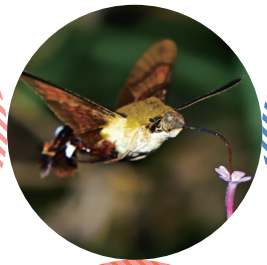
2025 Fall International Conference of KSAE

KOREAN SOCIETY OF APPLIED ENTOMOLOGY

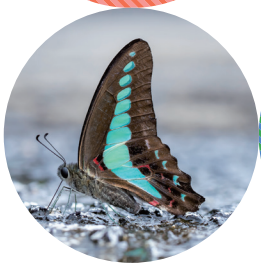
Unveiling New Frontiers in Asian Entomology

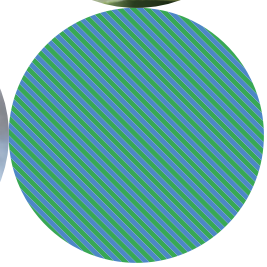


자료집 보기

22(Wed)-24(Fri) October 2025

JEJU SHINHWA WORLD LANDING





Hosted by (사)한국응용곤충학회 Korean Society of Applied Entomology

Organized by (사)한국응용곤충학회 Korean Society of Applied Entomology, 국립제주대학교 JEJU NATIONAL UNIVERSITY

Sponsored by 교육부 Ministry of Education, KOFST, 제주관광공사 JEJU TOURISM ORGANIZATION

2025 Fall International Conference of KSAE

KOREAN SOCIETY OF APPLIED ENTOMOLOGY

Unveiling New Frontiers in Asian Entomology

자료집 보기

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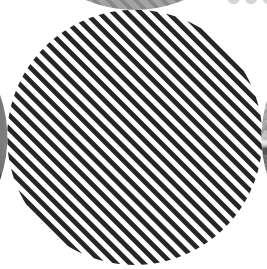
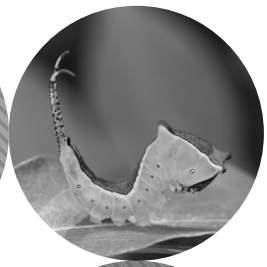
JEJU SHINHWA WORLD





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국립제주대학교 JEJU NATIONAL UNIVERSITY

Sponsored by 교육부 Ministry of Education

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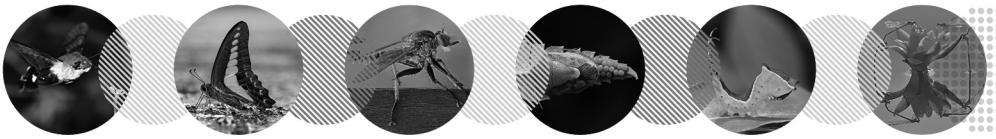
본 사업은 기획재정부의 복권기금 및 과학기술정보통신부의 과학기술진흥 기금으로 추진되어
사회적 가치 실현과 국가 과학기술 발전에 기여합니다.
This work is supported by the 'Lottery Fund' of the 'Ministry of Strategy and Finance' and the 'Science and Technology Promotion Fund' of the 'Ministry of Science and ICT', contributing to the realization of social value and the development of national science and technology.



인사말

안녕하십니까.

이번 추계학술대회의 슬로건은 “Unveiling New Frontiers in Asian Entomology”로, 아시아 곤충학의 새로운 지평을 여는 미래 지향적 비전을 담고 있습니다. 이 주제는 우리 학회가 한국양봉학회, 한국잠사학회 등과 함께 추진하고 있는 세계곤충학회(ICE 2033, 대전) 유치를 향한 국제적 여정의 이정표이기도 합니다. 짧은 준비 기간에도 불구하고 세계곤충학회 유치 제안서 작성에 헌신해주신 김주일 사무총장을 비롯한 조직위원회 위원 여러분께 깊은 감사를 드립니다. 아울러, 유치 활동에 지지 서한을 보내주신 이승돈 농촌진흥청장님, 김영광 국립산림과학원장님, 김도형 바이엘코리아 연구소장을 비롯한 모든 관계자 여러분께 진심으로 감사의 인사를 전합니다.

우리 학회는 현재 세대교체의 전환점에 있습니다. 2000년대 이후 회원 수가 급증하였으며, 다양한 분야의 젊은 곤충학자들이 중심을 이루고 있습니다. 이번 ICE 2033 유치 과정이 이러한 인재들이 학회의 주역으로 성장하고, 국제 무대에서 활약할 수 있는 발판이 되기를 진심으로 기대합니다.

이번 추계학술대회는 제주 신화월드에서 개최되며, 총 361건의 발표가 진행됩니다. 기조강연 2편, 심포지엄 56편, 구두발표 71편(고등학생 발표 6편 포함), 포스터발표 213편, 소모임 19건 등으로, 그 어느 해보다 풍성한 프로그램이 준비되었습니다. 소중한 연구 성과들이 이번 학회를 통해 활발히 공유되고, 열띤 토론을 통해 더욱 발전하기를 바랍니다.

특히 제주에서 개최되는 이번 학회에서는 지역 농업과의 연계를 위한 특별세션으로, “친환경 병해충 관리”를 주제로 한 심포지엄이 마련되었습니다. 지난해 춘계학회에서는 곤충학에서의 ESG (사회가치경영)를 다룬 바 있는데, 이러한 프로그램은 지역사회와 연계된 사회적 책임 실현의 일환으로서 더욱 의미가 있다고 생각합니다. 앞으로 우리 학회가 개최되는 지역의 현황과 이슈를 반영한 정례적 특별세션 운영도 검토해볼 수 있을 것입니다.

끝으로, 학회를 준비해주신 사무국과 학술위원회 위원님들의 노고에 깊이 감사드리며, 먼 곳에서 참석해주신 국내외 연사님들, 그리고 소중한 시간을 내어 학회에 함께해주신 회원 여러분 모두의 학문적 교류와 성과가 풍성히 이루어지기를 진심으로 기원합니다.

감사합니다.

2025년 10월 22일
(사)한국응용곤충학회
34대 회장 **김 동 순**

Welcome Message

Dear colleagues, researchers, and honored guests,

It is my great pleasure to welcome you to the 2025 Fall Meeting of the Korean Society of Applied Entomology, held at Shinhwa World in Jeju.

This year's theme, "Unveiling New Frontiers in Asian Entomology," reflects our shared vision to expand the horizon of entomological research across Asia. It also symbolizes our society's strategic journey toward the successful hosting of the International Congress of Entomology (ICE 2033) in Daejeon, in collaboration with the Korean Society of Sericultural Science and the Korean Society of Apiculture. I would like to express my sincere appreciation to Professor Juil Kim, Secretary-General of our society, and all members of the organizing committee for their tireless efforts in preparing the bid in such a short time. I also wish to extend my deepest thanks to Dr. Seungdon Lee (Administrator of the Rural Development Administration), Dr. Young-Kwang Kim (President of the National Institute of Forest Science), and Dr. Dohyoung Kim (Site manager, Bayer CropScience Korea), along with many others who have provided letters of support for our ICE 2033 bid.

Our society now stands at a generational turning point. Since the 2000s, we have experienced a rapid increase in membership, and our community is now enriched with diverse and passionate young entomologists. I sincerely hope that the ICE 2033 journey will serve as an opportunity for the next generation of scientists to take the lead and grow as international contributors in entomology.

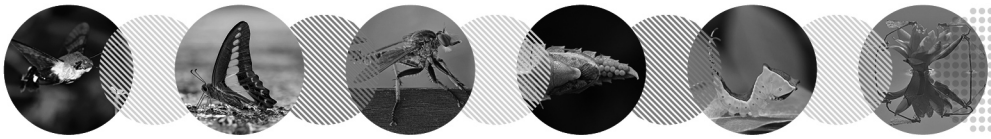
This fall meeting brings together a total of 361 presentations, including 2 keynote speeches, 56 symposium talks, 71 oral presentations (6 by high school students), 213 posters, and 19 organized gatherings. I hope these valuable research outcomes will be shared, discussed, and further developed through this dynamic academic platform.

In particular, we are proud to host a special symposium on "Eco-friendly Pest Management", aimed at engaging with local farming communities here in Jeju. This initiative builds on our previous exploration of ESG (Environmental, Social, and Governance) themes in entomology and represents our society's broader commitment to social value and public engagement. I believe it is worth considering the regular inclusion of regional issue-based special sessions in future meetings held throughout the country.

I would like to once again thank the secretariat and academic committee for their dedication, and I extend a warm welcome to all participants, especially our invited speakers from abroad. I wish you all a fruitful and inspiring academic experience during this conference.

Thank you very much.

President of the Korean Society of Applied Entomology
Dong-Soon Kim



Program

■ 2025 Fall International Conference of KSAE ■

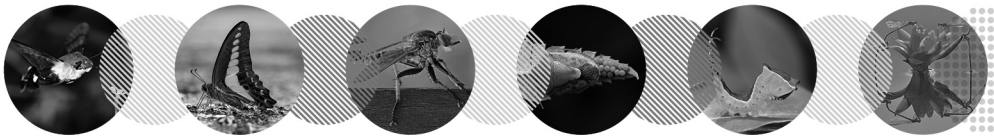
- Unveiling New Frontiers in Asian Entomology -

22 October (Wed)

Time	Contents	Room
12:30~	Registration	Desk
	Oral Presentation I (Competition)	
14:00~16:30	Post Graduates, All subjects	Landing Ballroom (A+B) (LGF)
	All Members, Taxonomy, Phylogeny	Youngju Room (GF)
	All Members, Ecology, Industrial Entomology I	Olle Room (GF)
	High School Students	Baengnok Room (GF)
16:30~16:40	Coffee Break	
	Plenary Lecture I	
16:40~17:20	Advances in Industrialization Technologies and Green Pest Management Practices for the Predatory Bug *Arma chinensis* Lisheng Zhang (Chinese Academy of Agricultural Sciences)	Landing Ballroom (A+B) (LGF)
17:20~17:40	Coffee Break	
	General Meeting	
17:40~18:00	Introduction, Business Report, Awards of Story Picture Competition of Agricultural Pests and Dongoh Farming Foundation and High School Student Competition	Landing Ballroom (A+B) (LGF)
	Welcome Reception	
18:20 ~	Buffet Dinner	Landing Ballroom (A+B) (LGF)
	Small Group Meetings	
20:00~21:30	Insecticide Resistance Monitoring of Western Flower Thrips in Pepper Cultivation Facilities DongWoon Lee (Kyungpook National University)	Youngju Room (GF)
	dsRNA as a Biopesticide: Mechanism Studies and Applications June-Sun Yoon (Jeonbuk National University) Mi-young Noh (Chonnam National University)	Olle Room (GF)
	Ecology and Management of Forest Insect Pests Jong-Kook Jung (Kangwon National University)	Udo Room (GF)
	Korea Research Group of Pest & Disease Modeling Sunghoon Baek (EPINET.co., Ltd.)	Baengnok Room (GF)
	2033 ICE Local Organizing Committee (LOC) Meeting Juil Kim (Kangwon National University)	Eorimok Room (GF)

23 October (Thu)

Symposia		
09:00~11:30	Current Opinion in Insect Toxicology: Mechanism and Functions Juil Kim (Kangwon National University)	Landing Ballroom A (LGF)
	Integrated Research for Plant Protection: Cross Dialogue between Plants and Insects Jung-Joon Park (Gyeongsang National University)	Landing Ballroom B (LGF)
	Genomic Regulatory Networks in Arthropods: Physiological Roles and Applied Potentials Yoonseong Park (Kansas State University) Donghun Kim (Kyungpook National University)	Landing Ballroom C (LGF)
	Insect Chemical Ecology in Korea 8th : New Frontiers in Chemical Ecology Junheon Kim (National Institute of Forest Science) Gwang Hyun Roh (Gyeongsang National University)	Youngju Room (GF)
	Integrative Studies on Social Insects: Ecology, Physiology, Behavior, and Applications Young Ho Kim (Kyungpook National University)	Olle Room (GF)
11:30~11:40	Coffee Break	
Plenary Lecture II		
11:40~12:20	Prediction of Rice Damage by Hemipteran Pests: a Spatially Explicit Model Using Land Use Data for Mapping Hazard Ken TABUCHI (Tohoku Agricultural Research Center, NARO)	Landing Ballroom A (LGF)
12:20~14:00	Lunch (provided by KSAE)	Landing Dining (GF)
Symposium / Oral Presentation II (Competition & Non-Competition)		
14:00~16:30	Eco-Friendly Pest Management for Jeju Organic Farmers: Practical Strategies and Biopesticide Solutions Dong-Soon Kim (Jeju National University) Young Su Lee (Gyeonggi-do Agricultural Research and Extension Services)	Landing Ballroom A (LGF)
	All members, Ecology II	Landing Ballroom B (LGF)
	All members, Physiology, Pest Control I	Landing Ballroom C (LGF)
	All members, Physiology, Pest Control II	Youngju Room (GF)
	All members, All subjects	Olle Room (GF)
16:30~16:40	Coffee Break	
Poster Session (Competition & Non-Competition)		
16:40~17:40	Poster Presentation	Foyer (LGF)
17:40~18:40	Students Mixer (Beer & Finger Food)	
Small Group Meetings		
20:00~21:30	Editorial Board Meeting: Publishing Policies, Research Ethics & Education, etc. Kijong Cho (Korea University) Jung-Joon Park (Gyeongsang National University)	Landing Ballroom A (LGF)
	Academy Committee Meeting DongWoon Lee (Kyungpook National University) Donghun Kim (Kyungpook National University)	Landing Ballroom B (LGF)



