. solani*, and *Humicola grisea* were evaluated for their insecticidal efficacy against larvae, pupae, and adults of *T. castaneum*. Bioassays were conducted using contact and impregnated paper assay methods at four dilutions (1:1, 1:10, 1:50, 1:100), with mortality assessed over 12–72 h intervals. Characterization of nanoparticles confirmed spherical morphology (36 nm average size), crystalline structure, and protein capping, ensuring its stability and bioactivity. The results revealed concentration and time dependent mortality, with *F. oxysporum*-mediated nanoSiO₂, consistently exhibiting the highest efficacy, causing 90% larval and adult mortality within 72 h of exposure period via contact assay method. The contact assay recorded efficient over impregnated paper assays, highlighting the importance of direct nanoparticle insect interaction. Interestingly, higher dilutions demonstrated superior bioefficacy, attributed to enhanced nanoparticle dispersion, stability, and cuticular penetration. The findings foster fungal-mediated silica nanoparticles as eco-friendly, sustainable nanobiopesticides for managing *T. castaneum*, offering an effective alternative to chemical insecticides while reducing risks of resistance in stored grain insect pest

Keywords: Bioassay, *F. oxysporum*, NanoSiO₂, *Tribolium castaneum*, Wheat flour





Bio-Efficacy of Biodynamic Formulations against Diamondback Moth, *Plutella Xylostella* (L.) on Cabbage Under Laboratory Conditions

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Plutella xylostella (L.) commonly known as diamondback moth is a serious pest of cruciferous crops. Laboratory experiment was carried out at Department of Entomology, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Telangana during Rabi, 2020-21 to evaluate the bioefficacy of different biodynamic formulations against third instar larvae of diamondback moth, *P. xylostella* (L.) on cabbage. The experiment was set up in completely randomized block design with three replications. Leaf disc no-choice method was followed to determine the per cent antifeedant activity and larval mortality of biodynamic formulations against third instar larvae of *P. xylostella*. The results revealed highest per cent antifeedant activity and mortality by *Agniastra* @ 5% (19.88 and 30.00%, respectively) followed by *Brahmastra* @ 5% (17.30 and 23.66%, respectively) and *Neemastra* @ 5% (14.51 and 23.33%, respectively). Whereas, the lowest per cent antifeedant activity and mortality was recorded in waste decomposer (4.88 and 2.66%, respectively) and was at on par with untreated control 4.71 and 2.22 per cent, respectively.

Keywords: Antifeedant activity, Biodynamic formulations, Cabbage, Leaf disc method, *Plutella xylostella*





Bio-efficacy of Potassium Salt Active Phosphorus (PSAP) for Sustainable Management of Insect Pests in Soybean

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Soybean is a key oilseed crop, and Madhya Pradesh is India's leading soybean-producing state. However, insect pests including the girdle beetle (*Obereopsis brevis*), tobacco caterpillar (*Spodoptera litura*), stem fly (*Melanagromyza sojae*), whitefly (*Bemisia tabaci*), aphids (*Aphis glycines*), and jassids (*Empoasca kerri*) cause significant yield losses by damaging leaves, stems, and pods. Eco-friendly and compatible management options are required to minimize pest damage while sustaining crop productivity. A field experiment was conducted at the Research Farm of JNKVV, College of Agriculture, Ganjbasoda, during the kharif season to evaluate the efficacy of Potassium Salt Active Phosphorus (PSAP) against soybean insect pests. The variety JS-2063 was sown in a randomized block design with seven treatments and three replications. PSAP was applied as a foliar spray @ 2.5 kg/ha at scheduled intervals in combination with recommended agronomic practices. Results revealed that treatment T₂ (recommended dose of NPK + recommended plant protection measures + foliar spray of PSAP @ 4 g/L) was the most effective. This treatment recorded the highest yield (19.25 q/ha) and significantly reduced infestations of *Chrysodeixis acuta*, *S. litura*, and *B. tabaci*. Notably, PSAP application did not negatively affect populations of natural enemies such as ladybird beetles, highlighting its suitability for integrated pest management (IPM). It may be concluded that Foliar application of PSAP, integrated with recommended nutrient and protection practices, enhances soybean yield while effectively managing key insect pests in an eco-friendly and sustainable manner.

Keywords: Insect pests, IPM, PSAP, Soybean, Yield





Cellular Immune Responses of Fall Armyworm, *Spodoptera frugiperda* Against Entomopathogens and Insecticides: Insights for Advancing Biopesticide-Based Green Pest Management Strategies

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Fall armyworm, *Spodoptera frugiperda* a major invasive pest of maize, poses significant challenges to crop production in India. During 2023, larvae were collected from maize fields in Rajendranagar, Telangana, and reared on an artificial diet until the F₁ generation. Third-instar larvae of the F₁ generation were used in bioassays to evaluate the efficacy of insecticides, entomopathogenic fungi, and their sequential applications. Insecticide susceptibility was assessed using the topical application method. Among the tested insecticides, emamectin benzoate was the most toxic (LC₅₀: 0.99–1.02 ppm), while spinetoram was comparatively less toxic (LC₅₀: 1.14–1.21 ppm). Virulence bioassays with *Beauveria bassiana* and *Metarhizium rileyi* demonstrated effective pathogenicity against *S. frugiperda*. Sequential applications, particularly spinetoram followed by *M. rileyi*, exhibited an additive effect, achieving mortality rates up to 92%. Complementary immune response assays revealed an initial elevation in total haemocyte counts (THCs), including prohaemocytes, granulocytes, and plasmatocytes, as well as enhanced cellular responses such as encapsulation, nodulation, and phagocytosis. This activation was followed by a decline, suggesting immune suppression at later intervals. Fungal treatments (*M. rileyi* and *B. bassiana*) significantly enhanced THCs, whereas insecticide treatments (emamectin benzoate and spinetoram) induced moderate immunosuppression. Notably, sequential applications (spinetoram + *B. bassiana*; spinetoram + *M. rileyi*) further weakened immune defenses, at 24 hours, thereby increasing larval susceptibility to fungal infections. These findings highlight the potential of integrating entomopathogenic fungi with insecticides to exploit immunosuppression in *S. frugiperda*, offering a promising eco-friendly approach for its sustainable management.

Keywords: insecticides, entomopathogenic fungi, bioassay, cellular immune response, haemocytes





Characterization of the Entomopathogenic Fungus *Akanthomyces muscarius* and its Virulence against *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) Larvae

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The tomato leaf miner, *Tuta absoluta*, a serious invasive pest of solanaceous plant species, mainly *Solanum lycopersicum*, invaded India in 2014. For better pest management strategies, entomopathogenic fungi play a significant role in suppressing the pest population and are an alternative to chemical insecticides. In the present study, an indigenous entomopathogenic fungus, *Akanthomyces muscarius* (Petch.), was isolated and identified based on morphological and molecular characters. The molecular studies included the amplification of two nuclear-ITS and LSU regions. A phylogram was constructed by combining ITS/LSU with MEGA 7, which contains 19 nucleotide sequences, respectively. Our isolate FC20 clustered with *A. muscarius* in the ITS/LSU combined phylogenetic tree with 99% bootstrap values. The isolated *A. muscarius* was tested for pathogenicity against *T. absoluta* at a conidial concentration- 1×10^8 spores/ml. At this concentration, 50% mortality was observed in the 4th instar larval stage of *T. absoluta*. The present data show that the indigenous strain *A. muscarius* is virulent against larval instar, but there is potential to improve the virulence of *A. muscarius*, which can be a potential candidate to control the Tomato leaf-miner

Keywords: Biocontrol agent, Entomopathogenic fungi, Pest, Phylogenetic, *Tuta absoluta*.



Comparative Assessment of UAV and Traditional Spraying Methods for Controlling Major Rice Insect Pests

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The present investigation assessed the relative performance of Unmanned Aerial Vehicle (UAV)-mediated insecticide delivery in comparison with conventional knapsack spraying for managing key rice pests like yellow stem borer (YSB), rice leaf folder (RLF), and brown planthopper (BPH). The field trials were carried out at the ICAR-Indian Agricultural Research Institute (IARI), New Delhi, using the variety Pusa Basmati 1885. Two sequential spray schedules were implemented: isocycloseram 18.1 SC and chlorantraniliprole 18.5 SC at the vegetative stage (60 days after transplanting, DAT), followed by triflumezopyrim 10 SC and pymetrozine 50 WG at 85 DAT, aimed at suppressing Lepidopteran and Hemipteran pests, respectively. UAV applications were conducted at two operational heights (2.0 m and 2.5 m). Results revealed that UAV spraying significantly curtailed YSB incidence, with isocycloseram applied at 2.0 m height recording the lowest dead heart percentage (2.20%) at 14 days after spraying (DAS). Similarly, RLF damage was least (0.55%) under UAV spraying of isocycloseram at 2.0 m. For BPH, triflumezopyrim applied through UAV at 2.5 m height produced the greatest reduction in population density (1.50 insects per hill). Moreover, both UAV and knapsack treatments exerted negligible adverse effects on natural enemies, including spiders and rove beetles. Overall, the findings highlight UAV-based spraying as a more effective, sustainable, and environmentally compatible alternative to conventional knapsack application, ensuring superior pest suppression through optimized droplet distribution and better canopy penetration.

Keywords: Brown planthopper, Leaf folder, Rice pests, UAV spraying, Yellow stem borer





Eco-friendly Formulations against Pod Bug (*Clavigralla gibbosa*) in Kharif Mungbean

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Mungbean (*Vigna radiata* L.) plays a vital role in providing dietary protein, particularly for resource-poor communities. With increasing emphasis on sustainable pest management, the efficacy of botanicals and eco-friendly formulations against *C. gibbosa* in mungbean variety ML 1808 during kharif 2022 and 2023 at the Entomological Research Farm, PAU, Ludhiana were investigated. The crop was grown following recommended practices in randomized block design with three replications, and treatments included PAU homemade neem and dharek extracts, neem oil, castor oil, sesame oil, linseed oil, 5% NSKE, and detergent powder, with Actara 25 WG (Thiamethoxam 40 g/acre) as chemical standard and untreated plots as control. Foliar sprays were applied twice at flowering and pod-filling stages, and pod bug populations were monitored up to 10 days after each spray. From the results, Actara 25 WG consistently recorded the lowest *C. gibbosa* population, verifying its superior efficacy. However, PAU homemade neem extract (2000 ml/acre) and homemade dharek extract (2000 ml/acre) performed significantly better than other botanicals and were at par with Actara at certain intervals, indicating potential as eco-friendly alternatives. In contrast sesame, linseed oils and detergent powder showed minimal effectiveness against pod bugs. No visual phytotoxicity was observed in any treatment. It is concluded that although Actara 25 WG remains the most effective option, PAU homemade neem and dharek extracts may be integrated into mungbean pest management strategies as sustainable and safer alternatives for reducing *C. gibbosa* infestation.

Keywords: Botanicals, *C. gibbosa*, Mungbean, Neem, Phytotoxicity



Eco-friendly Management of Fall Armyworm (*Spodoptera frugiperda*) Using Biopesticides in the Jammu Region

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The fall armyworm (*Spodoptera frugiperda*), an invasive pest of maize and other cereals, has emerged as a major agricultural threat in the Jammu region. Its polyphagous nature, rapid dispersal, and resistance to synthetic insecticides have created an urgent need for alternative, eco-friendly control strategies. Biopesticides, derived from natural organisms and their metabolites, offer a sustainable approach for long-term management. In Jammu, promising candidates include *Bacillus thuringiensis* (Bt), entomopathogenic fungi such as *Beauveria bassiana* and *Metarhizium anisopliae*, nucleopolyhedrovirus (NPV), and neem-based formulations. These agents exert control by targeting larval mortality, inhibiting growth, and reducing reproduction, while leaving minimal environmental residues. Field trials and farmer participatory studies in maize-growing belts of Jammu have demonstrated that biopesticides not only suppress larval populations effectively but also conserve natural enemies, thereby enhancing biological control. Integration of biopesticides with cultural practices such as timely sowing, crop rotation, and destruction of crop residues further strengthens pest management outcomes. Compared to conventional insecticides, biopesticides ensure food safety, reduce ecological risks, and promote sustainable agricultural practices. Nevertheless, challenges such as limited farmer awareness, availability, and need for proper application techniques restrict their widespread adoption. Strengthening extension services, conducting field demonstrations, and improving accessibility can accelerate their acceptance among farmers. Overall, biopesticides provide an effective, eco-friendly, and economically viable strategy for managing fall armyworm in the Jammu region, ensuring both crop protection and environmental sustainability.