24 October (Fri)

Symposia II		
09:00~11:30	Developmental Strategy of Natural Enemy Business and Field Application in Asia Kyeong-Yeoll Lee (Kyungpook National University)	Landing Ballroom A (LGF)
	Insect Contaminants in Food and Packaging: Hygienic Issues & Management Dong-Soon Kim (Jeju National University) Jahyun Na (Korea University)	Landing Ballroom B (LGF)
	Entomology Across the Mobility Spectrum: Ground-Dwelling to Flying Insects in Ecosystem Doo-Hyung Lee (Gachon University) Yun-Sik Lee (Pusan National University)	Landing Ballroom C (LGF)
	Insecticide Resistance Monitoring & Management Junho Yoon (Seoul National University)	Youngju Room (GF)
	Advanced Strategies against Invasive insect pests Sora Kim (Jeonbuk National University)	Olle Room (GF)
11:30~12:30	Closing Ceremony (Awards of Competition and Raffle Tickets, Presidential Address)	Landing Ballroom A (LGF)

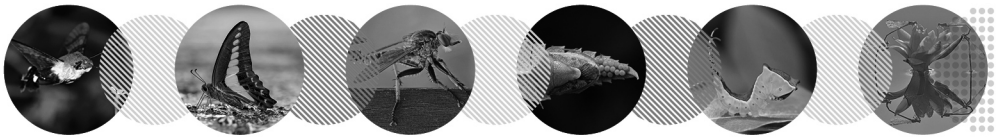
부스 및 전시 안내	
곤충사진전시	제10회 곤충사진 공모전 수상작
JOB CAFE	기관, 기업체와 취업을 희망하는 회원들과의 만남

Contents

Plenary Lecture

Symposium

S1. Current Opinion in Insect Toxicology: Mechanism and Functions



S2. Integrated Research for Plant Protection: Cross Dialogue between Plants and Insects

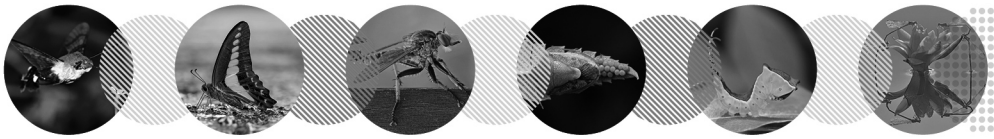
10. 23. Thu | Landing Ballroom B (LGF) | **Organizer :** Jung-Joon Park (Gyeongsang National Univ.)

S3. Genomic Regulatory Networks in Arthropods: Physiological Roles and Applied Potentials

10. 23. Thu | Landing Ballroom C (LGF) | **Organizer :** Yoonseong Park (Kansas State Univ.), Donghun Kim (Kyungpook National Univ.)

S4. Insect Chemical Ecology in Korea 8th : New Frontiers in Chemical Ecology

10. 23. Thu | Youngju Room (GF) | **Organizer :** Junheon Kim (National Institute of Forest Science), Gwang Hyun Roh (Gyeongsang National Univ.)



S5. Integrative Studies on Social Insects: Ecology, Physiology, Behavior, and Applications

10. 23. Thu | Olle Room (GF) | **Organizer :** Young Ho Kim (Kyungpook National Univ.)

S6. Eco-Friendly Pest Management for Jeju Organic Farmers: Practical Strategies and Biopesticide Solutions

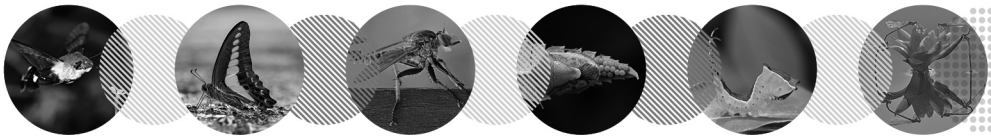
10. 23. Thu | Landing Ballroom A (LGF) | **Organizer :** Dong-Soon Kim (Jeju National Univ.), Young Su Lee (Gyeonggi-do Agricultural Research and Extension Services)

S7. Developmental Strategy of Natural Enemy Business and Field Application in Asia

10. 24. Fri	Landing Ballroom A (LGF)	**Organizer :** Kyeong-Yeoll Lee (Kyungpook National Univ.)

S8. Insect Contaminants in Food and Packaging: Hygienic Issues & Management

10. 24. Fri	Landing Ballroom B (LGF)	**Organizer :** Dong-Soon Kim (Jeju National Univ.) Jahyun Na (Korea Univ.)



S9. Entomology Across the Mobility Spectrum: Ground-Dwelling to Flying Insects in Ecosystem

10. 24. Fri | Landing Ballroom C (LGF) | **Organizer :** Doo-Hyung Lee (Gachon Univ.), Yun-Sik Lee (Pusan National Univ.)

S10. Insecticide Resistance Monitoring & Management

10. 24. Fri | Youngju Room (GF) | **Organizer :** Junho Yoon (Seoul National Univ.)

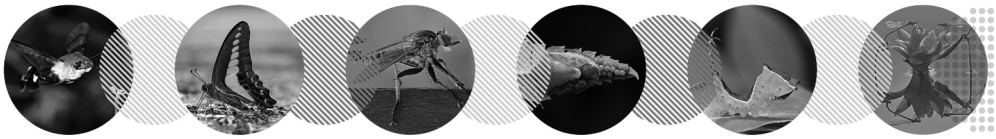
S11. Advanced Strategies against Invasive insect pests

10. 24. Fri | Olle Room (GF) | **Organizer :** Sora Kim (Jeonbuk National Univ.)

Oral Presentation - Competition

1. Post Graduates - All subjects

10. 22. Wed | Landing Ballroom (A+B) (LGF) | **Moderator :** Geonho Cho (Sunchon National Univ.) Junho Yoon (Seoul National Univ.)

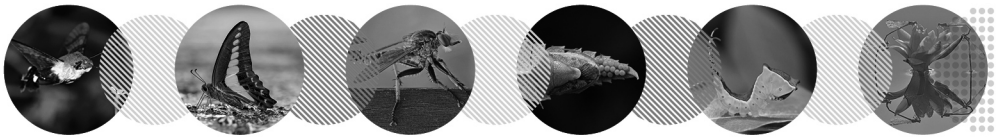


2. All members - Taxonomy, Phylogeny

10. 22. Wed | Youngju Room (GF) | **Moderator :** Sol-Moon Na (Animal and Plant Quarantine Agency), Jun-Mo Koo (Ewha Womans Univ.)

2. All members - Ecology, Industrial Entomology I

10. 22. Wed | Olle Room (GF) | **Moderator :** Sunghoon Baek (Epinet Co., Ltd) June Wee (Chungnam National Univ.)

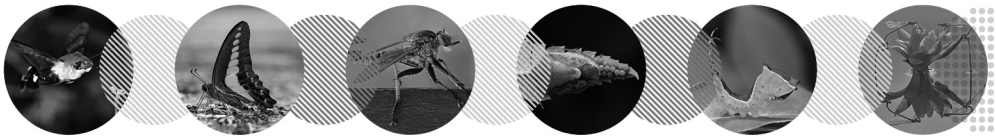


2. All members - Ecology, Industrial Entomology II

10. 23. Thu | Landing Ballroom B (LGF) | **Moderator :** Kyeong Yong Lee (National Institute of Agricultural Science), June Wee (Chungnam National Univ.)

2. All members - Physiology, Pest Control I

10. 23. Thu | Landing Ballroom C (LGF) | **Moderator :** Doo-Hyung Lee (Gachon Univ.), Yun-Sik Lee (Pusan National Univ.)



2. All members - Physiology, Pest Control II

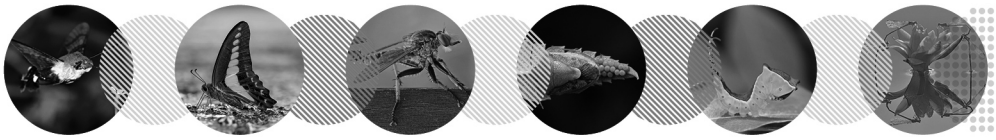
10. 23. Thu | Youngju Room (GF) | **Moderator :** Kyungjae Andrew Yoon (Chungbuk National Univ.), Jong-Hoon Kim (Pukyong National Univ.)

High School Students

10. 22. Wed	Baengnok Room (GF)	**Moderator :** Changku Kang (Seoul National Univ.) Keon Mook Seong (Chungnam National Univ.) Seunghyun Lee (Seoul National Univ.)

Oral Presentation - Non-Competition

10. 23. Thu	Olle Room (GF)	**Moderator :** Junheon Kim (National Institute of Forest Science) Kyungsan Choi (BySTo)



Poster Presentation - Competition

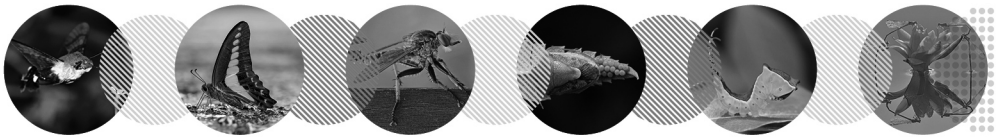
1. Undergraduate

Moderator : Sol-Moon Na (Animal and Plant Quarantine Agency)
Jun-Mo Koo (Ewha Womans Univ.)

2. General - Taxonomy / Phylogeny

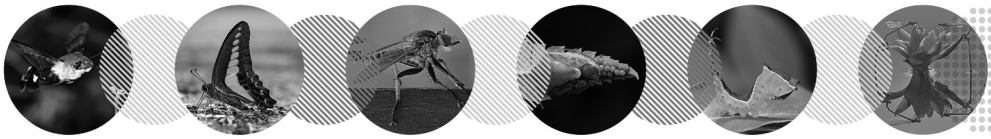
Moderator : Sol-Moon Na (Animal and Plant Quarantine Agency)
Jun-Mo Koo (Ewha Womans Univ.)

Moderator : Geonho Cho (Sunchon National Univ.)
Yeong-Bin Cha (Korea National Arboretum)



Moderator : Sora Kim (Jeonbuk National Univ.)
Dong-June Lee (Honam National Institute of Biological Resources)

Moderator : Hwalran Choi (Seoul National Univ.)
Seunghyun Lee (Seoul National Univ.)

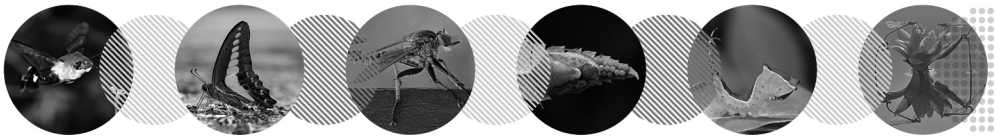


2. General - Physiology

Moderator : Gwang Hyun Roh (Gyeongsang National Univ.)
Jinmo Koo (Kyungpook National Univ.)

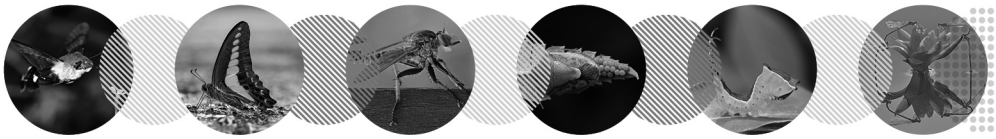
2. General - Pest Control

Moderator : Kyungjae Andrew Yoon (Chungbuk National Univ.)
Hwal-Su Hwang (Kyungpook National Univ.)



Moderator : Sung-Wook Jeon (National Institute of Agricultural Sciences)
Mi Hye Seo (National Institute of Horticultural and Herbal Science)

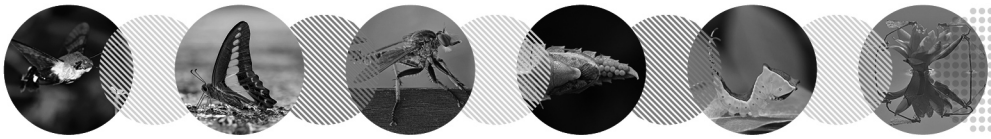
Moderator : Min-Ki Kim (Gyeongsangbuk-do Agricultural Research and Extension Services)
Youngjin Park (Gyeongkuk National Univ.)



2. General - Ecology

Moderator : June-Sun Yoon (Jeonbuk National Univ.)
Yun-Sik Lee (Pusan National Univ.)

Moderator : Kyeong Yong Lee (National Institute of Agricultural Science)
Bo-Sun Park (National Institute of Agricultural Science)

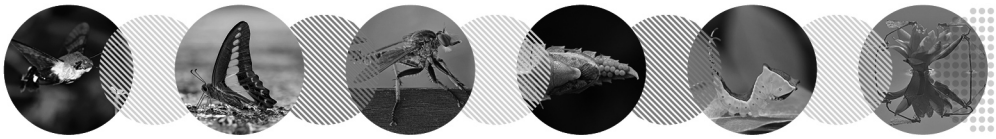


2. General - Industrial Entomology

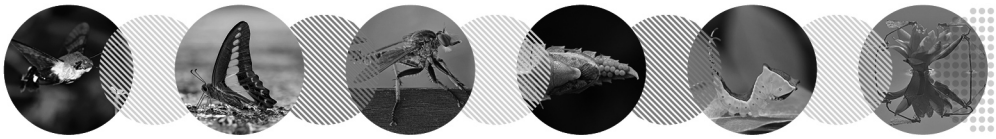
Moderator : Young Uk Park (Chungcheongbuk-do Agricultural Research & Extension Services)
Ye Jin Kyung (Chungcheongbuk-do Agricultural Research & Extension Services)

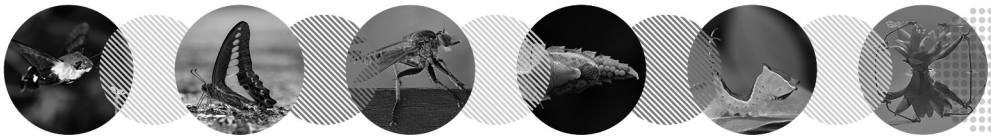
Poster Presentation - Non-Competition

1. Taxonomy / Phylogeny

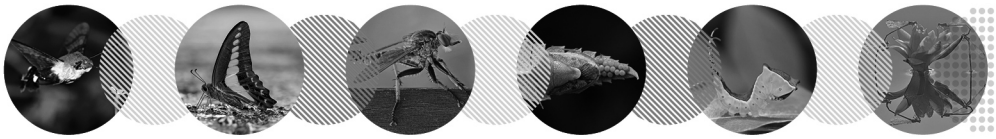


2. Physiology / Pest Control

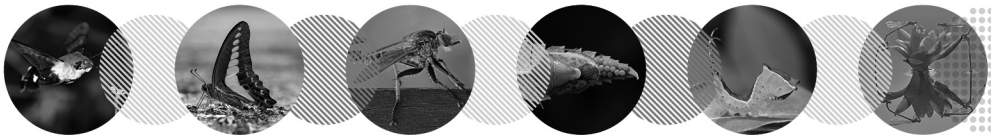




3. Ecology



4. Industrial Entomology



Small Group Meeting

1. Insecticide Resistance Monitoring of Western Flower Thrips in Pepper Cultivation Facilities

10. 22. Wed | Youngju Room (GF) | **Organizer :** DongWoon Lee (Kyungpook National Univ.)

2. dsRNA as a biopesticide: Mechanism studies and Applications

10. 22. Wed | Olle Room (GF) | **Organizer :** June-Sun Yoon (Jeonbuk National Univ.), Mi-young Noh (Chonnam National Univ.)

3. Ecology and management of forest insect pests

10. 22. Wed Udo Room (GF) **Organizer :** Jong-Kook Jung (Kangwon National Univ.)

4. Korea Research Group of Pest & Disease Modeling

10. 22. Wed Baengnok Room (GF) **Organizer :** Sunghoon Baek (EPINET. co., Ltd.)

5. 2033 ICE Organizing Committee Meeting

10. 22. Wed Eorimok Room (GF) **Organizer :** Juil Kim (Kangwon National University)

Plenary Lecture

Plenary Lecture 1

Advances in Industrialization Technologies and Green Pest Management Practices for the Predatory Bug *Arma chinensis*

Lisheng Zhang, Yuyan Li, Maosen Zhang, Chuanzhen Xue, Junjie Chen, Mengqing Wang and Jianjun Mao

State Key Laboratory for Biology of Plant Diseases and Insect Pests, Key Laboratory of Natural Enemy Insects, Ministry of Agriculture and Rural Affairs, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing, P. R. China

This study comprehensively presents technological innovations in the mass production, long-term storage, and field application of the predatory stinkbug *Arma chinensis* for sustainable pest management. Significant advances include the development of an upgraded production line (version 3.0) for the prey insect *Mythimna separata*, which improved reproduction efficiency by 30%, increased feed utilization by 15%, and tripled space efficiency, yielding total cost savings of ¥5.37 million. Simultaneously, an artificial diet for *Arma chinensis* was optimized through nutritional reformulation and refined processing, leading to higher egg production and feeding efficiency. Rearing parameters including temperature, humidity, and light were systematically fine-tuned, improving survival rates and reducing cannibalism.

Further contributing to annually production, efficient long-term storage techniques were developed based on diapause regulation and low-temperature acclimation. A diapause induction protocol under short photoperiod (8–10 h) and low temperature (15°C/5°C) achieved induction rates exceeding 90%, allowing adult viability for up to 160–300 days. A stepwise cooling acclimation process (26°C → 4°C) enabled successful storage of adults for approximately 7 weeks at 4°C. High survival rates were also attained for fourth- and fifth-instar nymphs stored at 15°C/5°C under 8L:16D conditions, exceeding 80% after 30 days and 82% for fifth-instars after 60 days. Post-storage assessments confirmed that reproductive output, egg hatch rate, offspring development, and predation capacity remained largely uncompromised. These integrated innovations have supported the mass production of over 32 million *Arma chinensis* individuals, deployed across 726,100 mu of tobacco and 304,900 mu of corn and other crops, generating economic benefits of ¥66.84 million. Additional achievements include the identification of alternative prey species (*Tenebrio molitor* and *Spodoptera frugiperda*), development of cost-effective insect-free artificial diets reducing cost per insect by 29.6%, and streamlined packaging and combined feeding strategies that enhance adult recovery and reproduction. Collectively, this research provides a practical and efficient system for the large-scale rearing, storage, and application of *Arma chinensis*, facilitating reduced pesticide use, improved ecological sustainability, and enhanced quality in agricultural production.

Plenary Lecture 2

Prediction of Rice Damage by Hemipteran Pests: a Spatially Explicit Model Using Land Use Data for Mapping Hazard

Ken Tabuchi
Tohoku Agricultural Research Center, NARO, Japan

Effective pest management requires an understanding of how agricultural landscapes influence crop vulnerability. We present a spatially explicit model for predicting rice damage caused by the sorghum plant bug *Stenotus rubrovittatus*. This model is based on land use patterns within a 300-meter radius of rice fields and does not use pest abundance data. It generates hazard maps that guide the application of pesticides and the allocation of labor. The model has been successfully applied in northern Japan and is currently being adapted for another key pest in southern regions. By incorporating multiple species, our goal is to develop a comprehensive prediction system that supports decision-making in various agricultural settings. Because many Asian agricultural landscapes consist of relatively small fields, this approach is expected to be particularly effective in Asia. The framework improves the efficiency of pest control and strengthens the resilience of rice production under changing environmental conditions by enabling stakeholders to visualize risk in space and time. Beyond its practical utility, the method advances landscape ecology by explicitly linking pest dynamics to land-use structure. This presentation will demonstrate how to leverage spatial data and landscape features to forecast pest risks, allocate resources more effectively, and support sustainable crop protection in diverse agricultural settings.

Symposium

S1-1

High-Efficiency Production of Subunit Vaccine Antigens Using Silkworm-Baculovirus Expression System

Jae Man Lee
Kyushu University

Subunit vaccines offer high safety and flexible design but remain limited due to low yields and complex post-translational modifications required for proper folding and immunogenicity. The silkworm–baculovirus expression system (Silkworm-BEVS) provides a solution, enabling reliable production of difficult-to-express antigens and accelerating subunit vaccine development. Oral vaccine platforms based on these antigens allow non-invasive administration and are suitable for mass vaccination, offering new possibilities for controlling emerging and re-emerging infectious diseases, including zoonoses. At Kyushu University, we have established a high-efficiency Silkworm-BEVS platform for recombinant vaccine antigen production. By optimizing antigen design, engineering baculoviruses, and applying molecular breeding of silkworm hosts, we aim to enhance antigen yield and quality, enabling economical large-scale production. This presentation will highlight strategies for improving recombinant vaccine antigen expression using silkworms, with applications in both conventional and oral subunit vaccines for widespread immunization and emerging infectious disease prevention.

Key words: Subunit vaccine, Silkworm-BEVS, Recombinant protein, Vaccine antigen production, Oral vaccine platform

S1-2

First Line or Last Line of Defense? Divergent Metabolic Strategies of Deltamethrin Resistance in Bed Bugs and Cotton Bollworms

Si Hyeock Lee[1], Juil Kim[2], Ju Hyeon Kim[3], Hyun Kyu Shin[1] and Kijung Kwon[1]
[1]Seoul National University, [2]Kangwon National University, [3]Seoul National University College of Medicine

Metabolic resistance can act as either a frontline or last-line defense, depending on how insects deploy detoxification pathways. In the common bed bug, *Cimex lectularius*, deltamethrin resistance is strongly associated with enhanced metabolism. Synergist assays and transcriptomics revealed contributions from cytochrome P450s and esterases, with several enzymes showing cuticle-enriched expression. This localized detoxification likely reduces insecticide penetration at the point of contact, limiting toxicant availability before reaching internal targets. Cross-resistance to dinotefuran was also observed, largely mediated by these metabolic factors, underscoring the broader role of cuticle-based detoxification in bed bug persistence. By contrast, the cotton bollworm, *Helicoverpa armigera*, exhibits a centralized defense. Resistant larvae induce CNS-specific P450s that metabolize deltamethrin at the neuronal target site, mitigating hyperexcitation. This strategy is coupled with inducible catalase activity to buffer P450-driven reactive oxygen species, highlighting the integration of detoxification and oxidative stress management. These contrasting mechanisms, cuticular vs. CNS-coupled detoxification, illustrate how insects evolve divergent metabolic strategies, redefining resistance as either a first line or last line of defense.

Key words: Bed bug, Cotton bollworm, Deltamethrin resistance, CNS-expressed cytochrome P450, Cuticular esterase

S1-3

Salivary glands as promising targets for vector control

Sanghyeon Kim and Daniel R. Swale
Emerging Pathogens Institute, Department of Entomology and Nematology, University of Florida

Arthropod saliva is a complex mixture of peptidic and non-peptidic molecules that not only facilitates feeding but also serves as a medium for pathogen transmission. Some pathogens exploit saliva-induced modulation of host responses to promote their transmission and infection, termed saliva-assisted transmission (SAT). In this presentation, two strategies for modulating arthropod salivary glands will be discussed: chemical modulation of potassium channels in ticks and mosquitoes, and RNA interference targeting salivary proteins in Varroa mites. ATP-gated inward rectifier potassium (KATP) channels are highly expressed in salivary glands and play a key role in regulating saliva secretion. Pharmacological modulation of saliva secretion, and thus blood feeding, was achieved in ticks and mosquitoes using KATP channel inhibitors and activators, with KATP activation resulting in reduced vector competence for Dengue virus serotype 2 in mosquitoes. In Varroa mites, proteomic profiles of secreted saliva were altered following acquisition of Deformed Wing Virus. Furthermore, knockdown of salivary proteins reduced feeding activity, fertility, and vector competence in Varroa mites. Together, these findings highlight salivary glands as promising targets for vector control through the modulation of feeding activity and pathogen transmission.

Key words: Sialome, vector, pathogen, tick, mosquito, Varroa mite

S1-4

Insecticide Resistance in Medical Insects: Mechanisms and Public Health Implications

Ju Hyeon Kim
Department of Tropical Medicine and Parasitology, Seoul National University College of Medicine, Seoul 03080

The range of arthropod-targeted biocides available in Korea is relatively limited, not only for the management of mosquitoes, bed bugs and cockroaches of public health importance, but also for therapeutic use against human ectoparasites such as scabies mites and head lice. The increasing prevalence of resistant mosquito and cockroach populations nationwide, recurrent treatment failures in scabies, large-scale bed bug outbreaks with control failures together underscore the urgent need for a proactive resistance management system. This presentation will provide an overview of the current status of insecticide resistance in medical and urban pests, with particular emphasis on newly identified molecular and physiological mechanisms underlying pyrethroid resistance. In addition, we propose alternative insecticides with potential applicability against pyrethroid-resistant medical arthropod populations, both for public health control and for therapeutic use.