Keywords: Biopesticides, Fall armyworm, Integrated Pest Management, Jammu region, Sustainable management





Eco-Friendly Pest Management: Innovations in UAV-Based *Trichogramma* Delivery

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The human population is continuously rising and is projected to reach 9.5 billion by 2025 to meet the growing demand for food, agricultural production must be strengthened. Traditionally, this has relied heavily on chemical pesticides to control a wide range of pests, including insects. However, there is an urgent need to develop safer and more sustainable alternatives, such as biological control. Egg parasitoids belonging to the family *Trichogrammatidae* are considered excellent candidates for the biological control of lepidopteran pests and even some other insect orders. Female *Trichogramma* spp. lay their eggs inside the host eggs, parasitizing them. These egg parasitoids can be mass-produced relatively easily, but the major challenge lies in their effective release into the field. Conventionally, parasitized eggs are introduced using Trichocards or by planes. In recent years, UAV have transformed agriculture by enabling precise crop monitoring and targeted application of fertilizers/pesticides. Despite these advantages, drone-based technology for releasing *Trichogramma* is still evolving, with challenges related to accuracy, reliability, and evaluation methods. Direct release of eggs by drones often reduces survival due to lack of protection, while capsule-based systems improve delivery but remain expensive. The recent innovation of *Trichogramma* balls provides a promising solution. These biodegradable balls protect the eggs from sunlight, rain, predators, and mechanical damage while allowing airflow for oxygen supply, ensuring higher survival and effectiveness. They also leave no pollution and enable more precise field coverage. This paper highlights the potential of UAV-assisted *Trichogramma* balls as an eco-friendly, efficient, and sustainable approach to pest control.

Keywords: Egg parasitoids, Pest management, Smart agriculture, *Trichogramma* spp., UAV





Effectiveness of BAT and MAT Based Modules against *Zeugodacus cucurbitae* (Coquillett) in Bitter gourd

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A field study was conducted to evaluate the effectiveness of BAT (Bait Application Technique) and MAT (Male Annihilation Technique) based modules to manage the fruit fly, *Zeugodacus cucurbitae* (Coquillett) in bitter guard at Banda University of Agriculture & Technology, Banda and at farmers' fields in Kharif 2023 and 2024. The result indicated that the application of BAT-1 (spray liquid mixture of jaggery @ 10% + malathion @ 1 ml/l) + MAT 1 (bottle trap @ 25/ha – 50×50×12 mm³ plywood block soaked in ethyl alcohol: cue lure: malathion in the ratio of 6:4:1 for 48 hrs) combination before flowering stage performed better than BAT-1 + repellent (neem oil @ 10000ppm), BAT-2 (spray jaggery @ 10% + spinosad 45 SC @ 0.2 ml/l) + repellent, MAT-1 + repellent, MAT- 2 (bottle trap @ 25/ha – 50×50 ×12 mm³ plywood block soaked in ethyl alcohol : cue lure : spinosad 45 SC in the ratio of 6:4:1 for 48 hrs), BAT-2 +MAT 2 as compared to farmers practices and control. The maximum activity of fruit flies recorded from September to November 2023, maximum catches (14.00/ trap) were recorded in 4th week of September, whereas in 2024 it was maximum (87/ trap) in 3rd week of October in BAT1 + MAT1, which yielded 89.09 & 91.37% healthy fruits as compared 86.06 & 86.07% in farmers practices and 60.53 & 71.84% in control, respectively, during 2023 & 2024. The maximum cost: benefit ratio (1:8.79) was also obtained from BAT1 + MAT1 followed by MAT1 (1:8.09). In addition to the major fruit fly, *Zeugodacus cucurbitae*; two other important fruit flies have been recorded from Bundelkhand region i.e., *Z. diversus* and *Bactrocera divideri*.

Keywords: *Zeugodacus cucurbitae* 1, BAT 2 , MAT3, Bitter Guard4



Efficacy of Biopesticides against *Helicoverpa armigera* in Pigeon Pea (*Cajanus cajan*) Under North Kashmir Conditions

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The field experiment on pigeon pea (*Cajanus cajan*), entitled “Efficacy of different biopesticides against *Helicoverpa armigera*,” was conducted at the Faculty of Agriculture, Wadura, Sopore, during *Kharif* 2024. The experiment was laid out in a Randomized Block Design (RBD) comprising nine treatments, including an untreated control, with three replications. The study was conducted to evaluate the efficacy of selected biopesticides against *H. armigera* under North Kashmir conditions, with Thiocloprid 21.7 EC included as a chemical check. The treatments consisted of Neem Seed Kernel Extract (NSKE 5%), Neem oil (1%), Pyrethrum (1%), Spinosad 45 SC, Abamectin 1.9 EC, green leaf extracts (GLE) of *Artemisia* (5%) and *Anthomas* (5%), Thiocloprid 21.7 EC, and an untreated control. Analysis of cumulative percent reduction over control revealed that Spinosad (76.03%) was the most effective treatment, followed by Abamectin (61.67%), Thiocloprid (55.46%), Pyrethrum (46.23%), Neem oil (37.16%), NSKE (31.88%), GLE *Artemisia* (28.55%), and GLE *Anthomas* (20.02%). It was concluded that Spinosad and Abamectin were the most effective biopesticides, showing efficacy comparable to the chemical check. Hence, these biopesticides can be recommended as eco-friendly and sustainable alternatives for the management of *H. armigera* in pigeon pea under North Kashmir conditions.

Keywords: Abamectin, Biopesticides, *Helicoverpa armigera*, Pigeon pea, Spinosad





Efficacy of Botanicals against Epilachna Beetle (*Henosepilachna vigintioctopunctata*) and Blister Beetle (*Mylabris pustulata*) on Cowpea [*Vigna unguiculata* (L.) Walp.]

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A field experiment was carried out at the Agriculture Research Farm of Baba Raghav Das Post Graduate College Deoria (Uttar Pradesh) India during *Kharif* season 2024 to evaluate the efficacy of botanicals against *Epilachna* beetle and blister beetle on cowpea. Results revealed a significant variation among different botanicals. The Neem oil was observed most effective treatment against *Epilachna* and Blister beetle (4.18 and 2.22 beetle/plant, respectively), followed by Azadiractin 0.15% w/w (7.02 *Epilachna* and 3.70 blister beetle/plant). Other treatment viz., NSKE 5% recorded 6.36 *epilachna* beetle and 3.91 blister beetle/plant where as clove oil treated plots harvoured 8.29 *Epilachna* beetle and 4.18 blister beetle/plant, considered moderately effective treatments. The least effective treatment was karanj oil (2ml/l) with 10.44 *epilachna* beetle/plant and 5.40 blister beetle/plant, but was found significantly superior over untreated control (13.88 *epilachna* beetle and 8.41 blister beetle/plant). It has been concluded that neem oil and azadiractin 0.15% w/w are highly effective eco-friendly alternatives for sustainable management of *epilachna* beetle and blister beetle on cowpea crop.

Keywords: Blister beetle, Botanicals, Cowpea, *Epilachna* beetle, *Kharif* season



Entomopathogenic Potential of Soil-Isolated *Metarhizium anisopliae* (Metschnikoff) Sorokin against Ash Weevil (*Myllocerus subfasciatus*)

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The ash weevil *Myllocerus subfasciatus* Guérin-Méneville (Curculionidae; Coleoptera) poses a significant threat to various crops, particularly in tropical and subtropical regions. The adults are foliage feeders while grubs feed on the roots making them difficult to manage. In search of sustainable and eco-friendly management options, the present study focused on the isolation and characterization of the entomopathogenic fungus *Metarhizium anisopliae* (Metschnikoff) Sorokin from rhizospheric soil and evaluated its pathogenic potential against *M. subfasciatus*. Soil samples were collected from different districts of Tamil Nadu, Kerala and Karnataka. The fungal isolates were obtained using the insect bait method with *Galleria mellonella* (Linnaeus) (Pyralidae; Lepidoptera) larvae. The findings of isolates through morphological identification confirmed *Metarhizium* spp. the colony was white in colour on vegetative phase and dark green on reproductive phase. Molecular identification was performed using ITS-rDNA sequencing, and BLAST analysis confirmed the identity as *M. anisopliae*. The isolates were submitted in NCBI database and got the accession numbers. Bioassays conducted under laboratory conditions demonstrated significant pathogenicity of the isolate against second instar ash weevil grubs, with mortality rates exceeding 70% within 4–7 days post-inoculation. The sporulation and virulence were studied through SEM and ultramicroscopic studies. TNAU ENTMA TDM 8 demonstrated superior efficacy with lowest LC₅₀ of 2.13x10⁵ conidia/ml respectively in the second instar grub of *M. subfasciatus*. The lethal time (LT₅₀) values were 4.95 days to assess virulence. The findings suggest that among the isolates the *M. anisopliae* TNAU ENTMA TDM 8 possesses promising biocontrol potential and could serve as an effective component in integrated pest management (IPM) strategies for ash weevil control. Under field validation next to chemicals it worked well the commercial *Metarhizium* strains available in markets. Further formulation development is recommended to facilitate its practical application.

Keywords: Ash weevil, Histopathology, *M. anisopliae*, SEM, TNAU ENTMA TDM 8





Seasonal Incidence of Rose Aphid, *Macrosiphum Rosae* on Rose and its Management under Protected Condition in Kashmir

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The current study carried out during the year 2022 in Floriculture experimental field of Sher-e- Kashmir University of Agricultural Sciences and Technology- Kashmir to observe the seasonal incidence of aphids and evaluate different insecticides against aphids on rose. It was evident that the initial incidence of aphid population started from March- 12th SMW while the population of aphid build-up was observed from second week of April (14th SMW) reaching the peak in June- July (26th and 27th SMW). A positive correlation was reported between aphid population and minimum and maximum temperature. This might be caused by insects' accelerated metabolism in response to a rise in temperature, which would have a direct effect on their activity. A negative correlation was observed between aphid population and relative humidity (minimum and maximum). T₇ (Thiamethoxam 25% WDG @0.3 g/L) was found as the most effective treatment for suppressing the aphid populations followed by T₆ (Acetamiprid 20% SP @ 0.2g/L) and T₅ (Thiacloprid 21.7 % SC @ 0.5 ml/L).

Keywords: Aphids, Incidence, Protected condition, Rose





Evaluate the Efficacy of Insecticides against Brown Plant Hopper

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A field experiment was conducted to determine the efficacy of insecticides against Brown plant hopper (BPH), *Nilaparvata lugens* (Stål), in rice during *kharif* 2022 and *kharif* 2023. at Agricultural Research Station Shirgaon, District Ratnagiri, under Doctor Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Evaluation of different insecticides against Brown plant hopper on rice indicated that all the treatments were found significantly superior in recording the minimum number of BPH over the untreated control. Among all treatments, T₃ (Triflumezopyrim 10 SC), was found most effective against Brown planthopper, which was found statistically at par with T₈ (Fipronil 15 + Flonicamid 15 WDG), followed by T₄ (Dinotefuran 20 SG), T₆ (Buprofezin 22 + Fipronil 3 SC), T₇ (Pymetrozine 50 WG), T₁ (Sulfoxaflor 21.8 SC), T₂ (Imidacloprid 6 + Lambda cyhalothrin 4 SL) and T₅ (Flonicamid 50 WG). Economics of all the treatments revealed that T₆- Buprofezin 22 + Fipronil 3 SC @ 1ml /lit emerged as the most economical one, recording the highest ICBR 1:14.14 It was followed by, T₄- Dinotefuran 20 SG @ 0.3 gm/lit and T₂- Imidacloprid 6 + Lambda cyhalothrin 4 SL @ 0.6 ml /lit recording ICBR of 1:9.68 and 1:8.24, respectively.

Keywords: Brown plant hopper, Cost-benefit-ratio, Insecticides, Kharif, Rice





Evaluation of Entomopathogenic Fungi against *Holotrichia longipennis* (Blanchard) in Organic Amended Soils

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In India, white grubs have been included in the category of national pests and are reported to cause damage to a wide variety of cultivated crops. In view of this, bioassay studies were done to evaluate the potential of *Beauveria bassiana* and *Metarhizium anisopliae* against white grubs, and to study the effect of organic amendments on infectivity of *B. bassiana* and *M. anisopliae* against first, second and third instar grubs of *H. longipennis*. The first instar larvae of *H. longipennis* were found to be most susceptible to both entomopathogenic fungi, with the mean mortality rate of 61.56 and 63.90 per cent for *B. bassiana* and *M. anisopliae* respectively. Regardless of concentrations or instars, soil consistently performed better as a substrate than sand in terms of mortality rates. The best performing substrates for the entomopathogenic activity of *B. bassiana* were soil + FYM (7:3) and soil + vermicompost (7:3), causing 57.65 and 57.33 per cent mean mortality, respectively for first instar. Upon treatment with *M. anisopliae*, highest mean mortality of 60.92 per cent was observed for soil + FYM (7:3). When ratio of soil to organic amendments shifted from 9:1 to 7:3, the mean corrected mortality consistently increased. In case of soil + FYM, the mortality was found to be 49.33 per cent for *B. bassiana* and 55.93 per cent for *M. anisopliae* at the ratio of 9:1 and it increased (57.65% for *B. bassiana* and 60.92% for *M. anisopliae*) at the ratio of 7:3 against first instar.