Key words: resistance, insecticide, biocide, medical insect, mosquito, bed bug, cockroach, scabies mite

S1-5

Understanding and Managing Diamide Insecticide Resistance in Lepidopteran Pests: Insights into RyR Mutations and Metabolic Mechanisms

Juil Kim[1], Murtaza Khan[1], Si Hyeock Lee[2] and Ralf Nauen[3]
[1]Kangwon National University, [2]Seoul National University, [3]Bayer AG

Diamide insecticides function as modulators of ryanodine receptors (RyR) in insects and are categorized under group 28 by the Insecticide Resistance Action Committee (IRAC). Since their introduction in 2007, insecticides such as chlorantraniliprole and flubendiamide have been widely used to manage a variety of pests, particularly within the order Lepidoptera, as well as species in Coleoptera, Hymenoptera, Diptera, Hemiptera, and Thysanoptera. However, prolonged and extensive use has led to the emergence of resistance, especially among lepidopteran pests. This resistance is primarily attributed to RyR gene mutations and the upregulation of the detoxifying system. The mode of inheritance and associated fitness costs vary depending on whether the resistance mechanism is target-site-based or metabolism-based. This review examines the molecular mechanisms underlying diamide resistance in lepidopteran pests, drawing from published literature and the author's research findings. Particular focus is given to well-characterized RyR mutations such as G4946E and I4790M, as well as detoxification enzymes like CYP9A40, which has recently been implicated in resistance among noctuid pests. Practical strategies for resistance management are also discussed.

Key words: Diamide insecticides, Lepidoptera, Ryanodine receptor, Detoxification enzymes, Integrated resistance management

S2-1

Ecological and integrated pest management using system dynamics model : a case study in forest ecosystem

Saebom Eom[1], Taechul Park[1] and Jung-Joon Park[1,2]
[1]Department of Plant Medicine, Gyeongsang National University, Jinju, Republic of Korea
[2]Institute of Agriculture and Life Science, Gyeongsang National University, Jinju, Republic of Korea

Pine wilt disease is a lethal affliction caused by *Monochamus alternatus* and *Bursaphelenchus xylophilus*. This disease poses a severe threat to pine forests on the Korean Peninsula, causing not only significant ecological disruption but also devastating losses to the forestry industry and related economies. The spread of the disease is a complex process influenced by the interplay of various biological, environmental, and economic factors, often accelerated by unpredictable events such as wildfires and landslidesTo understand the causal relationships among various components based on the dynamics of pests and diseases within the forest ecosystem, this study utilized a system dynamics model. This model is a computer-aided approach for strategy and policy design. The main goal is to help people make better decisions when confronted with complex, dynamic systems. The approach provides methods and tools to model and analyze dynamic systems. Model results can be used to communicate essential findings to help everyone understand the system's behavior. This study established a quantitative model by selecting biological, environmental, and economic factors associated with pine wilt disease and, through simulation, analyzed how the dynamics of the pests and diseases change over time.

Key words: system dynamics model, simulation, pine tree, *Monochamus alternatus*, *Bursaphelenchus xylophilus*

S2-2

Development of a Random Forest Model for Predicting Annual Accumulated Growing Degree Days in South Korea

Yong Ho Lee[1,2], Young Ju Oh[3], Weon-Tai Jeon[5] and Sun Hee Hong[4]

[1]OJeong Resilience Institute, Korea University, [2]Humanities–Ecology Convergence Resilience Lab, Hankyong National University, [3]Institute for Future Environmental Ecology Co., Ltd, [4]Department of Plant Resources and Landscape Architecture, Hankyong National University, [5]National Institute of Crop Science, Rural Development Administration

Growing degree days (GDD) are widely used to predict insect and plant responses, but fixed base temperatures in climate databases limit species-specific accuracy. Using data from 103 weather stations in South Korea (1995–2024), we developed annual accumulated GDD models with temperature and topographic variables. Random Forest outperformed regression models, showing higher R^2 and lower RMSE. The model enables flexible site-specific GDD estimation, supporting forecasts of species distributions, climate change assessments, and pest management strategies in agriculture and forestry. This study was supported by Rural Development Administration (RS-2024-00428455)

Key words: growing degree days, random forest, predictive model, distribution, base temperature

S2-3

The molecular and biochemical cross-communications between maize and insects

Yong-Soon Park[1,2] and Sun Hee Hong[3]

[1]Department of Plant Resources, Kongju National University

[2]Agricultural and Fisheries Life Science Research Institute, Kongju National University

[3]School of Plant Science and Landscape Architecture, Hankyong National University

Here, we report a novel anti-herbivory mechanism mediated by a tonoplast-localized 9-LOX, ZmLOX5, and its linolenic acid-derived product, 9-hydroxy-10-oxo-12(Z),15(Z)-octadecadienoic acid (9,10-KODA). Transposon-insertional disruption of *ZmLOX5* resulted in the loss of resistance to insect herbivory. *lox5* knock-out mutants displayed greatly reduced wound-induced accumulation of multiple oxylipins and defense metabolites, including benzoxazinoids, abscisic acid (ABA) and JA-isoleucine (JA-Ile). However, exogenous JA-Ile failed to rescue insect defense in *lox5* mutants, while applications of 1 μM 9,10-KODA or the JA precursor, 12-oxo-phytodienoic acid (12-OPDA), restored wild-type resistance levels. Metabolite profiling revealed that exogenous 9,10-KODA primed the plants for increased production of ABA and 12-OPDA, but not JA-Ile. While none of the 9-oxylipins were able to rescue JA-Ile induction, the *lox5* mutant accumulated lower wound-induced levels of Ca^{2+}, suggesting this as a potential explanation for lower wound-induced JA. Seedlings pretreated with 9,10-KODA exhibited rapid or more robust wound-induced defense gene expression. In addition, an artificial diet supplemented with 9,10-KODA arrested fall armyworm larvae growth. Finally, analysis of single and double *lox5* and *lox10* mutants showed that *ZmLOX5* also contributed to insect defense by modulating *ZmLOX10*-mediated green leaf volatile signaling. Our study uncovered a previously unknown antiherbivore defense and hormone-like signaling activity for a major 9-oxylipin α-ketol.

Key words: maize, insect, lipoxygenase

This work was supported by the Biological Control of Weeds Endemic to Asia and Australia that are Invasive in the United States, USDA, 202500140001.

S2-4

Indirect impacts of herbicides on collembolan communities through vegetation shifts

June Wee[1], Yun-Sik Lee[2], Yongeun Kim[3], Sun Hee Hong[4], Jinsol Hong[3] and Kijong Cho[5]
[1]Department of Applied Biology, Chungnam National University, Daejeon 34143, Korea
[2]Department of Biology Education, Pusan National University, Busan 46241, Korea
[3]OJeong Resilience Institute, Korea University, Seoul 02841, Korea
[4]School of Plant Science and Landscape Architecture, Hankyong National University, Anseong 17579, Korea
[5]Department of Environmental Science and Ecological Engineering, Korea University, Seoul 02841, Korea

Glyphosate-based herbicides (GBHs) are among the most extensively used agrochemicals worldwide, raising concerns about their unintended ecological hazards. While GBHs are primarily designed to eliminate weeds, their indirect effects on non-target soil fauna mediated through vegetation change remain poorly understood. We conducted a two-year field experiment in two grassland fallow fields in Korea to evaluate how repeated GBH exposure alters plant communities and, in turn, affects collembolan diversity and community structure. Our findings provide empirical evidence that GBHs can indirectly restructure belowground biodiversity by altering vegetation, highlighting vegetation-mediated pathways as overlooked routes of herbicide hazard.

Key words: Agricultural intensification, ecosystem resilience, bioindicator, soil biodiversity

S2-5

Decoding plant protection against stem-borer: linking ecological interaction to molecular defense

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[1]School of Biological Sciences, Seoul National University
[2]Institute for Data Innovtion in Science, Seoul National University
[3]Department of Biological Sciences, Korea Advanced Institute for Science and Technology

From field to lab, from ecology to molecular biology, we trace how stem-borer resistance in *Nicotiana attenuata* emerges across scales. In field assays, *Trichobaris* adults sort among hosts by sensing plant volatiles that fail to predict larval performance, exposing a sensory filter that decouples choice from offspring success. Comparative experiments then revealed organ-partitioned defenses; spatially localized responses in stems versus leaves align enemy niches on the same plant. Guided by these patterns, lab and field manipulations uncovered a pith-specific lignification program that mechanically constrains galleries and suppresses feeding. Finally, genetic dissection identified jasmonate bHLH regulators MYC2/MYC3 that redirect phenylpropanoid flux to orchestrate rapid lignin deposition. This integrative arc links behavior, tissues, and genes, and yields actionable markers for breeding stem-borer resistance under environmental change.

Key words: *Trichobaris mucorea*, *Nicotiana attenuata*, chemical ecology, lignin

S3-1

Cross gender transferred N-AP as the regulator of the post-mating oviposition in the oriental fruit fly

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[1]Key Laboratory of Entomology and Pest Control Engineering, College of Plant Protection, Southwest University, Chongqing 400715, China

[2]Key Laboratory of Agricultural Biosafety and Green Production of Upper Yangtze River (Ministry of Education), Southwest University, Chongqing 400715, China

This study aimed to identify key small-molecule effectors in the male accessory gland (MAG) secretion that trigger oviposition in females and elucidate the molecular mechanism by which these compounds are perceived by the female reproductive system to induce egg-laying. Using the globally invasive pest *Bactrocera dorsalis* (oriental fruit fly) as a model, we employed behavioral assays, metabolomics, RNA interference, ultra-high-performance liquid chromatography, calcium imaging, in situ hybridization, transcriptome sequencing, and gene editing coupled with behavioral analyses. These approaches were used to (1) identify small-molecule compounds transferred from the male MAG during mating that stimulate oviposition and (2) dissect their mechanistic action in females. We identified N-AP, a small molecule in the male MAG secretion, as the key bioactive compound triggering oviposition. Quantitative analysis revealed the dynamic transfer of N-AP from the MAG to the female reproductive tract during mating. RNAi knockdown confirmed that N-AP synthesis in males regulates female egg-laying. Furthermore, we demonstrated that N-AP binds to the ionotropic receptor complex BdIR25a+BdIR85a in the female reproductive tract to activate oviposition. This study unveils a novel "N-AP–IR" signaling system governing post-mating oviposition in *B. dorsalis*: N-AP, secreted by the male MAG, is transferred to the female reproductive tract during copulation and is specifically detected by the BdIR25a+BdIR85a receptor complex expressed in signum-surrounding cells, thereby inducing egg-laying.

Key words: *Bactrocera dorsalis*; N-AP; egg-laying; ionotropic receptor

S3-2

Mapping the insect neuropeptide galaxy

Yoonseong Park
Department of Entomology, Kansas State University, Manhattan, KS, USA

Neuropeptidergic signaling systems are critical regulators of development, physiology, and behavior in multicellular organisms. Typically, the coevolution of neuropeptides and their receptors defines the evolutionary dynamics of these ligand-receptor pairs. However, exceptions to this pattern often arise due to pleiotropic interactions between ligands and receptors in the course of evolutionary events involving gene duplications and losses. In this presentation, I will explore the biological forces that shape molecular evolutionary patterns in neuropeptidergic systems. A deeper understanding of these mechanisms, including the deorphanization of G protein-coupled receptors (GPCRs), the primary class of neuropeptide receptors, has paved the way for practical applications, particularly in arthropod pest control. Our lab has identified several novel insect neuropeptidergic systems, many of which are now considered promising targets for next-generation pesticides due to their essential roles across multiple life stages. To support and advance biorational pesticide development, we focus on investigating taxon-specific neuropeptidergic systems in arthropods.

Key words: neuropeptide, galaxy, coevolution

S3-3

Functional specialization of two transcript variants of *tyrosine hydroxylase* gene in exoskeletal cuticle and egg chorion of the Asian tiger mosquito, *Aedes albopictus*

Mi Young Noh[1] and Yasuyuki Arakane[2]
[1]Department of Forest Resources, Chonnam National University
[2]Department of Applied Biology, Chonnam National University

The Asian tiger mosquito, *Aedes albopictus*, one of the most serious vectors of human diseases, can transmit various vector-borne diseases. Eggs from this mosquito become darker and harder shortly after oviposition and exhibit high desiccation resistance. Tyrosine hydroxylase (TH) is involved in the tyrosine-derived tanning pathway, which is critical for coloration and hardening of cuticle and eggshell in many insects. In this study, we identified two isoforms of TH produced presumably by alternative promoters in *Ae. albopictus* and other mosquito species analyzed. We cloned full-length cDNAs encoding these two TH isoforms from *Ae. albopictus* and denoted them tentatively AalTH-ep (epidermal) and AalTH-ov (ovary) based on their developmental and tissue-specific expression patterns. RNAi experiments indicate that AalTH-ep play a role in adult cuticle coloration, while AalTH-ov is required for a progressive melanization of the eggshell/chorion and for conferring normal morphology of the outer-endochorion, a structure that is required for eggshell integrity and embryo hatching in *Ae. albopictus*.

Key words: *Aedes albopictus*, Tyrosine hydroxylase (TH), Eeggshell/chorion, Exoskeleton/cuticle, Melanization

S3-4

EpOME signaling pathway in insect immunity

Yonggyun Kim
School of Life Science and Biotechnology, Andong National University

Insect immunity is innate and its recognition depends on pre-programmed pathogen receptors. Oxylipins derived from polyunsaturated fatty acid (PUFA) propagate the recognition signals to nearby tissues. Two kinds of C18 and C20 oxylipins play crucial roles in regulating immune responses. Interestingly, C20 eicosanoids are detected at the early infection stage and later C18 PUFAs are induced in a lepidopteran insect, *Spodoptera exigua*. The C18 EpOME acts like vertebrate resolvin to quench the excessive and unnecessary immune responses. Its metabolite, (DiHOME, is the hydrolyzed and inactive forms of EpOMEs. The hydrolysis is catalyzed by soluble epoxide hydrolase (sEH). Single cell RNA sequencing of the hemocytes indicates that EpOME is synthesized in specific cell clusters. A deletion mutant in a GPCR using CRISPR-Cas9 did not respond to EpOME and failed to antagonize the intracellular signal induced by PGE2. The EpOME receptor was heterologously expressed in Sf9 cells and recused the cells treated with RNAi specific to the S. frugiperda ortholog. A human ortholog was effective to rescue the cells. All these results supports the identification of a specific receptor to EpOME.

Key words: Innate immunity; Insect; Oxylipin; EpOME; DiHOME; scRNA-Seq; CRISPR

S3-5

Chigger mite, *Leptotrombidium pallidum*, salivary proteins are recognized and remembered by the adaptive immune system of scrub typhus patients

Il-Hwan Kim[1], Kyeong-Jin Jeong[2], Ju Hyeon Kim[3], Chang-Seop Lee[4] and Jose M. Ribeiro[5]
[1]Division of Biomedical Metrology, Korea Research Institute of Standards and Science, [2]Korea Institute of Toxicology, [3]Department of Tropical Medicine and Parasitology, Seoul National University College of Medicine, [4]Department of Internal Medicine, Jeonbuk National University Medical School, [5]Laboratory of Malaria and Vector Research, National Institutes of Health, USA

Chigger mite is an arthropod vector that transmits *Orientia tsutsugamushi* to human, which causes scrub typhus. In this study, we aimed to evaluate the presence of antibodies specific toward chigger mite salivary proteins from serum of scrub typhus patients. We performed transcriptome analysis of chigger mite, *Leptotrombidium pallidum*, and selected four salivary protein markers for potential mite exposure in human. Then, we performed indirect ELISA using patient serum samples with four marker proteins. Among 100 scrub typhus patients, over 20 patients showed a positive immune reaction with at least one chigger mite salivary protein. Our results suggest a potential application of chigger mite salivary proteins for identification of mite exposure in human as well as diagnosis of scrub typhus.

Key words: Scrub typhus, *Leptotrombidium pallidum*, *Orientia tsutsugamushi*, mite salivary proteins, host-vector-pathogen interactions

S3-6

Chronologically inappropriate morphogenesis (Chinmo) is required for maintenance of larval stages of fall armyworm

Jinmo Koo
Department of Plant Medicine, Kyungpook National University, Daegu, Republic of Korea

Insect metamorphosis requires precise temporal regulation of transcription factors. While Broad complex (Br-C) and Eip93F (E93) promote pupal and adult development, the mechanisms maintaining larval identity are less clear. Chronologically inappropriate morphogenesis (Chinmo) has been proposed as a larval specifier in Drosophila, but its role in lepidopterans remains unknown. Using a binary transgenic CRISPR/Cas9 system in the fall armyworm (Spodoptera frugiperda), we knocked out Chinmo and Kr-h1, a juvenile hormone (JH) response gene. Kr-h1 knockout alone induced precocious metamorphosis only after L5, whereas double knockout of Chinmo and Kr-h1 triggered premature metamorphosis at L3. Transcriptome sequencing and single-cell multiome ATAC analysis revealed that Chinmo prevents early metamorphosis by restricting chromatin accessibility at promoters of Br-C and E93. These findings identify Chinmo as a key larval specifier in lepidopterans, acting with JH signaling to maintain larval identity and block premature metamorphosis.

Key words: metamorphosis, Fall armyworm, Chinmo

S3-7

From salivary secretion to cuticle expansion: biogenic amines in the feeding biology of hard ticks

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Biogenic amines serve as critical neuromodulators and/or neurohormones regulating diverse physiological processes in arthropods, including ticks. In Ixodidae (Hard ticks), dopamine has emerged as a well-characterized modulator, playing pivotal roles in salivary secretion, host attachment, the timing of rapid engorgement, and limiting cuticle expansion during blood feeding. Octopamine, although less extensively studied, has been implicated in regulating cuticle expansion, highlighting its distinct yet complementary function to dopamine. By contrast, the role of serotonin in tick physiology remains largely unexplored, representing a promising avenue for future research. Together, these findings highlight the significance of biogenic amines in tick feeding and development, and suggest unexplored avenues for enhancing our understanding of tick physiology and tick–host interactions.

Key words: Hard ticks, biogenic amine, tick feeding, tick-host interaction

S4-1

Identification and evaluation of volatile attractants from *Fusarium solani*-infected kidney beans for gravid female *Bradysia impatiens* (Diptera: Sciaridae)

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Fungus gnat, *Bradysia impatiens* (Johannsen), is a serious pest of various crops in greenhouses, and the larvae mainly infest the roots of strawberry, tomato, watermelon, and cucumber. Each adult female frequently produces up to 100 eggs, and the egg-to-adult life cycle can be finished in 10 days. Therefore, there is a need to develop control strategies for gravid female adults of *B. impatiens*. In this study, we conducted experiments with gravid *B. impatiens* females to evaluate attraction to traps baited with eight host source odors (cheonggukjang, enoki mushroom, *Fusarium solani*-infected kidney bean, sterile kidney bean, king oyster mushroom, oyster mushroom, potato, and white mushroom) using laboratory two- and multiple-choice bioassays. In two-choice bioassays, significantly more gravid *B. impatiens* females were captured in traps baited with the eight host sources than in controls. Among the eight host sources, the most significant number of gravid *B. impatiens* females was captured in traps baited with *F. solani*-infected kidney bean in multiple-choice bioassays. Moreover, the gravid *B. impatiens* females oviposited a significantly greater number of eggs with the *F. solani*-infected kidney bean than the *F. solani* or sterile kidney bean alone. Then, we compared the volatile organic compounds (VOCs) released by *F. solani*-infected kidney bean and sterile kidney bean using gas chromatography-mass spectrometry (GC-MS) and selected 25 compounds. Among the 21 compounds tested individually, five compounds (dimethyl disulfide, toluene, tetrachloroethylene, 2,4-dithiapentane, and *o*-xylene) attracted gravid *B. impatiens* females in two-choice bioassays. These results suggest that these compounds can be used as agents for population control and monitoring of *B. impatiens* in the greenhouse.

Key words: fungus gnat, volatile organic compounds, oviposition, bioassay, control

S4-2

New frontiers in chemical ecology for sustainable pest management

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In this presentation, I will provide an overview of recent advances in chemical ecology aimed at developing sustainable, environmentally friendly pest management strategies that reduce reliance on conventional pesticides. I will highlight ongoing research at the Bioeconomy Science Institute – Plant & Food Research, including the development of innovative push-pull systems, the discovery of novel semiochemicals, screening for plant resistance and the integration of chemical ecology with cutting-edge imaging and omics technologies to enhance the efficiency of in vitro rearing for biological control agents, offering promising tools for future agroecosystem resilience.

Key words: chemical ecology, pest management, semiochemicals, push-pull, plant resistance

S4-3

Antennal olfactory receptor neurons responding to host and non-host plant volatiles and sex pheromone in *Dioryctria abietella* (Denis & Schiffermüller, 1775) (Lepidoptera: Pyralidae) characterized by single sensillum recording

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Olfactory perception plays an important role in insect ecology. In phytophagous insects, olfactory receptor neurons (ORNs) located in the antennae detect specific olfactory cues, including pheromones and host-derived volatile compounds. Single sensillum recording (SSR) is a widely used technique that enables direct measurement of neural responses to odorants at the single-neuron level, allowing the characterization of specific response profiles of ORNs. *Dioryctria abietella* (Denis & Schiffermüller, 1775) (Lepidoptera: Pyralidae) is a major cone pest of various conifer species including *Pinus koraiensis* and *Abies koreana* in the Republic of Korea. However, response profiles of ORNs in the antennae of *D. abietella* to its sex pheromone components and plant volatiles have not yet been investigated. Here, using the SSR technique, we characterized ORNs in antennal sensilla of *D. abietella* in response to 40 host and non-host plant volatiles and two sex pheromone components, providing first insights into the olfactory system of this pest species.

Key words: olfactory receptor neuron (ORN), single sensillum recording (SSR), *Dioryctria abietella*

S4-4

Pheromone communication system of *Spodoptera litura* and *Spodoptera exigua*

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The tobacco cutworm (*Spodoptera litura*) and the beet armyworm (*S. exigua*) are major pests that attack a broad range of crops, and some chemicals are shared by these two species as female sex pheromone components. In this study, we compared the sex pheromone–based chemical communication systems of the two species from morphological, electrophysiological, and behavioral perspectives. Scanning electron microscopy (SEM) of the antennae revealed the presence of male-specific long trichoid sensilla in both species, as well as some other sensilla exhibiting species-specific distributions. Gas chromatography–electroantennogram detection (GC-EAD) analyses of 17 pheromone and structurally related compounds demonstrated that the two species share common olfactory sensitivity to some compounds while displaying species- or sex-specific response profiles to some other compounds. In subsequent field trapping tests, some compounds either enhanced or suppressed male attraction. Taken together, the results indicate that *Spodoptera* moths possess species-specific chemical communication systems, thereby extending our understanding of their pheromone-mediated communication and providing useful information for developing environmentally sustainable strategies to manipulate their behavior.

Key words: field trapping test, GC-EAD, olfactory sensilla, pheromone, SEM

S4-5

Untargeted metabolomics reveals tissue-specific regulation under specialist herbivory, identifying metabolites with potential ecological roles

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Plants synthesize diverse specialized metabolites under tissue- and context-specific regulation, yet it remains unclear how tissue-specific herbivory shapes pre- and post-attack metabolomes within each tissue. Using untargeted metabolomics, we compared constitutive and tissue-specific herbivory-induced states across tissues of *Capsella bursa-pastoris*, a cosmopolitan weed. Profiles separated mainly by tissue; roots had the most constitutive tissue-specific features. Herbivory increased between-tissue dissimilarity, and stems showed the largest set of induced features. The top herbivore-induced stem feature was constitutively higher in roots, consistent with tissue-specific biosynthetic control. Multi-omic evidence indicates a hydrolyzed glucosinolate derivative that may contribute to resistance against root specialists, underscoring adaptive diversification and tissue-specific regulation of specialized-metabolite pathways.

Key words: shepherd's purse, specialist herbivores, tissue specificity, untargeted metabolomics

S4-6

Common mistakes in semiochemical research

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The identification of semiochemicals and the development of attractants rely on three core techniques: electrophysiological recording, chemical analysis, and behavioral bioassays. A standard workflow has been established, typically involving headspace sample preparation, GC-EAD analysis, chemical characterization, and subsequent behavioral testing. Despite this established framework, a number of recurring methodological pitfalls continue to hinder progress. For instance, differences in volatility among odorants are often overlooked when preparing test blends; airflow turbulence is frequently neglected in Y-tube olfactometry; and the role of non-antennal sensory organs is commonly underestimated in morphological and electrophysiological studies. This presentation highlights these and other common mistakes, and discusses how addressing them can improve the efficiency, reliability, and accuracy of semiochemical research.