Keywords: Bioassay, Entomopathogenic, Instars, Organic amendments, White grubs





Exploring wild Pigeonpea Germplasms for their Stable Resistance to Multiple Destructive Bruchid Species in India

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Bruchids are major post-harvest pests of pigeonpea, causing extensive losses during storage. This study evaluated 68 wild pigeonpea accessions from *Cajanus* and *Rhynchosia* for resistance against three predominant Indian bruchid species (*C. analis*, *C. chinensis*, and *C. maculatus*) using a high-throughput screening pipeline over four years. Screening conditions included free-choice, no-choice and confirmatory no-choice followed by biochemical characterization for over over four years. The resistance classified based on seed damage and susceptibility index. Four *Rhynchosia bracteata* accessions showed complete and consistent resistance, preventing bruchid development entirely. Additionally, several *Cajanus scarabaeoides* lines demonstrated resistance to *C. maculatus* and *C. chinensis*, but moderate against *C. analis*. Multivariate (MANOVA) and univariate (ANOVA) analyses revealed significant variation in seed and infestation traits within/between-species and experimental conditions; with seed damage, adult emergence, and development period emerging as primary resistance indicators. Antibiosis was the dominant resistance mechanism, while antixenosis was observed mainly in *C. maculatus* and linked to seed morphology traits like weight and size. Machine learning (Random Forest) consistently identified seed phenolics, tannins, and insect developmental traits as strong predictors of resistance. FAMD and hierarchical clustering clearly distinguished resistant and susceptible accessions, enhanced by biochemical trait patterns. Exploratory analyses also uncovered a female-biased sex ratio (<0.5) in bruchid emergence across resistant accessions, pointing to host-influenced constraints on reproduction. These findings identify *R. bracteata* as a promising multi-species resistance source and *C. scarabaeoides* as a valuable species-specific donor, offering critical genetic material for breeding bruchid-resistant pigeonpea and for dissecting resistance-associated biochemical and genetic pathways.

Keywords: *Cajanus*, *Callosobruchus*, Pigeonpea, Resistance, Wild germplasms





Field Evaluation of Ecofriendly Insecticides against Major Insect pests of Rice in Rainy Season

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A field evaluation was undertaken on the efficacy of some novel insecticides against major insect pests of rice under Eastern Uttar Pradesh conditions in rainy season (Kharif) at farmer's field of Deoria (U.P.), India during the years 2020 and 2021 in randomized block design. A total of nine insecticidal treatments excluding untreated check were evaluated and were applied twice at 30 DAT and 60 DAT (Days after transplanting) between transplanting stage to flowering stage on local rice cultivar Samba Mahsuri. Among the insecticides evaluated cartap hydrochloride (50 SP) treated plots recorded significantly lower population of insect pests (GLH, leaf folder, stem borer and earhead bug) with abundant natural enemies and highest yield (35 q/ha) whereas chlorpyrifos (20 EC) was worst against natural enemies but produce yield (31.72 q/ha) next to cartap hydrochloride. A non-significant difference in efficacy of insecticides viz, imidacloprid, thiamethoxam, indoxacarb, chlorantraniliprole and fipronil was observed against insect pests. Although the performance of *Bt* formulation and NPV were found significant in pest population reduction over untreated plots at all the intervals of observation. The best treatment was recorded as *Bt* var. *kurstaki* 3.5% @ 2 ml/lit and Neem oil @ 2ml/lit proved significant result regarding ecofriendly approach of pest management, registered spider population 4.5/Sweep compared to chemical insecticides (1.5 – 3.5/Sweep). The incidence of dead-heart and white ear incidence (4.09 %) was recorded minimum in cartap hydrochloride treated plots compared to other treatments (upto 6.38 %).

Keywords: Eastern Uttar Pradesh, Ecofriendly Insecticides, Evaluation, Major Insect Pests, India.



Green synthesized silver nanoparticles as an ecofriendly tool for the management of diamondback moth (*Plutella xylostella* Linn.)

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The diamondback moth (*Plutella xylostella* L.), a major pest of cruciferous crops, rapidly develops resistance to various insecticides. This study explores the synthesis of silver nanoparticles (AgNPs) using aqueous extracts of Melia and Neem seeds as reducing agents. Characterization showed surface plasmon resonance peaks at 420–440 nm for Melia and 430–450 nm for Neem, with zeta potentials of –31.2 mV and –31.1 mV, respectively, indicating nanoparticle stability. Dynamic light scattering (DLS) revealed sizes of 40–90 nm for Melia and 50–150 nm for Neem, while field emission scanning electron microscopy (FESEM) confirmed spherical morphology. Energy dispersive X-ray (EDX) spectra verified elemental silver. Bioassays on 2nd instar larvae of *P. xylostella* showed 100% mortality with Melia-mediated AgNPs at 300 ppm, compared to 93.33 per cent with Neem AgNPs. Melia AgNPs also inhibited adult emergence by 93.10 per cent, versus 79.31 per cent with Neem at 200 ppm. Both treatments delayed larval development, with LC₅₀ values of 11.506 ppm for Melia and 30.823 ppm for Neem. AgNPs were more effective than crude plant extracts or controls in suppressing feeding behavior. These findings suggest that Melia-mediated AgNPs offer superior stability and insecticidal efficacy, highlighting the potential of plant-mediated nanotechnology for eco-friendly, sustainable pest management.

Keywords: Biopesticides, Diamondback moth, Green synthesis, Neem, Nanotechnology, Silver nanoparticles





Studies on Bio-efficacy of Various Insecticides against Jassid (*Empoasca kerri*) and Spotted pod borer (*Maruca vitrata*) on Cowpea [*Vigna unguiculata* (L.) Walp.]

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A field experiment was conducted during *Kharif* season 2024 in Randomized Block Design with three replications at the Agricultural Research Farm of Baba Raghav Das Post Graduate College, Deoria, Uttar Pradesh, India. The efficacy of various insecticides *viz.* Spinetoram 11.7 SC, Emamectin benzoate 1.9 EC, Flubendiamide 39.35 SC, Imidacloprid 17.8 SL, Fipronil 2.92 EC, were evaluated against Jassid (*Empoasca kerri*) on cowpea. The results on overall performance of insecticides revealed that Imidacloprid 17.8 SL @ 0.5 ml/l was the most effective treatment with minimum population (1.72 jassid/3leaves), followed by Spinetoram 11.7 SC @ 0.25 ml/l (3.06/3leaves), Fipronil 2.92 EC @ 2 ml/l (3.32/3leaves) and Flubendiamide 39.35 SC @ 0.1 ml/l (3.72/3leaves). The treatment Emamectin benzoate 1.9 EC @ 1 ml/l (5.26/3leaves) was found least effective treatment but was significantly superior over untreated check (8.42/3leaves). In term of yield and C:B ratio, Emamectin benzoate recorded the highest pod yield (22 q/ha) with C:B ratio of 1:5.52 owing to its effectiveness against spotted pod borer, followed by Flubendiamide (20 q/ha) C:B ratio 1:1.86, Fipronil (18.5 q/ha) C:B ratio 1:3.92, Spinetoram (18 q/ha) C:B ratio 1:4.68, Imidacloprid (17.25 q/ha) C:B ratio 1:1.99, whereas untreated plot recorded the lowest pod yield (11.83 q/ha). Thus, Imidacloprid proved to be the best treatment against jassid infestation, whereas maximum yield was obtained in Emamectin benzoate owing to its superior effectiveness against spotted pod borer, which is major pod damaging pest of cowpea.

Keywords: Cowpea, Bio-efficacy, *Empoasca kerri*, *Maruca vitrata* and Insecticides.



Theme V

**Commercial Entomology – Insects
as Food and Feed, Pollination
Ecology and Food Production, Silk
and Lac Producing Insects.**





Status of Apiculture in India, Recent Threats and Conservation of Pollinators

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India with diverse climate and flora offers congenial habitat for the diverse groups of pollinators to thrive and perform well. Hon'ble Prime Minister's initiatives led to the establishment of National Beekeeping and Honey Mission (NBHM) in the year 2020 and which diverted lots of attention towards the well-being of pollinators and its conservation in addition to development of beekeeping sector in the Country. The rapid expansion of migratory bee keeping with *Apis mellifera* and rejuvenation of *A. cerana* beekeeping has resulted in rapid increase in the honey production in the last two decades. India is the second largest producer of honey after China with the total production of 133,000 MT and it is the fourth largest exporter after China, New Zealand and Argentina with an impressive annual growth rate of 76.8 per cent (NBB, 2023 and APEDA, 2023). The honey market in India was valued at ₹23.3 billion in 2022 and is expected to grow at a CAGR of 8.4 per cent to ₹38.8 bn by 2028. Consumption in India, however, had been dismally low a with per capita annual consumption of 37.1 g as compared to the largest honey consumers in terms of total volume like China, USA, Turkey, Iran, Germany, Russia, UK, Japan, France, Spain, Poland, Canada and Italy. The Small Hive Beetle (SHB), *Aethina tumida* is an invasive pest and scavenger that inflicts significant damage on *Apis mellifera* L. colonies globally beyond its native range. In September 2022, this pest was detected for the first time in *A. mellifera* in India from North 24 Parganas, Bengal, India. Subsequently, it has spread to the many parts of the country. In Andhra Pradesh alone, the severe outbreak of Small Hive beetle led to the loss of 12,000 colonies with a monetary loss of Rs.13.2 crores to beekeepers in Andhra Pradesh and Telangana. Infestation of SHB is also observed in *A. cerana* and *A. dorsata* colonies in areas with high incidence causing frequent absconding. The multipronged pollinator protection strategies can be adopted for the conservation of the insect pollinators like nationwide monitoring plan for the pollinators, resilient agro-ecosystems for the pollinator conservation and management, adoption of emerging technologies for the monitoring and management of the bee pollinators, assessing the impact of climate change and air pollution and development of the Integrated Pest and Pollinator Management (IPPM) practices. Many of AICRP Honey Bees and Pollinator centers are working on the conservation of native pollinators through designing new suitable





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Theme-V

Commercial Entomology – Insects as Food and Feed,
Pollination Ecology and Food Production, Silk and Lac Producing Insects.

hives and nesting structures, advocating suitable flora and advising migratory beekeepers through construction of floral calendars, replacing synthetic chemical with bio-pesticides/botanicals for the management of bee pests etc.



Lead Presentation



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In collaboration with

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Bridging the Pollination Gap: Enhancing Apple Productivity through Pollinator Management in Kashmir Himalaya

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Pollination plays a pivotal role in sustaining horticultural productivity and quality, especially in apple, the dominant fruit crop of the Kashmir Himalaya. Despite being the apple bowl of India, accounting for nearly 75% of national production, inadequate pollination remains a major constraint, leading to significant yield and quality losses. Globally, pollinators contribute to more than 80% of crop pollination, with honey bees alone responsible for 65–70% of insect-mediated services. In Kashmir, however, the existing 1.50 Lakh managed bee colonies fall grossly short of the estimated 4.0 Lakh colonies required for effective pollination across the valley's 1.72 lakh hectares of apple orchards. Paray *et al.*, 2016 has documented 44 insect pollinator species across 25 genera and 11 families, identifying key species such as *Apis cerana*, *Apis mellifera*, *Lasioglossum marginatum*, *Xylocopa* spp., and *Eristalis tenax*. Pollination deficit surveys indicate that 7.68 % apple trees do not experience pollination deficit; 14% apple trees experience 20 % pollination deficit and 78% of apple trees experience 40–80% pollination deficit. Factors such as habitat loss, pesticide misuse, pollinizer scarcity, and climate change further exacerbate the challenge. Technological innovations, including managed nesting sites for creating wooden structures, reeds for enhancing the populations of wood dwelling native insect pollinators and soil mounds around the borders of apple orchards for soil dwelling pollinators, development of floral calendars, and farmer-led pollination service enterprises, have shown promising outcomes. Strategic goals now focus on reversing declining productivity, enhancing pollination services, and improving farmer incomes through conservation, augmentation, and commercialization of pollinators and pollinizers. This research underscores that strengthening pollination management is not only crucial for quality apple production and productivity but also for biodiversity conservation and ecosystem sustainability in the Kashmir Himalaya.