Key words: bioassay, chemical ecology, electroantennogram, GC-EAD, semiochemical

S5-1

Insights into the Molecular Physiology of Task Specialization (Polyethism) in Honey Bee

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Division of labor in honey bees exemplifies polyethism, where workers flexibly shift from nursing to foraging depending on colony demands. This behavioral plasticity is associated with molecular regulation in the brain. We examined how pesticide exposure influences task specialization in nurse bees. Bees were exposed to neurotoxic pesticides, and nursing behavior was evaluated using queen cell assays. In parallel, expression of foraging-related genes in head was analyzed to explore molecular changes linked to behavioral shifts. Pesticide exposure reduced nursing activity while enhancing the expression of forager-associated genes, suggesting a precocious transition. These findings demonstrate that gene regulation underlies flexible task switching and that environmental stressors can disturb this balance. Such disruption of polyethism may destabilize colony organization and contribute to population decline, underscoring the importance of understanding molecular and behavioral responses to pesticides.

Key words: Honey bee, Polyethism, Nursing behavior, Pesticide exposure, Task flexibility

S5-2

Rethinking Control Strategies for the Invasive Hornet *Vespa velutina*: Ineffectiveness of Spring Queen Trapping and Preliminary Predator Survey

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This study evaluated the effectiveness of queen trapping for the invasive hornet *Vespa velutina* through a two year field experiment (2023-2024) at ten apiaries in Andong, South Korea. No significant differences in hornet abundance ($T(30)$=1.50, P=0.144; $T(30)$=-0.83, P=0.412) or nest density ($T(5)$=-2.48, P=0.065; $T(5)$=-1.48, P=0.213) were observed between trapping and non-trapping sites, indicating limited control efficacy. Additionally, eight new predator species-including mammals, birds, and congeneric hornets-were documented, with Crested honey buzzards, Asian badgers, and Asian giant hornets exerting notable predation pressure. Therefore, mangament strategies for *Vespa velutina* should move beyond conventional control methods and adopt an integrated, ecosystem-based approach that incorporates ecological traits and the potential role of natural enemies in sustainable biological control.

Key words: *Vespa velutina*, invasive hornet, control, queen trapping, predation.

S5-3

Task allocation and age-polyethism in the Formosan subterranean termite

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Elaborate task allocation and collective behaviors are fundamental characteristics of social insects, including ants, bees, wasps, and termites. In contrast to the well-characterized systems of social Hymenoptera, task allocation and age polyethism remain relatively poorly understood in termites, despite the fact that all extant species exhibit eusociality. Investigating these behaviors in termites presents several challenges, including their hemimetabolous development, cryptic nesting habits, and extensive foraging territories. In this presentation, I will review recent progress in understanding task allocation and age polyethism in termites. Particular emphasis will be placed on methodological advances that have enabled empirical studies in this group, as well as on the broader evolutionary and ecological implications of division of labor in hemimetabolous eusocial insects.

Key words: Heterotermitidae, polyethism, collective behaviors, social insects

S5-4

Supercoloniality in the Argentine Ant (*Linepithema humile*) and its Ecological Consequences

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The Argentine ant, *Linepithema humile* (Mayr, 1868), is one of the world's most notorious invasive ants due to its unique social structure of supercoloniality. This system, characterized by the absence of intraspecific aggression and genetic uniformity in cuticular hydrocarbon profiles, enables rapid monopolization of resources and large-scale cooperation across vast areas. Such traits facilitate the displacement of native ants and the restructuring of invaded communities. Evidence from invaded regions, including Japan, South Korea, and the Mediterranean islands, shows that diverse native ant assemblages are often replaced within a few years by *L. humile*-dominated communities. These transitions drive sharp declines in native species richness and abundance, while also disrupting key ecosystem processes such as seed dispersal, soil turnover, and decomposition. The resulting biotic homogenization simplifies ecological networks, leading to taxonomically and functionally uniform systems. The persistence and expansion of supercolonies challenge conventional control measures. Understanding the behavioral and genetic bases of supercoloniality is therefore essential for predicting invasion dynamics and designing sustainable management strategies that specifically target recognition systems and colony organization.

Key words: Argentine ant, *Linepithema humile*, Supercoloniality, Invasive species, Biotic homogenization

S5-5

Bumble Bees in Agriculture: Focus on Commercial Pollinators

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Bumble bees have become indispensable commercial pollinators in modern agriculture, with over two million colonies used annually worldwide. In Korea, indoor mass-rearing technology was established in 2003, and about 18 companies now produce bumble bees, supplying approximately 350,000 colonies in 2024. Their use, once centered on tomato, has expanded to 10 crops including strawberry and apple. Advances in precision rearing have improved colony foundation and queen production rates by 1.3-fold, providing stable supplies of pollinators. Smart hive technologies further optimized colony environments, resulting in a 1.6-fold increase in foraging activity and a 14.9% yield improvement in tomato production. Recently, pollination systems are being tested in plant factories, highlighting new opportunities for controlled-environment agriculture. These advances underscore the critical role of bumble bees as sustainable pollinators and their expanding applications in precision agriculture.

Key words: Bumble bee, Commercial pollination, indoor rearing, Precision agriculture

S6-1

Modes of action of biopesticides: from single compounds to complex mixtures

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Biopesticides, including botanicals, microbials, and other natural compounds, represent safer alternatives to synthetic insecticides and are increasingly utilized in pest management programs. As they are typically applied as complex mixtures, optimizing their efficacy requires a thorough understanding of the properties, including the chemical profiles and modes of action, of each constituent. However, recent studies have shown that the overall toxicity of these mixtures is significantly affected not only by the toxicology of individual components but also by their combined activities, which can result in synergistic or antagonistic interactions. Such interactions, particularly synergism, can provide greater efficacy. However, they also undermine the predictability of a mixture's efficacy and safety, leading to uncertainty in bioactivity and challenges in quality control. This presentation will first examine commonly commercialized biopesticides used in the organic farming system in Korea, identifying their active ingredients and currently proposed modes of action. Subsequently, it will explore how these components interact to produce synergistic or antagonistic effects, and how compositional variations can alter the toxicological profiles of the mixtures. Finally, a novel framework designed to assist in the development and quality control of scientifically sound biopesticides will be briefly demonstrated, using the example of Rosemary oil, a complex mixture of botanical volatiles frequently adopted as a miticide.

Key words: biopesticides; mode of action; mixture toxicity; insecticidal synergy

S6-2

Natural Enemy Education and Simple Production Techniques for Farmers

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The Sustainable Agricultural Research Center of Kyungpook National University has opened a natural enemy education course for the past 10 years (2016-2025) with the support of the Gyeongbuk Farmers' Academy to provide practical training on simple production of natural enemy and field application techniques. We developed simple and economical mass production technologies of the soil predatory natural enemies *Gaeolaelaps aculeifer, Stratiolaelaps scimitus*, and natural enemies of *Tetranychus urticae* such as *Phytoseiulus persimilis* and *Neoseiulus californicus.* We educated farmers how to produce natural enemies, how to apply them to fields, and has been contributed to the production of cost-effective agricultural crops. This education system expand to thousands of farmers through more than 20 agricultural-related institutions nationwide. Further, we helped farmers establish small-scale natural enemy production facilities and taught them rearing techniques so that they could produce natural enemies themselves. This initiative has enabled farmers to successfully utilize natural enemies and ultimately contributes to the development of domestic biological control industry.

Key words: biological control, natural enemy, predatory mites, simple production

S6-3

Diagnosis and control of insect pests for eco-friendly farming practices

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Pest control is a pressing issue in agricultural settings, including eco-friendly farming. Recently, the emergence of new pests and diseases is on the rise due to climate change, including global warming, increased international trade, and unpredictable weather events.

The most fundamental aspect of pest control begins with forecasting. Because diverse pests have diverse ecological characteristics, diverse forecasting techniques are required in the field. This presentation will introduce various pest diagnostic techniques developed in agricultural settings. Furthermore, through discussions, we aim to develop more advanced forecasting techniques. These forecasting techniques are expected to be useful in the event of future outbreaks of new pests and diseases.

Key words: Diagnosis, control, ,insect pests, eco-friendly farming, practices

S6-4

Field Application of Organic Agricultural Materials by Mode of Action

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The abnormal climate due to climate change is causing changes in the occurrence patterns of existing pests, and is increasing the incidence of sudden and exotic pests. In particular, for pests such as beet armyworm, tomato leaf miner, which have strong insecticide resistance in agricultural fields, standardized information is needed on efficient organic agricultural material selection and treatment methods for density management.

We conducted field research on organic agricultural material products for pest control registered in Korea to manage pest density below the level of economic damage by mixing and treatment cycles for each active ingredient and mechanism of action. By sharing these field application examples, we would like to provide information on practical control measures to farmers cultivating eco-friendly agricultural products.

Key words: organic agricultural materials, mode of action, pest management, beet armyworm, tomato leaf miner

S7-1

The Insulin signaling and juvenile hormone pathway regulates reproductive diapause in the ladybeetle *Coccinella septempunctata*

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Understanding the regulation of diapause in natural enemy insects is crucial for improving the long-term storage, transportation, and field deployment of biological control agents. This study investigates the dual regulation of insulin signaling (IIS) and juvenile hormone (JH) pathways in reproductive diapause of the seven-spotted ladybeetle (*Coccinella septempunctata*), a key aphid predator. We demonstrate that enhanced JH degradation plays a critical role in diapause induction. Applying methoprene (a JH analog) to pre-diapause females elevated JH signaling and reversed the diapause program, confirming that low JH levels are essential for diapause induction. Conversely, RNAi knockdown of JH degradation genes increased expression of JH-inducible gene (*Kr-h1*), reduced diapause characteristics, and promoted reproduction (accelerated ovary growth, yolk deposition, suppressed lipid accumulation). Further, we show that IIS regulates diapause via the transcription factor FoxO. In diapausing beetles, exogenous insulin application or RNAi knockdown of *CsFoxo* terminated diapause. Conversely, in non-diapausing beetles, RNAi knockdown of the insulin receptor (*CsInR*) arrested ovarian development and decreased JH levels, inducing a diapause-like state. Collectively, these results reveal that shutdown of insulin signaling activates *CsFoxO*, driving the diapause phenotype, while reduced JH titer facilitates reproductive diapause. This dual regulatory mechanism provides fundamental insights into *C. septempunctata* diapause control.

Key words: Natural enemy, Diapause, Predator, Pest control, Green IPM

S7-2

Eriborus sp. (Hymenoptera: Ichneumonidae), the principal parasitoid of the box tree moth, *Cydalima perspectalis* (Lepidoptera: Crambidae)

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The box tree moth (BTM), *Cydalima perspectalis* Walker, is a significant pest of *Buxus* species, inflicting defoliation and aesthetic damage on ornamental boxwoods commonly used in urban landscapes. Identified as a principal parasitoid of the BTM, *Eriborus* sp. (Hymenoptera: Ichneumonidae) is a solitary endoparasitoid that reproduces parthenogenetically. *Eriborus* sp. exhibits a high parasitism rate in urban settings and is considered the most significant parasitic natural enemy of the BTM population in Korea. This study characterized the fundamental biological, oviposition, and parasitism traits of the parasitoid. *Eriborus* sp. infects all larval instars of the host up to the fourth, killing the host before the final instar, the stage responsible for the most extensive damage. Analysis of the antennae identified 9 types of sensilla. Given its high adaptability and parasitism rate in urban environments, *Eriborus* sp. shows significant promise as a biological control agent for managing the BTM in landscaped areas. It also has potential for use in classical biological control in regions where the BTM is an invasive species.

Key words: box tree moth, parasitoid, biological control

S7-3

Compatibility of entomopathogenic *Beauveria bassiana* with arthropod predators

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Entomopathogenic *Beauveria bassiana* (Balsamo-Crivelli) Vuillemin has been widely developed and applied for the management of arthropod pests. However, due to its wide host range, the impact of *B. bassiana* on other arthropod natural enemies needs to be investigated. Here, we introduce our recent studies on the compatibility of *B. bassiana* and two arthropod predators, i.e., two ladybird beetles and one predatory mite. The relative toxicities of two native *Beauveria bassiana* strains (ARP14 and AAD16) were compared with a commercial strain (GHA) against *Harmonia axyridis* Pallas and *Chilocorus* sp. Both native strains were found to be relatively safe for the two ladybird beetles. During the evaluation of another predator, *Stratiolaelaps scimitus* (Womersley), we found that neither the native strain AAD16 nor the commercial strain GHA reduced the survival of the predator. In a series of subsequent bioassays, we found that the mite's survival even significantly increased with the addition of oil and prey mites. The importance of these findings and future perspectives are discussed.

Key words: entomopathogenic fungus, mycoinsecticide, biological control, ladybird beetle, predatory mite

S7-4

Plant surface architecture determines predator performance: a comparison of *Nesidiocoris tenuis* and *Chrysoperla carnea*

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The global spread of *Tuta absoluta* and rising insecticide resistance demand precision biocontrol. We compared egg predation by *Nesidiocoris tenuis* and *Chrysoperla carnea* across laboratory and on-plant assays, and examined how plant surface traits affect control efficacy. In the lab, predation on *T. absoluta* eggs increased with development (adult females for *N. tenuis*; third-instar larvae for *C. carnea*). On tomato plants, *N. tenuis* had higher egg predation than *C. carnea* at 0-24 h and 24-48 h, and in semi-closed cage assays, owing to the higher predation, the number of remaining eggs at 48 h was the lowest. However, on eggplant with short trichomes, *C. carnea* showed higher predation rate than *N. tenuis*, These results show that plant surface architecture can influence the predatory activity of natural enemies and suggest that selecting natural enemies according to plant traits can determine control efficacy.

Key words: *Tuta absoluta*, *Nesidiocoris tenuis*, *Chrysoperla carnea*, Trichome, Biological control

S7-5

Proposal of Policy Directions for ESG-based Promotion of the Natural Enemy Industry

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With the recent expansion of ESG (Environmental, Social, and Governance) management and investment across industries, the agricultural sector also requires strategies emphasizing sustainability and eco-friendliness. The natural enemy industry contributes significantly to ESG goals by reducing pesticide use, cutting carbon emissions, and conserving biodiversity, thereby enhancing environmental protection and social safety. However, its current share within the overall ESG industry remains only about 0.1%. Despite this, ESG investments of the natural enemy industry amount to approximately 4.7 trillion KRW globally and about 30 billion KRW domestically. This proposal aims to quantify the ESG contributions of the natural enemy industry and suggests establishing institutional frameworks such as a “Natural Enemy-based ESG Certification System” or a “Carbon Reduction Incentive Scheme through Biological Control.”

Key words: Natural enemy, ESG, Carbon reduction, Biodiversity, Sustainability

S8-1

Food Bio-Contaminant Entomology : Forensic Methodology & Case Studies

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The presence of insect contaminants across all steps of food production, packaging, distribution, and consumption is emerging as a critical issue in hygiene management and consumer trust. With the rise of consumer awareness and the spread of social media, the discovery of insect-origin contaminants in food products can lead to a significant loss in brand reputation and severe economic consequences for manufacturers and distributors. While forensic entomology has been extensively applied in the estimation of postmortem intervals and criminal investigations, relatively little attention has been paid to its application in food and packaging contamination. This field has yet to be fully recognized as an independent domain within entomological science. One possible reason is that food manufacturers are often reluctant to publicly disclose contamination incidents, making scientific investigation difficult. As a result, many such cases are quietly settled between the consumer and the company without proper entomological input or causal analysis. This presentation aims to highlight and formalize the emerging field of Food Bio-Contaminant Entomology, drawing from principles and methodologies developed in agricultural entomology. Several case studies involving insect contamination in food and packaging materials will be introduced, emphasizing the need for systematic forensic approaches to support transparent and scientific resolution of such incidents.

Key words: Insect contamination, Urban entomology, Medio-legal, Stored-product, Postmortem interval

S8-2

Reduce Insect Foreign Materials in Food Production, Storage, Distribution, and Consumption Facilities with Huddle Technology

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Food is exposed to biological hazards, such as insect pests and microbial contamination, throughout the production, distribution, and retailing processes. According to an analysis of foreign matter found in Korean food using data from MFDS the most frequently reported foreign material was insects. Insects foreign material contamination causing a feeling of disgust is a critical issue in the food industry because resulting in economic loss and damage to the reputation of the food company.

The purpose of this study was to develop and supply of common techniques to reduction foreign material in distribution and production level through cause analysis of principal foreign material and research on natural-friendly control techniques. we expected to the newly developed technologies reducing customers' anxiety about major foreign materials in distribution and manufacturing of food and improving the confidence in food hygiene and safety.

Key words: Insect foreign material, Huddle technology, Food facilities, Natural friendly control techniques, Food hygiene and safety

S8-3

Taxonomy and ecology of cement mite and Suidasia mite associated with food contamination; A case study

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Seasonal outbreak of cement mites were reported in the open container house and large storage facility. DNA barcoding and morphological identification confirmed the species as *Balaustium murorum* Hermann, 1804. Species in *Balaustium* are predatory on other soft-bodied arthropods and pollen. Later another issues on Suidasia mites on the cap of food container. The species was confirmed as *Suidasia nesbitti* Hughes, well known as a cosmopolitan storage mite. Nation-wide sampling confirmed all the samples were restricted to one species, and haplotype distribution showed its clustered distribution. Detailed taxonomic and ecological characteristics of those mites were discussed with the possible human health issues including interaction with storing the food and animal feeds in the domestic condition and allergenic reaction allergic reaction, dermatitis, and rhinitis.

Key words: Balaustium murorum, Suidasia nesbitti, Astigmata, contamination, allergenic

S8-4

Taxonomic Analysis of Insect Contaminants in the Korean Food Industry

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Care One co., Ltd.

A lack of taxonomic data in official statistics limits practical risk assessment for insect contaminants in food. Therefore, this study analyzed the taxonomic frequency of 545 insect (Class Insecta) cases identified from 754 foreign material complaints submitted to a professional pest management company in Korea between May 2018 and August 2025. The analysis identified insects from 13 Orders and 93 Families*, with Coleoptera (25.9%), Lepidoptera (22.6%), and Diptera (20.0%) accounting for 68.5% of all cases. The Key families identified within these dominant orders, in order of prevalence, include Pyralidae, Phoridae, Ectobiidae, and Tenebrionidae, which quantitatively establishes them as critical target groups for management. Based on objective data from actual industry claims, this study provides a significant scientific foundation for the development of future contaminant management strategies.

*The family count includes unidentified groups (e.g., "moths").

Key words: Food Contaminant, Insect Identification, Occurrence Trend, Taxonomic Survey, Empirical Data

S9-1

Spatial distribution patterns of migratory insect pests in Jeolla province

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Food crops, as staple foods, are the primary source of carbohydrates. Securing physical and economic access to safe and nutritious food is essential for food security and human health. Migratory insect pests, transported from southern China to Korea by the jet stream, are of particular concern as they cause direct and indirect damage to rice, a major staple crop. This study surveyed insect pest population densities in six locations in the Jeolla province with previous reports of migratory insect pest outbreaks. Spatial patterns were analyzed using SADIE (Spatial Analysis by Distance IndicEs), focusing on the spatial distribution and the aggregation index (I_a). Clustering indices (V_i, V_j) were further employed to characterize spatial patterns, and red–blue plots were used to visualize clustering on maps.

Key words: Rice paddy, Migratory insect pests, SADIE

S9-2

Soil physicochemical properties regulate arsenic fractionation and life stage-dependent toxicity in forest Collembola

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Arsenic contamination from mining areas threatens adjacent forest ecosystems through continuous spread. Collembola are validated indicators with high abundance and important roles in nutrient cycling, with restricted mobility optimal for local impact studies. This study investigated how forest soil physicochemical properties affect arsenic mobility and biological toxicity using Collembola (*Allonychiurus kimi*). Soil cation exchange capacity, available phosphorus, and aluminum oxide content were key factors controlling arsenic binding forms. Developmental stage-specific responses were observed: juveniles were primarily sensitive to highly mobile fractions (F1, F2), while adults showed stronger responses to less mobile forms including amorphous iron and aluminum oxide fractions (F3). These findings provide critical data for ecological risk assessment and environmental management in mining-affected areas.

Key words: Arsenic bioavailability, Soil physicochemical properties, *Allonychiurus kimi*

S9-3

Patterns of dispersal and the evolution of cave dwellers in Leptonetidae

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Poor dispersers typically show short-range endemism and strong microhabitat specialisation. Caves, as ecologically extreme environments, offer unique natural experiments for studying diversification. While previous studies have been focusing on taxonomic records, evolutionary patterns in many cave-associated lineages remain unclear. Using Leptonetidae, a dispersal-limited, cave-associated spider family, we reconstructed a phylogeny of 330 species from DNA sequences and applied comparative phylogenetic and biogeographical models to infer dispersal patterns and transitions between surface (epigean) and cave (troglobitic) species. Our analyses indicate a Mediterranean origin of Leptonetidae at approximately 158 Mya, followed by the spread of two major clades along opposite routes that both ultimately colonised East Asia. Transitions into caves arose repeatedly and independently across the tree, with several traces of reversals back to surface habitats. These results suggest that caves indicate rather lability in subterranean adaptation. Additionally, rapid radiations of eastern clades highlight a key role for historical biogeography shaping diversity, with major geographic events mediating frequent isolation.

Key words: Leptonetidae, cave adaptation, phylogenetics, biogeography, dispersal, diversification

S9-4

Habitat engineering by aquatic caterpillars: Ecological consequences of plant growth suppression

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Herbivorous insects exploit host plasticity in growth as well as defense, reshaping plant architecture to meet ecological needs. We examined the shelter-building caterpillar *Elophila turbata* and its host *Lemna minor* with metabolomics, transcriptomics, hormone profiling, and predation assays. Caterpillar regurgitant induced sustained γ-aminobutyric acid (GABA) accumulation in fronds, markedly suppressing growth. This GABA response was independent of jasmonate signaling and accompanied by transcriptional activation of stress, growth-inhibitory, and amino-acid metabolic pathways. Growth-suppressed fronds formed compact shelters that reduced detection and attack by aquatic predators. We further identified a silk-associated molecular pattern—L-DOPA—that significantly suppressed plant growth. Together, these results reveal a GABA-dependent, herbivore-elicited program that remodels host architecture to enhance herbivore survival, expanding plant–insect signaling paradigms to include adaptive growth suppression.

Key words: aquatic herbivores, duckweed, growth inhibition, predation, shelter-building

S9-5

Understanding of dispersal ecology of a major vector of pine wilt disease, *Monochamus saltuarius* (Coleoptera: Cerambycide)

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The longhorn beetle, *Monochamus saltuarius* (Coleoptera: Cerambycidae), is a major vector of pine wilt disease in coniferous forests in China, Japan, and South Korea. For effective management of the disease, understanding its dispersal ecology of the vector is important. In this study, we evaluated dispersal capacity and patterns of *M. saltuarius* adults in coniferous forests. For this, we first assessed applicability of two insect tracking methods, portable harmonic radar system and fluorescent marking system; potential effects of two tracking methods on the insect and detection efficacy were evaluated. Then, using the tracking methods, we evaluated the basic mobility of *M. saltuarius* including vertical and horizontal walking and flight patterns under varying environmental conditions. Finally, dispersal patterns of *M. saltuarius* were evaluated using mark-release-recapture under both semi-field and field conditions. Our study provides fundamental information for understanding dispersal ecology of *M. saltuarius.*

Key words: insect behavior, behavioral ecology, vector biology, pine wood nematode, mark-release-recapture

S9-6

Soil- and litter-dwelling beetle diversity and community across natural and plantation forests

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Forest development modifies forest ecosystems. This process can stabilize ecosystems and provide microhabitats for diverse organisms within forests. However, anthropogenic disturbances (e.g., logging, plantation etc.) have increasingly converted natural forests into commercial stands, potentially affecting forest biodiversity. These impacts vary depending on taxonomic groups. In this study, we compared soil- and litter-dwelling beetle community across three forest types: mature forests, secondary forests, and plantation forests. Species richness and abundance showed no significant differences among the forest types. However, iNEXT demonstrated that plantation forests have the highest potential diversity compared with other forest types. The beetle community in the plantations was not overlapped with those of the other forest types, whereas the beetle communities of mature and secondary forests showed similar structures. These findings suggest that commercial plantations can serve as unique habitats for certain beetle communities. Nevertheless, excessive anthropogenic disturbances can lead to community simplification, ultimately weakening ecosystem services provided by these organisms.

Key words: Coleoptera, assemblage, Korea, commercial forest

S10-1

Vector Surveillance and Resistance Monitoring in Malaria-Endemic Areas of Korea

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Since its re-emergence in 1993, vivax malaria has persisted in Korea with more than 600 annual cases reported during 2023-2024. Northern Gyeonggi Province, an endemic area adjacent to the Demilitarized Zone (DMZ), harbors a high diversity of *Anopheles* vector species that differ in vectorial capacity. As part of national malaria control efforts, we collaborated with the Republic of Korea Armed Forces to conducted vector surveillance and assess resistance patterns to pyrethroids. This presentation will describe the dynamics of vector populations and insecticide resistance profiles in endemic area, including GOP military bases near the DMZ and the Civilian Control Zone. The critical role of interagency cooperation between the military and civilian research sectors will also be highlighted.