Zero-waste Bioeconomy through Commercial Insect Integration: The Future of Lac-Centered Secondary Agriculture

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Lac, a resinous secretion from the lac insect (*Kerria lacca*), is a versatile bioproduct with diverse applications in the food, pharmaceutical, and cosmetics industries. As a major export commodity, it significantly contributes to the livelihoods of vulnerable tribal households in states like Jharkhand, Odisha, Chhattisgarh, Maharashtra and West Bengal, where income from lac can constitute up to 40% of their total farm income. However, the traditional methods of lac production in large host plant like Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*) and Ber (*Ziziphus mauritiana*) in forest or community land with minimal inputs are becoming less remunerative, as climate change poses a significant threat to production through increased biotic and abiotic stresses. While lac has been traditionally classified as a minor forest produce in most parts of India, its recent declaration as an agricultural commodity in Jharkhand and Chhattisgarh has paved the way for its integration into intensive agricultural practices. The introduction of bushy host plants such as *Flemingia semialata* and *Calliandra calothyrsus* has made this transition possible, and intercropping these with high-value, short-duration crops like strawberry and sweet corn further enhances the profitability of lac-based enterprises. The concept of a zero-waste bioeconomy aligns perfectly with this agricultural shift. Secondary agriculture is defined as "all practices and processes of converting agricultural produce, residues, and by-products into high-value commodities" to increase farmers' income. This research- and innovation-driven approach to economic activity focuses on the development of value-added food, feed, energy, and bio-based products from bioresources. A truly circular bioeconomy demands that all waste and co-products generated during downstream processing are converted into valuable products. Commercial insects, species whose products or themselves are sold for various beneficial uses—such as producing honey, silk, and dyes; serving as pollinators or a food source; or providing biomaterials—are poised to play a crucial role in this transition. Lac, a prime example of a commercial insect that has supported rural industry for centuries, can be synergistically integrated with other commercial insects like silkworm, honeybees, and black soldier fly to address challenges related to climate change, sustainable food and feed, and the creation of novel biomaterials. Our research at ICAR-National Institute of Secondary Agriculture, Ranchi explored the synergistic integration of lac with other commercial





insects. An initial effort to integrate tasar silkworm with lac cultivation on shared host plants like kusum and ber showed that silkworms could successfully complete their life cycle during the lac cultivation off-season. Additionally, the silkworm frass was found to enhance soil fertility, leading to a higher number of inoculable shoots in host plants for subsequent lac seasons. However, this effort was met with significant challenges, including the difficulty of collecting tasar silkworm larvae from large kusum trees and the risk of injury to mature silkworm larvae from ber thorns, which ultimately outweighed the benefits. A more promising avenue was the integration with the black soldier fly (BSF), *Hermetia illucens*. BSF's ability to convert low-value organic waste into high-value proteins and fats makes it a cornerstone of a zero-waste system. BSF larvae were evaluated on various agro-wastes from lac integrated farming systems (LIFS) and household organic waste. A study was conducted with six feeding substrates: chicken feed (control), kitchen waste without Brassica vegetables, Brassica vegetable waste, chopped semialata leaves, a 1:1 mix of kitchen waste and Brassica vegetable waste, and a 1:1 mix of kitchen waste and chopped semialata leaves. The results for the mean weight of 200 pre-pupae at 21 days were: chicken feed, 31.84 ± 0.64 g; kitchen waste, 26.98 ± 0.46 g; Brassica waste, 13.79 ± 1.97 g; semialata leaves, 5.04 ± 0.58 g; kitchen waste-Brassica mix, 20.04 ± 1.15 g; and kitchen waste-semialata mix, 21.68 ± 0.67 g. These findings demonstrated that while Brassica waste and semialata leaves are unviable as standalone substrates, they can be effectively used in combination with kitchen waste. The low performance of Brassica waste is likely due to the presence of glucosinolates, which act as a natural defence mechanism against insects. The integration with apiculture presented another significant synergy. The primary challenge for apiculture in Jharkhand is the lack of bee forage during the dearth period from July to December. It was hypothesized that lac insects, which produce abundant honeydew during this time, could serve as a vital food source. Initial observations showed that honeybees (*Apis mellifera* and *Apis cerana*) do visit lac encrustations, but at a relatively low frequency. To address this, experiments were conducted to identify bee-friendly crops suitable for intercropping within lac host tree plantations. Evaluation of five Rabi season crops—strawberry, sweet corn, buckwheat, mustard, and coriander—revealed that integrating *Apis cerana* colonies enhanced strawberry yield by 70%, mustard yield by 34%, and coriander yield by 28%. This intervention also increased bee visitation on *Flemingia semialata* by 65%, which, in turn, reduced sooty mold incidence on lac encrustation and improved seed set on the host plant. The research identified sweet corn as a primary pollen source, while mustard and coriander were the most balanced sources of both nectar and pollen. The improved yields translated into significantly higher Benefit: Cost (B:C) ratios for the integrated systems, with





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strawberry showing the highest gain (2.9 with bees vs. 1.7 without). Challenges remain, such as the need for organic pest management for lac pests as well as lac host plants and intercrops management, but this integrated model proves viable. This apiculture-integrated model also provides a more balanced organic waste feedstock composition for the black soldier fly. In conclusion, the integration of commercial insects like the lac insect, black soldier fly, and honeybee presents a viable pathway toward a zero-waste bioeconomy. While not all integration efforts are successful, as seen with the tasar silkworm, the synergies between lac, BSF, and apiculture offer a robust, diversified, and sustainable farming model. This integrated approach can be promoted in existing lac-producing areas, providing a diverse source of sustainable income and nutritional security for vulnerable tribal populations. This framework also supports rural industrialization and aligns with the Sustainable Development Goals (SDGs), offering a pathway for an Atmanirbhar, Vikshit Bharat.

Lead Presentation



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In collaboration with

The Entomological Society of India, ICAR-IARI Pusa Campus, New Delhi - 110012



Application of Wing Geometric Morphometrics in the Identification and Discrimination of Honey Bee (*Apis* spp.) Species

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Geometric morphometrics is a powerful analytical tool that combines statistical methods with graph theory to quantify and compare morphological structures. This study applies geometric morphometric techniques to identify and classify honey bee species based on wing shape variation, with the objective of assessing morphological diversity and evaluating the method's effectiveness in species discrimination. A total of 726 worker honey bee samples were collected from the Union Territory of Jammu and Kashmir, India. The left and right forewings were photographed and nineteen landmarks were digitized using Identify software. The landmark data were analyzed using Generalized Procrustes Fit, Principal Component Analysis (PCA), Canonical Variate Analysis (CVA) and allometric regression in Morpho and PAST software. PCA results showed that the first three principal components accounted for 80.492% of total shape variation with partial separation among *Apis dorsata*, *A. florea*, *A. cerana*, and *A. mellifera*. CVA further distinguished all four species without any overlap. Significant differences in wing size (centroid size) were also observed with *A. dorsata* exhibiting the largest size. This approach holds strong potential for applications in species identification, conservation planning, pollination biology and the management of honey bee populations crucial for food security and ecosystem health.

Keywords: CVA, Geometric morphometrics, PCA, Species discrimination, Wing shape variation





Commercial Entomology in Action—Resolving Insect Challenges in Trade and Industry

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Commercial entomology plays a pivotal role in diagnosing and mitigating insect-related disruptions across trade and industrial sectors. This paper presents two case studies that demonstrate the applied value of entomological expertise in resolving real-world challenges. The first case involved a container shipment from New Jersey to JNPT, where 19 insect specimens dead and live were discovered. Taxonomic identification revealed five orders: *Coleoptera*, *Lepidoptera*, *Hemiptera*, *Diptera*, and *Hymenoptera*. Notable species included *Tribolium*, *Spodoptera*, and *Nezara viridula*. Approximately 68% were cosmopolitan; 32% were North American associates. No signs of infestation were found. The presence of phototactic insects suggested incidental entry during nocturnal exposure to artificial lighting. A formal report helped avert quarantine action and supported insurance review. The second case addressed quality losses at POSCO Maharashtra Steel, where nocturnal insects damaged rolling steel sheets, causing financial losses exceeding ₹500,000. Field investigation identified artificial lighting as the primary attractant. Recommended interventions—modifying light spectra, installing bucket traps, replacing flowering plants, and sealing drains—reduced insect activity by 75% within two months. Together, these cases highlight the strategic role of entomologists in commercial settings. By integrating ecological insight with engineering and landscape management, entomology offers scalable solutions for biosecurity, quality assurance, and operational resilience.

Keywords: Consignment insects, Industrial insects, Insect losses, Steel industry, Quarantine





Development and Assessment of Novel Technology for Disease Management in Silkworm Rearing

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Silkworm diseases pose a significant threat to the productivity and sustainability of sericulture leading to substantial economic losses for farmers. Traditional methods of disease management often rely on chemical treatments which are environmentally harmful and pose risks to silkworm health. In response to these challenges a novel technology has been developed to provide an eco-friendly, efficient and sustainable solution for managing diseases in silkworms. The efficacy testing of the product was conducted by introducing the diseased silkworms with symptoms of specific diseases (grasserie, flacherie, muscardine and microsporodiosis) in a healthy population and subsequently, the batches were subjected to disinfectant (Serifin, Vijetha and Lime). Another batch where the respective diseased larvae were introduced but reared without applying any bed disinfectant, maintained as a control for comparison. Perusal of data revealed that serifin prevented the spread of infection within the populations effectively after the introduction of infected silkworms. Efficacy trials of the product were also conducted across diverse geographical regions of India under varying environmental conditions which also demonstrated promising results indicating its broad-spectrum efficacy and practical applicability. The antimicrobial activity of the disinfectant was further confirmed through *invitro* studies by incubating silkworm pathogens at $28 \pm 2^\circ\text{C}$ for 48 hours, and their subsequent imaging using a Field Emission Scanning Electron Microscope (FESEM) which revealed disrupted external surfaces of the pathogens, confirming its antimicrobial properties.

Keywords: Bacteria, Broad spectrum, Disinfectant, Electron Microscopy, Grasserie, Silkworm





Effect of Thermal Stress on Economic Traits in the Nistari Race of Mulberry Silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae)

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The mulberry silkworm, *Bombyx mori* L., is a poikilothermic insect that experiences variable temperature conditions in its natural environment, which directly affect growth and silk productivity. Studying thermo-tolerance under constant temperatures does not accurately reflect natural conditions. Therefore, the effect of repeated short-term heat and cold stress on the morpho-economic traits of the multivoltine Nistari race was investigated during the present study. The larvae were exposed daily to short-term heat and cold stress from hatching until spinning, while the control group was reared under optimum conditions. All the data was statistically analysed at 5% significance level. The results of the present study reveal that control larvae exhibited significantly higher weights of larval, cocoon, pupal, shell, and silk gland compared to the stressed groups, indicating that stable conditions maximize growth and biomass accumulation. Under heat stress, however, the shell ratio (%) increased significantly relative to the control group, despite reductions in cocoon and shell weight. Cold stress, on the other hand, reduced most traits without any beneficial effect. Additionally, no significant differences were observed in the total larval duration, effective rate of rearing (ERR%), or silk gland somatic index (SGSI%). Thus, our findings suggest that repeated short-term thermal stress imposes significant stress on the Nistari race, causing a marked reduction in key economic traits. Such reductions are indicative of an adaptive response where energy allocation shifts toward survival and maintenance rather than growth. Therefore, there is a need to develop thermo-tolerant Nistari lines for improved silk productivity under variable climatic conditions.

Keywords: Cocoon, Economic traits, Mulberry silkworm, Shell ratio, Thermal stress





Exploration of Multiple Roles of Spermidine in Silkworm, *Bombyx Mori*

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Spermidine is a ubiquitous biogenic amine that is crucial for growth and development. It was shown to stabilize chromatin and helps in replication, transcription and translation. *Bombyx mori* is an economically important insect where silk is actively produced during larval stages by silk glands. Over the past ten years our group showed quality and quantity of silk produced is significantly improved upon spermidine supplementation. The larvae of the spermidine treated group exhibited enhanced thermotolerance and a novel polyamine, caldopentamine was identified for the first time in silk glands. Spermidine supplementation promoted the early degeneration of silk glands by increasing the γ -aminobutyric acid (GABA) levels. The findings of our studies show that spermidine-fed larvae are nutritionally efficient and show increased silk production and egg production and are temperature tolerant which are economically highly beneficial to sericulture farmers.

Keywords: *Bombyx mori*, Egg production, Silk gland, Spermidine, Thermotolerant





Studies on Chalkbrood Disease (*Ascosphaera apis*) of *Apis mellifera* in Kashmir

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The present study on Chalkbrood Disease (*Ascosphaera apis*) of *Apis mellifera* in Kashmir was conducted in Baramulla district from June 2024 to May 2025. A total of 128 colonies were surveyed across three apiaries, with 20 colonies infected, giving an overall chalkbrood incidence of 15.6%. Incidence was highest in Apiary-A (19.44%), lowest in Apiary-B (11.36%), and intermediate in Apiary-C (16.66%). At the brood frame level, infection reached 46.66%, 37.50%, and 41.18% in Apiary-A, B, and C respectively. From 479 larval samples collected, 305 (63.67%) tested positive for Chalkbrood. Seasonal surveys showed peak incidence in July, with 14.30% in Apiary-A, coinciding with maximum brood area (2352 cm²) and elevated temperature (26.6 °C). Disease incidence declined in autumn and was absent in winter. Morphological examination confirmed *A. apis* as the causal agent, with spore cysts measuring 69.31 µm and spore balls 15.23 µm in diameter. ITS sequencing validated the identity and the sequence was submitted to GenBank (Accession No. PX060464.1). Chalkbrood incidence showed a strong positive correlation with temperature ($r = 0.91$) and brood area ($r = 0.63-0.69$), while humidity exerted weak influence. *Varroa destructor* infestation followed brood dynamics, averaging 5.15% on brood in spring, 3.93% in summer, and 2.16% in autumn, with corresponding infestations on adult bees of 2.63%, 2.97%, and 1.21%. A moderately strong positive association ($r = 0.51$) was observed between *Varroa* infestation and Chalkbrood incidence. The findings highlight Chalkbrood as a significant brood disease in Kashmir, strongly influenced by temperature, brood activity, and *Varroa* infestation, emphasizing the need for integrated colony health monitoring program in future.

Keywords: *Apis mellifera*, *Ascosphaera apis*, Kashmir, Morphological & Molecular characterization, *Varroa destructor*





Growth of Early Black Soldier Fly Larvae (*Hermetia illucens*) on Plant-Based Substrates

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The increasing global population produces a substantial quantity of food waste, underscoring a crucial challenge in food sustainability and security. An innovative approach for sustainable waste management and a circular economy is the use of black soldier fly larvae (*Hermetia illucens* L; BSFL), which can transform organic food waste into nutrient-rich biomass appropriate for use as fertilizers in agriculture. The larvae can also be used as feed for livestock due to their high protein content and nutritional value. For optimizing their large-scale production, the standardization of their initial feed is essential. Hence, the purpose of this study was to investigate the early growth performance of BSFL on plant-based diets. Newly hatched larvae were raised on various substrates comprising seven treatments including control. Observations on the larval length, width and weight were recorded by studying ten larvae from each treatment till 2nd -3rd instar. The results indicated that T4 (Bran + 10% sugar solution using tap water) exhibited the best performance of BSFL, providing a mean length of 8.88 mm, 2.67 mm width and 19.80 mg weight. In contrast, T2 (Post processed bran + tap water) showed sub-optimal results, with mean of 4.50 mm length, 0.89 mm width and 10.291 mg weight. Although the outcomes of this study is less comparable to those of the standard (Gainesville diet) and meat-based substrates generally followed in African and other South-east Asian countries, these diets can be efficient alternate methods in India and others countries having strong vegetarian traditions. The adaptability of BSFL allows for the modification of its nutritional properties by changing the substrate to align with their specific dietary requisite.

Keywords: Bioconversion, Biomass, Circular economy, Innovation, Kasgot





Studies on Foraging Activity of Major Insect Pollinators on Cucumber, *Cucumis Sativus* L.

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Cucumber (*Cucumis sativus* L.), an important member of the family Cucurbitaceae, is a monoecious crop that relies predominantly on insect pollinators for successful pollination and fruit set. Foraging activity of major insect pollinators, were evaluated and the results revealed significant differences among pollinators. The lowest foraging speed (time spent per flower) was recorded in *Apis cerana* (5.60 seconds), while the highest was in *Eristalis arbustorum* (51.55 seconds). The highest foraging rate (flowers visited/min) was observed in *A. cerana* (11.27) and the lowest in *E. arbustorum* (1.20). Pollen load analysis further confirmed that *A. cerana* carried the maximum number of loose pollen grains (4.0 lakh), whereas *E. arbustorum* carried the least (0.2 lakh). Overall, *Apis cerana* emerged as the most efficient pollinator of cucumber, demonstrating superior foraging activity and pollen-carrying capacity. The findings emphasize the importance of conserving and managing honey bee populations to enhance cucumber pollination and yield.

Key words: *A. cerana*, *Cucumis sativus*, Foraging activity, Insect pollinators





Entomology in Action: Butterfly Parks and Gardens as CSR-Driven Biodiversity Solutions

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Over the past decade, *iNaturewatch Foundation* and *Ladybird Environmental Consulting LLP* have pioneered the creation of 45 Butterfly Zones (6 butterfly parks, 9 butterfly habitats, and 30 butterfly gardens) across 10 states of India. Designed with native larval host and nectar plants, these zones collectively support over 80 butterfly species, demonstrating the potential of butterflies as ecological indicators and flagship species for conservation marketing. A defining feature of this work has been its strong foundation in Corporate Social Responsibility (CSR). Partnering with 27 companies across 15 cities, our projects have engaged thousands of employees and community members through volunteering programs, citizen science initiatives, and biodiversity education. Butterfly zones have thus become a medium through which corporations fulfill their sustainability goals while simultaneously investing in ecological restoration, employee well-being, and community engagement. Expanding this approach, our latest initiative, “Butterfly Patrol”, is developing 20 butterfly gardens in police stations across Navi Mumbai. This CSR-supported program enhances urban biodiversity while addressing workplace stress, demonstrating how butterfly habitats can deliver both ecological and psychosocial benefits. By aligning entomological knowledge with CSR strategies, butterfly zones and gardens illustrate how insects can drive eco-tourism, green branding, urban greening, and environmental education.

Keywords: Butterfly zones, Butterfly Patrol, CSR, Commercial Entomology, Eco-tourism, Urban biodiversity





CE-P 01

Comparative Evaluation of Chemical Composition and Quality Parameters of Honey from Diverse Regions of the Kashmir Valley

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Honey is a natural sweet substance produced by honey bees, from the nectar of plant flowers. Evaluation of chemical properties of honey from the Kashmir Valley” aimed to assess the chemical properties of various honey types (*Robinia pseudoacacia*, *Multiflora*, *Plectranthus rogius*) across five districts in the Kashmir Valley. The research was conducted at the Honey Purity Testing Laboratory within the Research and Training Centre for Pollinators, Pollinizers, and Pollination Management (RTCPPM), Division of Entomology, SKUAST-K, Shalimar. The parameters of investigation were reducing sugars, soluble solid content (SSC), total solids (TS), hydroxymethylfurfural (HMF), ash content, and pH. Statistical analysis revealed significant variations in chemical properties based on honey type and district. *R. pseudoacacia* honey from Pulwama exhibited the highest reducing sugar content (83.65%) while *Multiflora* honey from Kupwara had the lowest (62.88%). Sucrose levels were highest in *P. srogus* (8.74%) honey from Pulwama and lowest in *Multiflora* honey from Kupwara (4%). *P. rogius* honey from Kupwara demonstrated the highest SSC (81.37 °Brix), whereas *R. pseudoacacia* honey from Anantnag showed the lowest (78.12 °Brix). *P. rogius* honey from Anantnag had the highest TS (82.05 %), while *R. pseudoacacia* honey from Srinagar had the lowest (78.79 %). HMF was highest in *Multiflora* honey (40.73 mg/kg) from Anantnag and lowest in *P. rogius* honey (0.29 mg/kg) from Pulwama. The highest ash content was observed in *Multiflora* honey (0.14%) from Bandipora and the lowest in *R. pseudoacacia* honey (0.08%) from Anantnag. All samples exhibited acidic pH values, with the highest pH (4.28) recorded in *Multiflora* honey from Kupwara and the lowest in *P. rogius* honey (3.61) from Bandipora.

Keywords: Honey, Kashmir Valley, Physicochemical properties, Quality indicators, regional variation





CE-P 02

Decoding Diversity: A Morpho-Molecular Approach to *Andrena* Bees in Kashmir Valley

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The family *Andrenidae* represents a diverse group of solitary bees whose taxonomy is complicated by significant morphological variation. This study adopts an integrative morpho-molecular approach to investigate four *Andrena* species: *Andrena (Agandrena) agillissima*, *Andrena (Micrandrena) fucata*, *Andrena (Taeniandrena) ovatula*, and *Andrena (Zonandrena) gravida*, collected from Srinagar, Pulwama, and Budgam districts of the Kashmir Valley. Using 23 morphological characters combined with molecular analyses, we aimed to clarify species boundaries and improve identification accuracy. The morphometric analysis revealed distinct patterns that differentiate the species, while molecular data provided additional resolution to their phylogenetic relationships and genetic diversity. The study also highlights the biogeographical distribution of these species and their ecological adaptations to the varied environments of the region. Our findings emphasize the critical role of combining classical taxonomy with modern genetic tools for resolving the complex systematics of *Andrena*. This integrative approach not only enhances taxonomic precision but also contributes to understanding the evolutionary history and conservation needs of these key pollinators in the rapidly changing Himalayan landscape.

Keywords: *Andrena* species, DNA and Diversity, Genetic diversity, Morphological characters, Phylogenetic relationship





CE-P 03

Geometric Morphometric Analysis of Wing Shape Variation of Asiatic Honeybee (*Apis cerana*) from Kashmir

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This study aimed to investigate the effect of altitude on wing shape and size in *Apis cerana* populations and to analyze the change in forewings during the winter and spring seasons using geometric morphometrics. The research utilized geometric morphometric analysis to assess the wing shape and size variations focusing on more than 420 *Apis cerana* worker honeybee samples collected from different locations in Kashmir. The findings revealed significant differences in wing shape and size among honeybee population from different altitudes. The results of the principal component analysis (PCA) and canonical variate analysis (CVA) demonstrated variation in wing shape and showed less overlapping of honeybees collected from different region of kashmir valley. The honey bee wing also showed significant variation in centroid size among different regions and the region with the largest centroid size is Gagangir and smallest in Tangmarg. The region with the lowest (4.0021) mean mahalanobis distance was between Waliwar Achabal, and the highest (21.6567) between Sonmarg and Gagangir, indicating that the honey bees from this region have more dissimilar wing shapes than those from other regions. The region with largest centroid size was Gagangir and smallest was Tangmarg. The UPGMA tree also showed similarities between the honeybee wings of Waliwar and Achabal. From the study it may be concluded that the *Apis cerana* samples from Gagangir, Waliwar and Achabal may be superior than others. Similarly, the findings revealed significant differences in wing shape and size of honeybee colonies during different seasons. The results of Principle Component Analysis (PCA) and Canonical Variate Analysis (CVA) shows variations and a very rare overlapping in wing shapes of honeybee were observed collected during different months (seasons) of Kashmir valley. Highest (3.6647, 0.0172 and $p < 0.0001$, $p < 0.0001$) Mahalanobis distance and procrustes was observed between April and January respectively while February and





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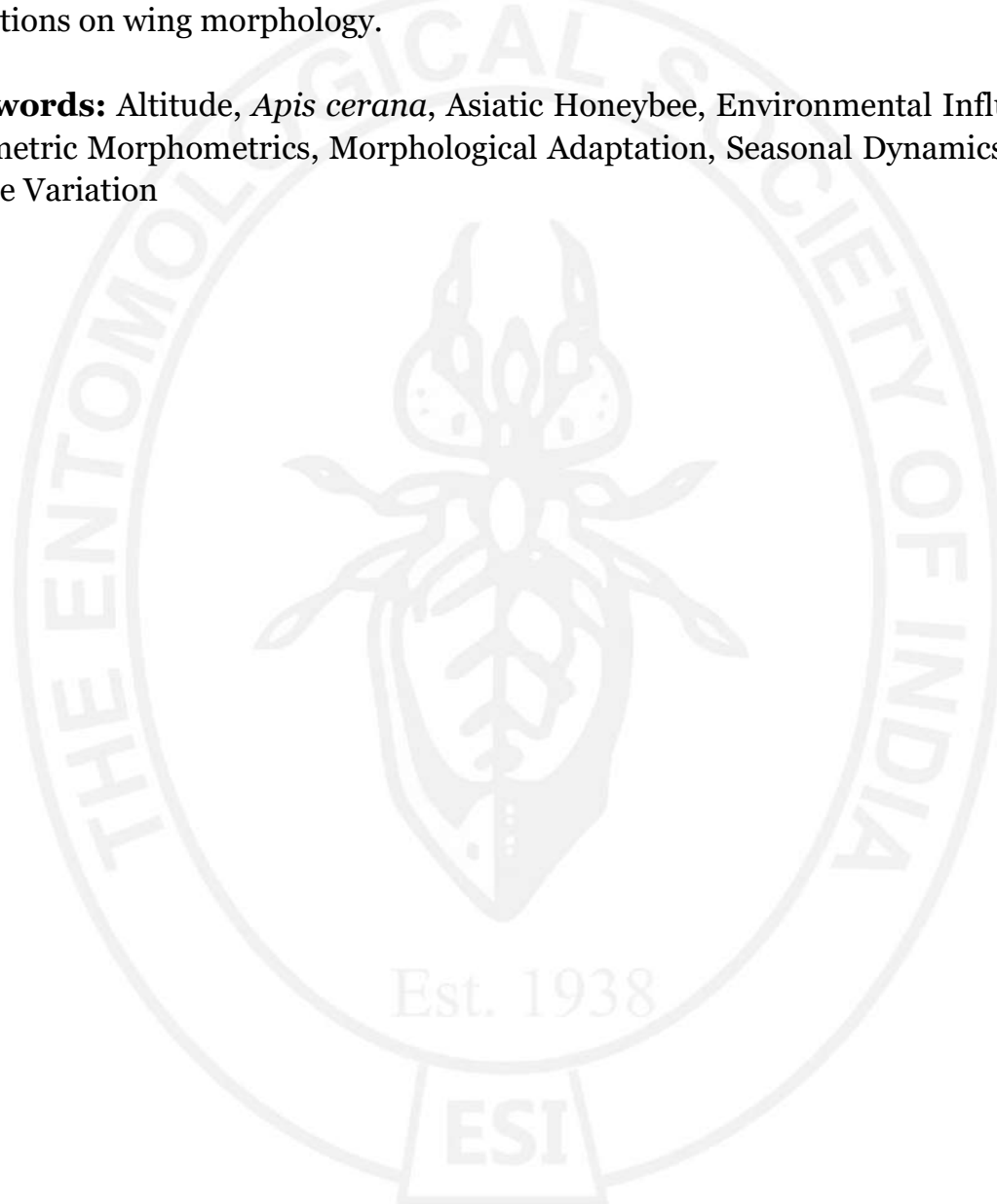
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December showed lowest (1.1962, $p=0.0026$) mahalanobis distance. Thus, the study provides valuable insights into the dynamic nature of wing shape in *Apis cerana* populations, emphasizing the potential influence of seasonal variations on wing morphology.

Keywords: Altitude, *Apis cerana*, Asiatic Honeybee, Environmental Influences, Geometric Morphometrics, Morphological Adaptation, Seasonal Dynamics, Wing Shape Variation



Poster Presentation



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In collaboration with

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Heterogenous edges have Spatial Advantage over Pure Crop for Wild Bee Abundance in Almond Plantations of Kashmir Karewas

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Almond plantations of Kashmir karewas are managed less intensively with zero spray of insecticides creating a very favorable niche habitat for wild bee and other pollinator populations. The karewas are interspersed with different micro environments and human settlements that give rise to varied types of edges in almond plantations. During the course of study, the edges were broadly categorized into forest edges, characterized by presence of diverse tree species with no soil tillage operations around and anthropogenic edges, characterized by presence of human settlements or other anthropogenic activities with disturbed soil due to tillage activities. The study compared the wild bee abundance in pure almond plantation, forest edges and anthropogenic edges. The wild bee abundance was recorded using bee bowl technique, employing yellow colored plastic bowls of radius 6 cm and volume 200 ml containing solution of 2 ml liquid soap in 1 litre water in experimental sites for a duration of 60 minutes. The results indicated that the wild bee population at the orchard edges was significantly different than the population in the interior of pure almond orchards, implying presence of edge effects. The wild bees were more abundant on the forest edge (10.250) followed by anthropogenic edges (6.071) and pure almond plantation (4.726) for the year 2020. The same trend (9.131, 6.488, 4.458) was followed for year 2021 as well, indicating wild bees prefer heterogeneous environment over pure crop plantations in almonds of Kashmir valley. The land use characteristics on local and landscape levels has been reported to affect the wild bee population and species present.

Keywords: Anthropogenic activities, Edge effects, *Lasioglossum*, *Prunus dulcis*





CE-P 05

Impact of Botanicals on Colony Performance of Honeybee, *Apis mellifera* in Kashmir

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The present investigation, “Impact of botanicals on colony performance of honeybees, *Apis mellifera* in Kashmir,” was conducted at Wadura Campus, SKUAST-K, during 2024-25. Six botanicals viz; Neem oil, lavender oil, citronella oil, eucalyptus oil, artemisia oil, and garlic extract along with a control were evaluated for their effects on colony performance and *Varroa destructor* management. Parameters assessed included worker activity, attraction to botanicals, walking speed, body mass, brood health, and *Varroa* mortality. Among the treatments, Neem oil caused the highest worker bee mortality (14.6%), followed closely by garlic extract (14.12%), while lavender oil was least toxic with 8.15% mortality. For brood, garlic extract exhibited maximum toxicity, causing 25.67% larval mortality, highlighting its adverse impact on brood viability. Attraction assays (bees/10 minutes) revealed that Lavender oil attracted the highest number of foragers (10.66), followed by Artemisia oil, while garlic extract recorded the lowest attraction. Evaluation against *Varroa destructor* showed that garlic extract and Neem oil achieved the highest efficacy (70.1%) in reducing mite populations, both under brood with bees and brood without-bee’s conditions. In contrast, lavender oil, though safer for bees, exhibited comparatively lower *Varroa* control. The results indicate that while garlic extract and neem oil are highly effective against *Varroa*, their adverse effects on brood survival warrant careful use. Lavender oil, being least toxic and most attractive, appears promising for enhancing forager activity without compromising colony health. Overall, the study suggests that botanicals are safe, eco-friendly, residue free alternatives that can be integrated into honeybee management programs, particularly within the fragile agro ecosystems of Kashmir.

Keywords: *Apis mellifera*, Botanicals, Colony performance, Efficacy, Kashmir, Mortality, *Varroa destructor*





Insect Visitor and Pollinator Diversity in Relation to Floral Characteristics and Weather Dynamics of Selected Medicinal Plants in the North-Western Kashmir Himalayas

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The present investigation examined the pollination ecology of four medicinally important plant species, namely *Taraxacum officinale* (Common Dandelion), *Iris germanica* (Bearded Iris), *Lavandula angustifolia* (English Lavender) and *Echinacea purpurea* (Purple Coneflower), under the temperate conditions of the North-western Kashmir Himalayas. The study, conducted during the flowering season of 2024 at the Herbal Garden, Faculty of Forestry, SKUAST-Kashmir, emphasized floral traits, insect visitor and pollinator diversity and their ecological interactions. Detailed floral analysis revealed distinct species-specific adaptations, including capitulum-type inflorescences in *Taraxacum officinale* and *Echinacea purpurea*, bilaterally symmetrical flowers with prominent nectar guides in *Iris germanica* and bilabiate corollas with basal nectaries in *Lavandula angustifolia*. Systematic surveys of insect pollinators/visitors recorded 19 species on *Taraxacum officinale*, 13 on *Iris germanica*, 15 on *Lavandula angustifolia* and 8 on *Echinacea purpurea*. Hymenopterans were the most dominant order, followed by Dipterans and Lepidopterans. Diversity indices indicated maximum species richness and community diversity in *Taraxacum officinale* and the lowest in *Echinacea purpurea*. Pollen adherence analysis highlighted *Apis mellifera* and *Bombus haemorrhoidalis* as particularly efficient pollinators due to their high pollen-carrying capacity. Correlation analyses revealed that pollinator abundance was strongly and positively associated with maximum temperature and sunshine hours, while relative humidity exhibited a negative influence. These findings underscore the intricate interplay of floral morphology, pollinator behaviour and microclimatic variables, providing critical baseline data for pollinator conservation and the sustainable utilization of medicinal plant resources in fragile Himalayan ecosystems.

Keywords: Floral traits, Insect diversity, Kashmir Himalayas, Medicinal plants, Pollen efficiency, Pollination Ecology





CE-P 07

Dissipation Dynamics, Kinetic Modeling and Dietary Risk Assessment of Imidacloprid Residues in Mustard (*Brassica juncea* L.), Pollen and Honey Determined by LC-MS/MS

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Exposure of *Apis mellifera* L. to the systemic, neonicotinoid insecticides, particularly Imidacloprid, has been recognized as a major factor contributing to the decline of honey bee populations, resulting in ecological and economic losses due to reduced pollination services. Honey bees may encounter Imidacloprid directly during field applications and indirectly through the consumption of nectar and pollen from treated plants. Imidacloprid, being extensively used in mustard cultivation against sucking pests enables translocation into pollen and nectar, potentially exposing honey bees and contaminating hive products. Evaluating its dissipation kinetics in pollen and honey is essential for assessing pollinator safety and ensuring compliance with food safety standards. Field studies during 2023-2024 revealed that in mustard pollen, the initial Imidacloprid deposit (1.519 ± 0.004 ppm) declined to 0.016 ± 0.001 ppm by day 21, with dissipation percentages of 40.15%, 75.11%, 82.62%, 91.97%, and 98.95% on days 1, 5, 10, 15, and 21, respectively. Residue degradation followed first-order kinetics with a half-life of 3.65 days, and the calculated waiting period (Ttol) was 17.96 days based on the MRL of 0.05 ppm. In honey, initial residues (0.212 ± 0.003 ppm) declined to 0.010 ± 0.001 ppm by day 21, with dissipation percentages of 10.84%, 25.00%, 51.41%, 72.17%, and 95.28%. The dissipation also followed first-order kinetics with a half-life of 5.33 days and a waiting period of 11.11 days. TMRC values in both pollen ($0.0455-0.0004$ mg) and honey ($0.0349 \times 10^{-3}-0.0016 \times 10^{-3}$ mg) decreased to undetectable levels by day 21, remaining well below the maximum permissible intake (MPI, 3.0 mg/day). Imidacloprid residues in mustard pollen and honey dissipated rapidly following recommended application, with first-order kinetics and half-lives of 3.65 and 5.33 days, respectively. High dissipation percentages ensured residue levels and dietary





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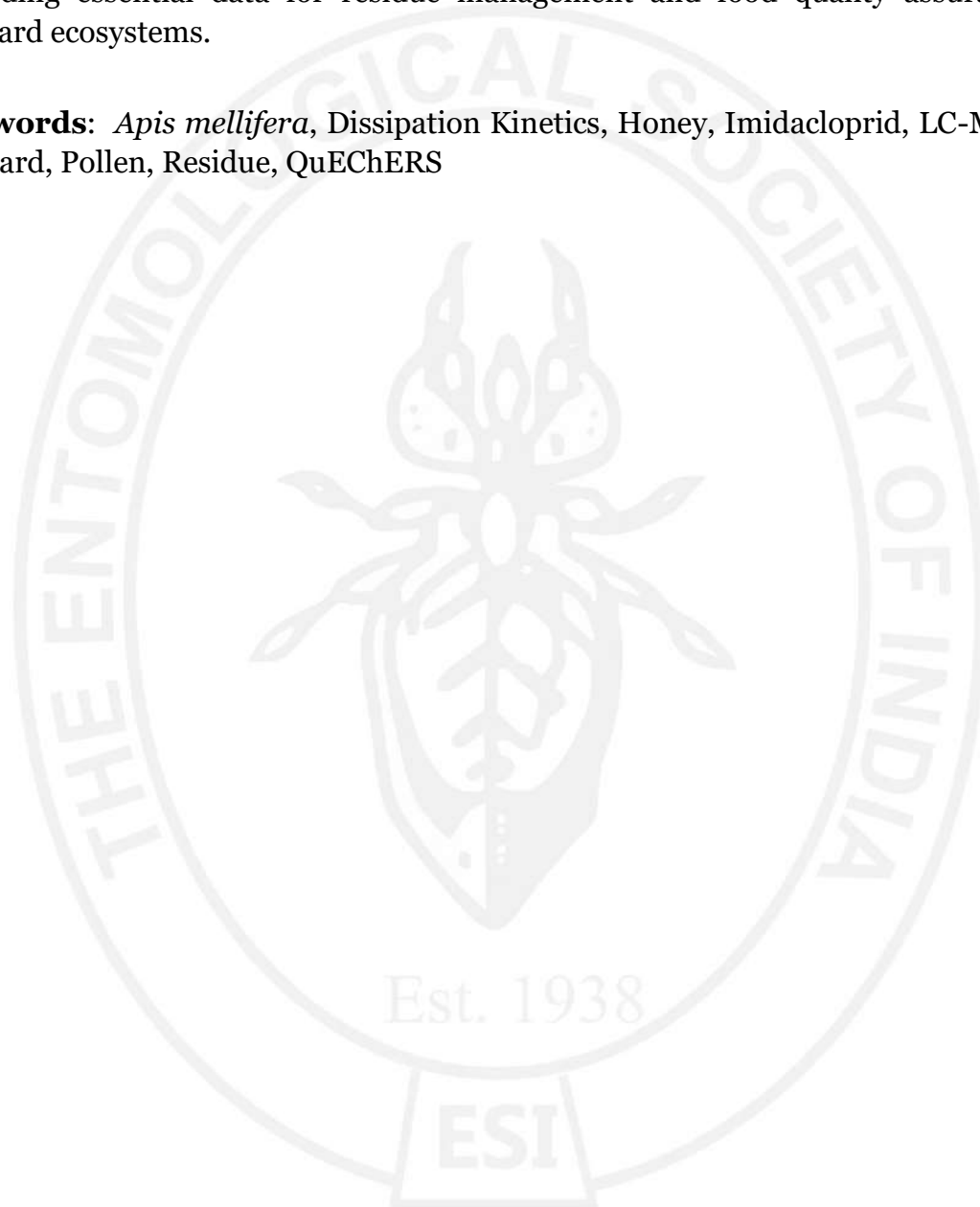
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Theme-V

Commercial Entomology – Insects as Food and Feed,
Pollination Ecology and Food Production, Silk and Lac Producing Insects.

intake values remained within safe limits. These findings suggest negligible consumer exposure and reduced pollinator risk under proper pesticide use, while providing essential data for residue management and food quality assurance in mustard ecosystems.

Keywords: *Apis mellifera*, Dissipation Kinetics, Honey, Imidacloprid, LC-MS/MS, Mustard, Pollen, Residue, QuEChERS



Poster Presentation



Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir,
Shalimar Campus, Srinagar - 190025 (UT of Jammu and Kashmir)

In collaboration with

The Entomological Society of India, ICAR-IARI Pusa Campus, New Delhi - 110012



Regional Ayurvedic Extracts as Potential Bio-Enhancers in Sericulture

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The present study evaluated the influence of selected Ayurvedic formulations on cocoon parameters of the silkworm *Bombyx mori* double hybrid (FC1 × FC2). Three formulations; Killanelli from Tamil Nadu (antiviral), Pathimukam from Kerala (immunity booster), and Shilajit from the Himalayan region (immunity and reproductive enhancer), were administered at 1000 ppm concentration in aqueous and methanolic extracts. Significant variation was observed in cocoon weight, shell weight, shell ratio, and economic index (EI) across treatments. Among the extracts, Shilajit methanolic extract (SJM) exhibited the highest performance with a cocoon weight of 1.921 g, shell weight of 0.384 g, shell ratio of 20.01%, and the highest EI value of 58.61. Pathimukam methanolic extract (PMM; EI = 54.91) and Killanelli aqueous extract (KNA; EI = 54.27) also performed well, while comparatively lower cocoon traits were recorded in Pathimukam aqueous extract (PMA) and Shilajit aqueous extract (SJA). The results highlight that Ayurvedic formulations, particularly Shilajit methanolic extract, significantly enhance cocoon quality and economic traits of silkworms, demonstrating their potential as sustainable and eco-friendly bio-enhancers in sericulture.

Keywords: Ayurvedic extracts, Bio-enhancers, *Bombyx mori*, Killanelli, Pathimukam





CE-P 09

Temporal Effects of Brassica Bloom on Key Developmental Indices in *Apis mellifera* L. Colonies

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Brassica juncea Linnaeus Czern and Coss, (Cruciferaeae) commonly known as Rapeseed-mustard, is a self-incompatible crop due to which flowers cannot utilize their own pollen which needs biological agents like honey bees for pollination and seed set. *Brassica* acts as a potential floral resource for colony developmental parameters of *Apis mellifera* L. under Kashmir Himalayas. The field study was carried out at two different locations viz; Shalimar and Ganderbal during 2022-2023, the brassica bloom period and the colony parameters viz., brood area (cm²), bee strength(cm²), pollen area (cm²) and honey area(g) in different frame strength colonies viz; (two-frame, four -frame, six-frame, eight-frame and ten-frame) was recorded maximum in ten frame colonies at Shalimar; (1237cm²), (1225.86 cm²), (1246cm²) and (3692.56g) respectively, twenty days after bloom (20 DAB). The minimum brood area (cm²), bee strength (cm²), pollen area (cm²) and honey area (g) in different frame strength colonies was recorded in two frame colonies as (325.73cm²), (316.05cm²), (306.38cm²) and (310.41cm²) respectively, at Shalimar 40 days after bloom. The colony developmental parameters are improving in accordance to the floral resource availability, and decreases as the bloom period comes to an end. Presence of ideal floral resources along with the adequate colony frame strength proved complementary for enhancing the various colony developmental parameters, thereby increasing the honey production. Besides the availability of potential pollinators, *Apis mellifera* L. during the brassica bloom improve seed set and productivity of mustard crop.

Key words: *Apis mellifera*, *Brassica*, Colony developmental parameters, Frame strength, Productivity





A Study the Succession of Insect Pollinators/Visitors on Different Sowing Dates of Niger, *Guizotia abyssinica* (L. f.) Cass, Crop

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A study was conducted at experimental farm of PC Unit Sesame and Niger, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, during Kharif 2021 and 2022. In all the dates of sowing (different dates sown crop) the occurrence of *Apis cerana indica*, *Apis mellifera*, *Apis florea*, *Apis dorsata*, *Eristalinus megacephalus* and *Parnada guttatus* were recorded on niger flowers from 3 to 45 days of flowering period, while the occurrence of *Amata cyssea* was recorded from 3 to 38 days of flowering period in 1st (15th July), 2nd (25th July), 3rd (5th August) and 5th (25th August) dates sown crop, while in 4th (15th August) and 6th (5th September) dates of sowing its activity recorded from only 17 to 45 and 17 to 38 days of flowering period, respectively. In case of *Apis florea* the highest occurrence (2.81/m²/5minutes) was recorded on 31th day of flowering, while the lowest occurrence (2.58/m²/5minutes) was recorded on 3rd day of flowering.

Keywords: Dominant pollinators, dates of sowing, *Apis mellifera*





First Evidence of Gamma-Aminobutyric Acid in *Bombyx Mori* Silk Glands: A Key Player that Mediates Spermidine-Driven Degeneration of Silk Glands

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Biogenic amines, especially spermidine and gamma-aminobutyric acid (GABA), are known modulators of autophagy. The silk glands of *Bombyx mori* are modified labial glands that synthesize silk, which has enormous commercial importance. Once silk is extruded, these glands rapidly degenerate through tightly regulated autophagy and apoptosis during the larval-to-pupal transition. Gamma-aminobutyric acid has not been identified in the silk glands till now, and therefore, its role in silk gland autophagy remains unknown. The current study aimed to evaluate the role of spermidine supplementation in the autophagy of silk glands. Fifth instar silkworms were fed with control and spermidine-supplemented mulberry leaves under standard conditions. Results showed a significant decrease in biogenic amines during the degradation of the silk glands. Significantly elevated levels of gamma-aminobutyric acid were identified during silk gland degeneration in both control and spermidine-fed groups. Increased gamma-aminobutyric acid leads to elevated levels of calcium deposits, contributing to the early silk gland degeneration of the silk glands in the spermidine group.

Keywords: Autophagy, Biogenic amines, GABA, Silk gland, Spermidine





Impact of Artificial Diet Supplementation on Colony Strength of *Apis mellifera* During Dearth Period

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The survival of *Apis mellifera* L. colonies depends on the availability of nectar and pollen. During dearth periods, natural forage is limited, which lowers colony productivity and strength. The current study assessed the artificial diet supplementations affected colony growth and activity throughout the dearth period in order to address this problem. The five diets used were Diet I (Soybean flour, skimmed milk powder, sugar, pollen, glucose, honey); Diet II (Black gram flour, sugar, skimmed milk powder, Brewer's Yeast); Diet III (Gram, brewer's Yeast, skimmed milk powder, sugar powder, pollen); Diet IV (Soybean flour, parched gram flour, brewer's yeast, sugar, glucose); Diet V (Control) in three replicates each. Honeybees were fed with diet formulations as patties over a 14-day period, consisting of 100 grams of weighed diet patties and were evaluated in comparison to control colonies for diet consumption, sealed and unsealed brood, honey reserves and bee activity. The soybean, gram, soybean with parched gram, and black gram diets had the highest overall attributes as compared to control groups. These results show significantly increase in colony productivity and build-up during dearth period. The creation of standardized supplemental diets to lessen the negative impacts of seasonal dearth on beekeeping operations is supported by these findings.

Keywords – *Apis mellifera*, Artificial diet, Colony strength, Dearth period, Diet consumption, Honey reserves





Assessment of Rearing and Reeling Parameters of New Bivoltine Silkworm Double Hybrids Reared in the Farmers' Field

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Field evaluation of silkworm foundation crosses *viz.*, B1 × B2, B1 × B4 and B6 × B8 and double hybrids *viz.*, (B1 × B2) × FC1, (B1 × B4) × FC1 and FC2 × (B6 × B8) of high temperature and muscardine disease tolerant silkworm breeds *viz.*, B1, B2, B4, B6 and B8 was carried out in farmers field, covering Chikkaballapura and Tumakuru districts of Karnataka. The control taken for foundation crosses were FC1 and FC2 hybrid and FC1 × FC2 for double hybrids. Rearing parameters *viz.* total larval duration (h), fifth instar larval weight (g/10 larvae), cocoon yield by number (No./10,000 larvae), cocoon yield by weight (kg/10,000 larvae), Single cocoon weight (g), shell weight (g), pupal weight (g), shell ratio (%). The foundation cross B1 × B4 was superior for most of the traits, while B1 × B2 for seven traits. Further, the cocoons from above rearings were used to produce 100 dfls each of double hybrids *viz.*, (B1 × B2) × FC1, (B1 × B4) × FC1, FC2 × (B6 × B8) and control FC2 × FC1 and were distributed to farmers. The double hybrid (B1 × B4) × FC1 was superior for seven out of ten traits while (B1 × B2) × FC1 for four traits. The reeling and raw silk assessment at CSTRI, Bengaluru showed that double hybrids (B1 × B4) × FC1 and (B1 × B2) × FC1 exhibited better performance for most of the parameters. Their dual tolerance and superior silk quality highlight the advantages to sericulture industry.

Keywords: Bivoltine, Cocoons, Hybrids, Rearing, Reeling





Beyond Crustaceans: Insects as Sustainable Sources of Chitosan and Protein Co-Products

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Chitosan is a natural polysaccharide derived from chitin through deacetylation, and it is increasingly recognized as a versatile biopolymer with applications across multiple industries. Traditional sources of chitin, such as Crustacean shells from shrimp, crabs, and lobster, face significant sustainability challenges due to their dependency on seasonal harvesting cycles, which limit year-round availability. Furthermore, large-scale reliance on marine sources raises environmental concerns, as excessive shellfish processing generates considerable waste, contributes to coastal pollution, and is tied to overfishing pressures that can disrupt marine ecosystems. Geographic limitations also play a role, since shellfish resources are concentrated in specific coastal regions, making global supply uneven and vulnerable to climate change, disease outbreaks, and fluctuations in the fishing industry. These constraints highlight the need for alternative, sustainable chitin sources beyond traditional marine biomass. This abstract explores the extraction of chitosan from high chitin content insects such as Crickets, Black soldier fly, Silkworm. These insects, often reared for protein production in circular economy models, generate chitin-rich exoskeletons and larval skins as by-products, addressing waste utilization while reducing CO₂ emissions up to 47 times lower than composting organic waste. Extraction processes typically involve demineralization, deproteinization, and deacetylation using chemical or biochemical methods yielding chitosan. Chitosan from insect sources finds applications in bio-medicine like UV-blocking, antimicrobial coatings, wound-healing hydrogels, enzyme delivery and in agriculture used for inducing drought and pathogen resistance, bio-control, fertilizer encapsulation and environmental uses such as superhydrophobic coatings and air filtration with 87% PM 2.5 capture. Compared to marine sourced chitosan, insect source chitosan has advantages like biocompatibility, biodegradability, non-toxicity, and cost-effectiveness. It is used in various sectors like food packaging for antibacterial UV filtering films, cosmetics (melanin-chitosan complexes for antioxidant UV filters), and bioplastics. Additionally, the protein extracted from these insects is used for making protein supplements such as powders, chocolate





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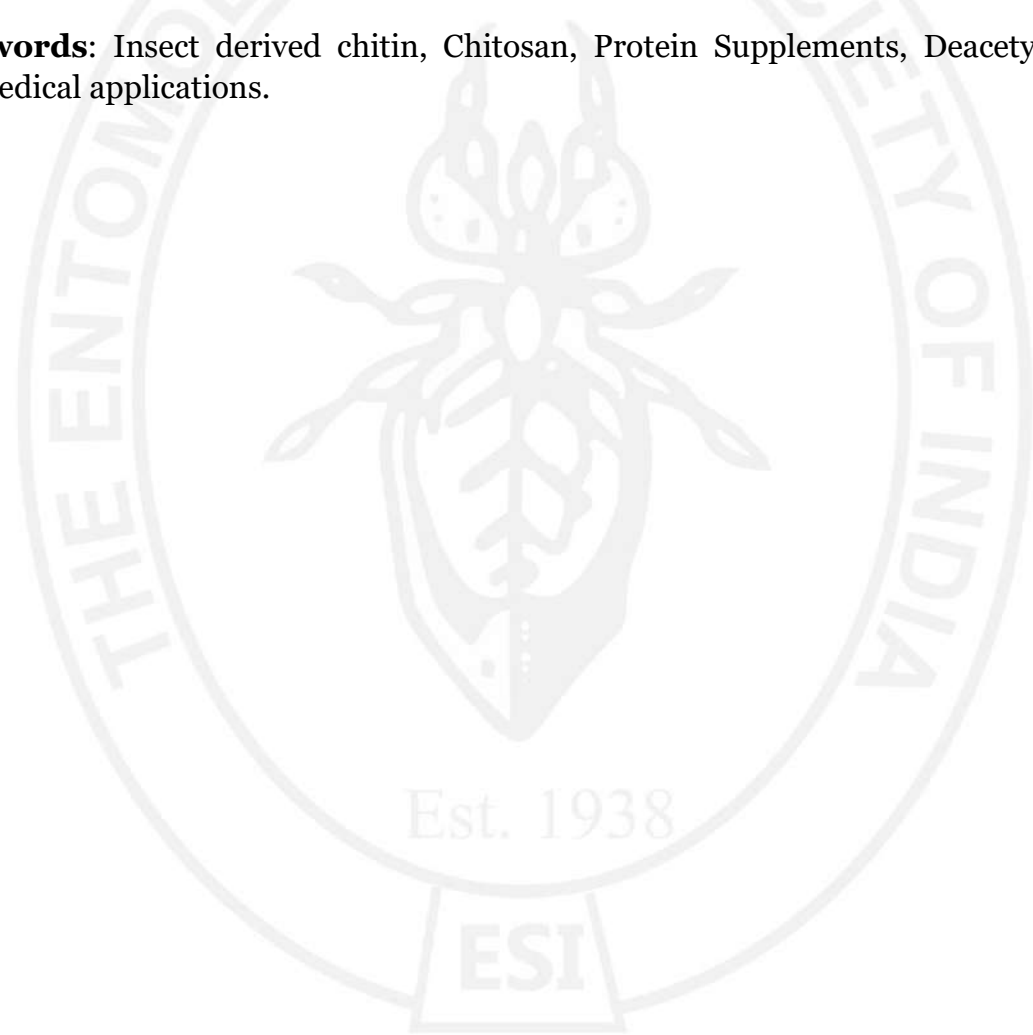
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bars, toppings, etc., offering high nutritional value with 30-76% protein content and essential minerals like iron, calcium, magnesium, phosphorus, and zinc. This dual extraction promotes sustainability by transforming low-value organic waste into high-value products, with insects like crickets and black soldier fly showing particular promise for human food and aquafeed due to low greenhouse gas emissions and efficient feed conversion, offering eco-friendly alternatives to marine biomass while enabling diverse applications in medicine, agriculture, environment, food, and nutrition within a circular economy framework.

Keywords: Insect derived chitin, Chitosan, Protein Supplements, Deacetylation, Biomedical applications.



Rapid Virtual Oral Presentation



Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir,
Shalimar Campus, Srinagar - 190025 (UT of Jammu and Kashmir)

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Effect of Varied Photoperiod Regimes on the Voltinism of Silkworm, *Bombyx mori* L

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The current study was conducted during the year 2023 to evaluate the effect of different photoperiod regimes on the egg parameters and voltinism behaviour of the silkworm *Bombyx mori* L. The bivoltine silkworm race SK7 (Berhampur) was selected as an experimental material. The disease-free layings (DFL's) were obtained from the Silkworm Germplasm Bank of College of Temperate Sericulture, Mirgund (SKUAST-K). The layings were incubated at $25\pm 1^{\circ}\text{C}$ temperature and relative humidity of $80\pm 5\%$ for about 11 days under different photoperiod regimes till hatching with a control group. Rearing of the treated batches was conducted by maintaining three replications per treatment adapting standard package of practices. The results of the study revealed non-significant results in all the egg and egg-shell colour, egg shape but showed variation in fecundity, Hatching percentage and diapausing and non-diapausing egg percentage. In terms of fecundity the significantly highest mean fecundity of 732.67 was recorded in the treatment T₆ (24L: 00D) where continuous light was given as a treatment. Conversely, the significantly lowest mean fecundity 618.67 was recorded in T₁ (00L: 24D) where dark environment was given as the treatment. Improvement in the parameter was observed with respect to the treatments exposed to longer light durations. Among the treatments, moths from only one treatment T₅ (20L: 04D) laid non-diapausing eggs (100%) that undergo direct development without any diapause. The non-diapausing egg percentage was found 100 per cent. On the contrary, all the moths from other treatments including control laid only diapausing eggs (100%). The total hatching percentage of non-diapausing eggs was 94.08 per cent. The remaining eggs were found dead. Egg and egg shell colour was light yellow at the time of oviposition. Light to dark Brown after two to three days of oviposition. Then all treated eggs except treatment five (20L: 00D) turned greyish due to diapause. The major finding of the study has been the change in the voltinism of the race under photoperiod of 20 hours light and 04 hours darkness which resulted in the expression of bivoltine character of





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the breed with hatching percentage of 94.08 per cent under natural conditions which means that these layings need not to be acid treated for second crop.

Keywords: *Bombyx mori*, Photoperiod, Regimes, Silkworm, Voltinism



Rapid Virtual Oral Presentation



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Exploring Silkworm Pupae as a Promising Biodiesel Precursor

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This study investigates silkworm pupae (*Bombyx mori*) waste from sericulture industries as a sustainable biodiesel precursor, addressing the need for non-food competing feedstocks in renewable fuel production. Silkworm pupae samples underwent Soxhlet lipid extraction using hexane, followed by transesterification with methanol and KOH catalyst under optimized conditions (60°C, 1:6 oil-to-methanol ratio, 1% KOH). The extracted pupae yielded 18-23% lipid content by dry weight, achieving 92-96% transesterification conversion efficiency. Gas chromatography-mass spectrometry analysis revealed a favorable fatty acid profile with 42% oleic acid and 18% linoleic acid. The resulting biodiesel met international quality standards (ASTM D6751, EN 14214) with cetane number of 52-56, kinematic viscosity of 4.2-4.8 mm²/s at 40°C, and acid value below 0.5 mg KOH/g. The balanced composition of saturated (32%) and unsaturated (68%) fatty acids contributed to excellent cold flow properties and oxidative stability. Results demonstrate that silkworm pupae represent a promising waste-to-energy feedstock for biodiesel production, offering environmental benefits through waste valorization while producing high-quality fuel that meets commercial standards, positioning this approach as a viable supplement to conventional biodiesel feedstocks in sustainable energy diversification strategies.

Keywords: Alternative fuels, Biodiesel, *Bombyx mori*, Silkworm Pupae, Sustainable energy, Transesterification, Waste valorization





Impact of Mating Duration on Reproductive and Biochemical Parameters of Mulberry Silkworm (*Bombyx mori* L.)

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The study was undertaken during spring 2024 to assess the impact of different mating durations (1-5 hours) on some reproductive and Biochemical parameters of the silkworm *B. mori* L. The healthy seed cocoons of inbred silkworm races viz; CSR2 and CSR4 were obtained from the Silkworm Germplasm Bank, CoTS, SKUAST-K, Mirgund. The selected cocoons were cut open for sex determination, the male and female pupae were segregated and maintained separately under ideal temperature at $25\pm 1^{\circ}\text{C}$ and relative humidity of 75-80% till moth formation. The male and female silk moths were utilized as experimental material and allowed to copulate as per the experimental plan. The study revealed that mating duration has significant impact on the pre-oviposition duration, oviposition duration, fecundity (number of eggs laid/laying), fertility (viable egg percentage), egg retention percentage, egg weight and hatching percentage in silkworm *B. mori* L. The pre-oviposition and oviposition durations decreased with increase in mating duration. Fecundity and fertility increased with increase in mating duration and maximum fecundity and fertility of 532 and 97 per cent was recorded at 5 hours mating duration. However, egg retention percentage decreased, while egg weight increased with increase in mating duration. Specifically, the hatching percentage was found to increase with longer mating durations and highest hatching percentage of 97 per cent was recorded at 5 hours mating duration. In case of biochemical parameters viz; carbohydrate and protein content of silkworm egg, no significant variations were observed across the treatments. The study highlights the importance of optimizing mating duration for reproductive success, making it a valuable factor in silkworm breeding programs aimed at maximizing viable egg production.

Keywords: *Bombyx mori*, Biochemical, Duration, Mating, Mulberry, Reproductive, Silkworm.





Insects as Food and Feed

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Insects are becoming more widely acknowledged as a wholesome and sustainable food source to help with upcoming issues with food security. Around the world, more than 2,000 bug species are eaten, especially in Asia, Africa, and Latin America. In addition to vital amino acids, polyunsaturated fatty acids, and minerals including iron, zinc, and vitamin B12, edible insects offer high-quality protein that ranges from 35 to 77 per cent of dry weight. Insect farming consumes a lot less space and water, generates 50–100 times fewer greenhouse gas emissions, and requires up to 12 times less feed than conventional livestock. For instance, only roughly 1.7 kg of feed is needed to produce 1 kg of cricket protein, as opposed to 8 kg for beef. Additionally, insects promote models of the circular economy by turning organic waste, such as food waste, into useful biomass. Notwithstanding these benefits, consumer adoption is still a challenge, particularly in Western cultures where entomophagy is not a common practice. Processing innovations that have the potential to increase acceptance include adding insect protein to flour, snacks, and meat substitutes. Given that the world's protein needs are expected to increase by 70% by 2050, insects offer a healthy, sustainable, and financially possible alternative protein source. To mainstream insects as a food source in cuisines around the world, more study, regulatory backing, and consumer education are essential.

Keywords: Entomophagy, Greenhouse gas, Insect Farming, Organic waste, Sustainable





Non-Apis Bee Pollinators and Their Floral Preference in Coastal Agroecosystems of Tamil Nadu

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Bee populations with high abundance and diversity are vital for ensuring effective pollination in both cultivated crops and natural ecosystems. While managed honeybees are widely recognized, wild non-Apis bees provide equally valuable services by contributing significantly to crop pollination and sustaining forests, grasslands, and wildflowers. Their ecological role, though difficult to quantify economically, remains indispensable. The present study was conducted in the Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar, during the Winter 2023 - 2024 and Summer 2024 seasons, to record the floral preferences of non-Apis bee pollinators. A total of 18 bee species were recorded across agricultural and horticultural ecosystems, representing the families Apidae, Megachilidae, Halictidae, and Vespidae. The plant species visited by bees were categorized based on their level of attraction. The major plant families attracting non-Apis bees, in order of increasing preference, were Lamiaceae, Asteraceae, Apocynaceae, Polygonaceae, Solanaceae, Fabaceae, Cucurbitaceae, and Verbenaceae. Apart from foraging on the flowers, the solitary bees were found nesting in soil and dried stems. Continuous availability of flowers in the ecosystem was found to sustain different species of bees during the seasons, Winter and Summer. The ranking of plant families based on their ability to attract pollinators provides crucial insights for conservation efforts. This information can be used to select plant species for habitat restoration projects aimed at enhancing pollinator diversity and ecosystem resilience. The presence of non-Apis pollinators across a diverse range of plant species highlights the importance of maintaining a rich and varied plant community to support pollinators that are vital for both ecological balance and agricultural productivity.

Keywords: Agroecosystems, Conservation Strategies, Floral preference, Non-Apis bees, Pollination, Ecology





Physicochemical Characterization of *Apis mellifera* Bee Pollen from Jammu & Kashmir

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Bee pollen, an important product of beekeeping, has become increasingly popular as a natural dietary supplement due to its remarkable nutritional profile and potential health benefits for various illnesses. This study examined the physicochemical properties of bee pollen sourced from different agro-climatic areas in Jammu and Kashmir, specifically from the species *Apis mellifera* L. The parameters, such as moisture content, protein, lipids, total sugars, reducing sugars, and mineral composition were examined. The moisture content varied between 2.1% and 6.8%, with some samples surpassing the acceptable limit of 4%. This indicates a pressing need for better drying and storage techniques. The protein content was notably high, averaging 19.8%, highlighting the value of bee pollen as a source of plant-based protein. On the other hand, lipid levels were relatively low, averaging 4.7%. Interestingly, reducing sugars comprised a significant portion of the dry weight, accounting for nearly half (47–49 g/100 g), which emphasize its potential as an energy-rich food. Phosphorus emerged as the most abundant element, followed by potassium, calcium, and magnesium. There were also notable differences in mineral levels depending on the location of the samples. Overall, our findings confirm that bee pollen from Jammu and Kashmir is a nutritionally rich food with promising applications in functional foods, nutraceuticals, and other value-added products. To further enhance the commercial potential and sustainability of bee pollen, it would be beneficial to establish region-specific quality standards and improve post-harvest management practices.

Keywords: *Apis mellifera*, Bee pollen, Honey bee, Nutritional Profile, Physico-Chemical





Study on Host Preference of Lac Insect Species (*Kerria manipurensis* Ahmad & Ramamurthy sp. nov.) Existing in Manipur

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One of nature's blessings to humanity is the lac insect, *Kerria lacca* Kerr. Because it generates resin, wax, and colour, and because its quantity, quality, and productivity depend on the hosts on which it is cultivated, lac insects are economically significant. The study examined the host preference of the lac insect species found in Manipur (*Kerria manipurensis* Ahmad & Ramamurthy sp. nov.) under greenhouse conditions during the 2019–20 *katki* season, using a completely randomised block design with five hosts replicated three times. Three distinct host parts, namely upper, middle and lower portions, had varying mean initial densities of first instar nymphs (10-19, 10-20, and 9-23 crawlers/cm²), and the corresponding mean initial mortality percentages were 10-19%, 10-20%, and 9-23% (per cm²). The first instar nymph's mean final density (crawlers per cm²) varied from 94 to 115, 94 to 115, and 93 to 114. At maturity, female insects had densities ranging from 2 to 8, 2 to 9, and 3 to 11 cells per cm². Cell weights were from 8–24, 9–24, and 8–23 (mg) on average. The insect's mean fecundity (eggs per cell) varied from 188-327, 197-317, and 188-316. On the upper, middle, and lower portions, the mean scraped lac yield varied from 62-173, 66-170, and 59-165 (g), respectively. According to the current study, during the *katki* season, *Flemingia macrophylla* was the most favoured host in the Manipur region.

Keywords: Crawler, Economic importance, Host preference, Katki, Lac Insect



Theme VI

**Scientific and Industrial Interaction -
Policy Frameworks on the Safe and
Sustainable Deployment of Eco-Friendly
Molecules in Pest Management.**





Scientific and Industrial Interaction- Panel Discussion

- ❖ **Debatable Issue:** Policy Frameworks on the Safe and Sustainable Deployment of Eco-Friendly Molecules in Pest Management.

Chairman/ Moderator: Dr. V.B. Patel
ADG (Horticulture and Plantation Crops) ICAR, New
Delhi

Co-Chairman/Co-Moderator: Dr. M. K. Verma
Director, ICAR-CITH, Srinagar

Discussion Panellist: (Policymakers and industry stakeholders)

- Dr. P. K. Chakrabarty, Former Member ASRB, ICAR, New Delhi
- Dr. B Sarath Babu, President, Plant Protection Association of India
- Director, Horticulture, Planning and Marketing
- Director Horticulture Kashmir
- Director Agriculture Kashmir
- Dr. F. A. Zaki, Ex. Dean, FoH, SKAUST-K
- Dr. Malik Mukhtar, Prof. & Head, RCRQA, SKUAST-K
- Dr. Gururaj Katti, Ex. PS (Entomology), ICAR-IIRR, Hyderabad
- Representative of JK BANK
- Representative of Pesticides Companies
- Officials from Line Departments (Agri./Horti.) of Kashmir





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Fig. 1-10. Various stages of *Paratetraneura* sp. on available and its life stages. 1. Swollen-like excrescence on the bark. 2. Infested unhealthy tree. 3. Tunnels made by the larvae under the bark portion. 4. Extended pupal skins. 5. Tree with dried branches. 6. Tree with sparse foliage. 7. Larva inside larva. 8. Prolegs. 9. Pupa. 10. Adult (female). For details see page no. 611 of this issue.

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SKUAST-K RANKINGS 2025



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Government of India

7th

Rank in
Agriculture & Allied
Sectors Category

by National
Institutional Ranking
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3rd

Best State
Agriculture
University

36th

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among all State
Public Universities

by National
Institutional Ranking
Framework-2025

75th

Rank in
University
category

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Institutional Ranking
Framework-2025

94th

Rank in
Overall
Category

by National
Institutional Ranking
Framework-2025

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University

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NEP 2020

Culture of Student Startups
& Entrepreneurship

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