Key words: *Anopheles,* malaria-endemic area, insecticide resistance, vector surveillance

S10-2

sfr-miR-10465-5p and sfr-miR-10476-5p modulate chlorantraniliprole susceptibility through CYP450 gene regulation in *Spodoptera frugiperda* (Smith)

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MicroRNAs (miRNAs) are emerging as crucial regulators of resistance in insect pests through their modulation of detoxification genes. However, their specific roles in mediating chlorantraniliprole susceptibility via cytochrome P450 (CYP450) regulation in *Spodoptera frugiperda* (Smith) remain relatively unexplored. In this study, we examined the regulatory functions of two miRNAs, sfr-miR-10465-5p and sfr-miR-10476-5p, in response to chlorantraniliprole exposure. Bioinformatic analysis predicted multiple CYP450s as potential targets of these miRNAs. Following chlorantraniliprole exposure, sfr-miR-10465-5p was significantly upregulated, while sfr-miR-10476-5p was downregulated, correlating with altered expression of their predicted target genes. Functional validation through mimic/inhibitor microinjection confirmed that these miRNAs modulate the expression of CYP4C1 (LOC118273960), CYP4C21-like (LOC118270458), CYP4C1-like (LOC118281718) and other related genes. Larvae injected with miRNA mimics showed enhanced mortality after chlorantraniliprole treatment, while inhibitors reduced mortality, indicating their regulatory influence on insecticide susceptibility. RNA interference (RNAi) targeting key CYP450 genes further validated their functional role in detoxification. Silencing of CYP4C1, CYP4C21-like and CYP4C1-like significantly increased larval mortality upon chlorantraniliprole exposure. Dual-luciferase assays demonstrated that sfr-miR-10465-5p and sfr-miR-10476-5p directly bind to the CDS regions of their target transcripts, confirming post transcriptional regulation. Tissue-specific expression profiling revealed the highest expression of both miRNAs and their CYP450 targets in the fat body, a known detoxification organ, thereby supporting their involvement in insecticide metabolism. Together, these findings highlight the regulatory function of sfr-miR-10465-5p and sfr-miR-10476-5p in chlorantraniliprole susceptibility via CYP450 gene modulation, providing novel insights into miRNA-mediated chlorantraniliprole susceptibility mechanisms in *S. frugiperda*.

Key words: MicroRNA, *Spodoptera frugiperda*, chlorantraniliprole, cytochrome *P450*, RNAi, CNPs dsRNA

S10-3

Pyrethroid resistance and *kdr* mutation profiles in field populations of the *Culex pipiens* complex

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Pyrethroid insectcides are the major control agents against mosquitoes in South Korea. Heavy reliance on a single group of insecticide often leads to concerns on insecticide resistence, especially as pyrethroids are reported for their cross-resistance across its class. The present study evaluated resistance ratio of four field-collected mosquito populations (Gimpo, Ganghwa, Yongin, and Gwanak) to representative pyrethroids, deltamethrin, d-phenothrin and prallethrin, by topical application. To identify the resistance mechanism, *kdr* allele frequencies are analyzed using specific primers for *Culex pipiens* complex, then compared to bioassay results. In test populations, resistance ratios varied from 2.5 to 44.6. No *kdr* allele was identified in Yongin strain but present at ~25% frequency in other populations. The study demonstrates the need for region-specific monitoring and management strategies for insecticide resistance management.

Key words: Pyrethroid, cross-resistance, *Culex pipiens*

S10-4

Molecular mechanisms of insecticide resistance in three major rice planthopper pests (Delphacidae) and development of diagnostic tools for integrated resistance management

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Carbamate, pyrethroid, and neonicotinoid resistance has become a significant challenge in managing rice planthoppers across Korea and Asia, particularly brown planthopper (*Nilaparvata lugens*, BPH), small brown planthopper (*Laodelphax striatellus*, SBPH), and white-backed planthopper (*Sogatella furcifera*, WBPH) (Hemiptera: Delphacidae). We investigated target-site mutations and conducted genome-based transcriptome analyses to elucidate the underlying mechanisms. The recent 2024 BPH outbreak highlighted its extensive resistance diversity, especially against neonicotinoids such as imidacloprid. Overexpression of *CYP6ER1* was identified as the key resistance mechanism in BPH, functionally analogous to *CYP6ER2* in SBPH. In the case of pyrethroids, no sodium channel mutations were detected; instead, metabolic resistance predominated, with *CYPSF* overexpression in WBPH and *CPY6CW9* in SBPH playing significant roles. These findings suggest that despite species-specific differences, there are convergent patterns in resistance evolution across planthoppers. Based on these insights, we propose an integrated resistance management framework that employs molecular diagnostic tools to monitor species-specific resistance development and guide the strategic use of insecticides with high efficacy.

Key words: Insecticide resistance, *Nilaparvata lugens, Laodelphax striatellus, Sogatella furcifera*, Cytochrome P450 monooxygenases, Integrated resistance management (IRM)

S11-1

Antennal sensilla of Lachninae Aphids (Insecta: Hemiptera: Aphidoidea) - morphology and significance

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Aphids are one of the most economically important groups of bugs and insects due to their great evolutionary success, which they have achieved due to their ecological plasticity, life cycles and polymorphism. Lachninae Herrich-Schaeffer, 1854, is one of the 23 subfamilies within Aphididae and is characterized by the largest size among aphids, which feed on both the green and woody parts of both coniferous and deciduous plants. A majority of the species are associated with trees and shrubs, with three root-feeding genera from the tribe Tramini. Undoubtedly, one of the equally important aspects of aphids success is the specific sensory organ system on their antennae – setae, rhinaria and rhinariola, which represent various types of sensilla. For several years Lachninae aphids become a great number of interests in the case of molecular and genomics research but morphological studies have been neglected. Today, I present a comparative scanning electron and light microscopy analyses of the antennal sensilla of selected Lachninae species. Different types of sensilla can be found on their antennae, like small multiporous placoid sensilla (primary and secondary rhinaria), large multiporous placoid sensilla (primary rhinaria), sunken coleoconic sensilla (rhinariola and accessory rhinaria) and different types of trichoid sensilla (setae). Besides their morphology and ultrastructure, I will try to show their significance in taxonomy and the phylogeny of particular groups.

Key words: Aphids, host plant, morphology, taxonomy

S11-2

Data-driven approaches to managing invasive species in agricultural ecosystems

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Invasive species management in agriculture remains underutilized in big data applications. This study examines integrating diverse data sources—museum collections, smart traps with AI recognition, crowdsourcing platforms, environmental DNA, and genomic databases—for invasive species management. Integration enables species distribution prediction, invasion pathway identification, and control strategy development. While big data offers unprecedented management opportunities, implementation faces challenges including lack of standardization, quality control issues, inadequate storage systems, and insufficient collaboration between computational scientists and practitioners. We recommend establishing universal data standards, implementing quality assurance protocols, and fostering interdisciplinary collaboration to harness big data's potential for protecting global food systems from invasive threats.

Key words: big data, invasion pathway, biosecurity

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S11-3

Population Genomics of Nonnative Wind-borne Pests

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Wind-borne insect pests migrate long distances annually into Korea, as they cannot overwinter locally, and cause significant damage to staple crops. Because their domestic outbreaks depend on source populations abroad and seasonal airflow patterns, accurate prediction remains difficult. In this study, we applied population genomics to two representative wind-borne species to assess genetic diversity, population structure, and the geographic origins of migrant populations across Asia. By integrating genomic data with atmospheric trajectory data, we traced spatiotemporal migration routes and identified likely source regions. Our results provide a genomic framework for monitoring cross-border pest invasions and provide a robust scientific basis for developing cooperative management strategies among Asian countries.

Key words: Population genomics, wind-borne pest, migration

S11-4

A trait perspective on the invasiveness potential of exotic insects in Korea

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The increasing introduction of exotic insects due to international trade andclimate change poses growing biosecurity challenges. Numerous non-native insect species have been detected worldwide, but only a subset have become invasive pests. To support risk-based prioritization, this study investigates whether climatic niche traits can serve as early predictors of invasiveness potential. We compiled global occurrence records for over 200 exotic insect species (excluding Koreanre cords) and estimated their climatic niche envelopes using bioclimatic variables from WorldClim. Species distribution models were constructed using multiple algorithms and combined into ensemble models. We calculated climatic suitability, niche breadth, and pairwise niche overlap as key ecological traits. Our results indicate that invasive species in Korea generally exhibit broader climatic niches and higher predicted suitability than other exotic species. However, this study focused exclusively on climate-related traits and did not yet incorporate species-specific ecological factors such as host range, dispersal ability, or reproductive strategy. While climatic modeling provides a useful first filter, integrating broader ecological trait data will be essential for improving the prediction and proactive management of future invasive pests.

Key words: invasive species, exotic insects, climatic nithe modeling, niche breath

S11-5

Heteroplasmy and multiple barcodes in the genus *Aphaenomurus* (Collembola, Tomoceridae): implications for pest misidentification

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Excessive intraspecific variation in mitochondrial barcoding genes, commonly observed across insects including pests, can reduce the discriminatory power of molecular identification and lead to serious errors in pest management. In a species delimitation study of the genus *Aphaenomurus*, we detected an extraordinary *COI* divergence of up to 17% among morphologically indistinguishable individuals. Cross-validation with multiple primer sets and clonal sequencing indicates that this extreme variation is most plausibly due to heteroplasmy—the coexistence of multiple mitochondrial haplotypes within individuals. These findings suggest that in taxa where heteroplasmy is suspected or reported, reliance solely on mitochondrial markers can compromise identification accuracy. We recommend integrating nuclear markers (e.g., *18S*, *28S*) or a multilocus framework, combined with broader geographic sampling, to improve diagnostic reliability. Future research should systematically assess the prevalence of heteroplasmy in insects with high intraspecific diversity and establish standardized molecular identification protocols to minimize misidentification risks in applied entomology and pest management.

Key words: *Aphaenomurus*, heteroplasmy, species delimitation, misidentification

Oral Presentation Competition

PG1

Morphological and molecular characteristics of the Korean population of two stenodemine bugs (Hemiptera: Miridae), with analysis on their Mitogenome data

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The tribe Stenodemini, which belongs to the subfamily Mirinae, is largely characterized by its slender body shape. Due to their ecological specialization of feeding primarily on grasses (Poaceae), many species are recognized as agricultural pests. In Korea, eleven species have been recognized, including two recently recorded species, *Stenodema longula* and *Megaloceroea recticornis*. Based on a review of their biological traits from previous observations and research, these two species have the potential to emerge as significant phytophagous pests in Korea. However, studies on their molecular and morphological characteristics remain limited in East Asia. This paper presents new mitogenome data for these two species. Using this data, we have confirmed their molecular traits and analyzed the phylogenetic relationships between Korean specimens and populations from other countries. Specifically for *S. longula*, we conducted a comprehensive examination of its morphological and molecular differences from closely related species in neighboring countries. This analysis aims to re-evaluate the morphological characteristics currently used for species identification.

Key words: Miridae, Stenodemini, Korean population, mitogenome

PG2

Host Preference and Temperature Based Life Table of Tomato Leafminers, *Tuta absoluta* (Lepidoptera: Gelechiidae) in Korea

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Leaf miner, *Tuta absoluta*, introduced into South Korea, during 2023 and currently distributed all over the tomato producing areas in the country. The pest has a wide host range and short life cycle that enabled it to adapt in new areas; however, in south Korea, the biological characteristics of the pest on the alternative host plants and in different temperature are not well known. Therefore, the current study aimed at identifying the alternative host, and temperature based developmental biological characteristics of the insect. The effect of different temperature on the developmental stages were studied using detached tomato leaves under four different temperatures, 15, 27, 30 and 33± 1°C; 60 ± 5% RH. The newly laid leaf miner eggs were incubated in each temperature. Upon hatch, one neonate was separately kept on each leaf and replicated 15 times. The same procedure was followed for the host plant preference study in constant temperature (25 °C). Accordingly, egg hatch took 13, 4, 3, and 3 days at temperature of 15, 27, 30 and 33, respectively. In summary, the total life cycle took 65.36, 23.46, 21.46 and 19.45–days when the insect subjected to temperature of 15, 27, 30 and 33 °C, respectively. Similarly, larval survivability, pupation, and eclosion percentage slightly declined as temperature increased. On the other hand, the tomato leaf miner developmental stages vary when the larvae feed on the different host plants. The highest larval survivability was recorded from *Solanum lycopersicum*, followed by *Solanum nigrum*. Comparatively, *Solanum linnaenum* and *Solanum melongena* showed lowest larval survivability percentage.

Key words: Alternative host, Developmental, Host range, Life table, Tomato leaf miner

PG3

Functional diversity of insect hemocytes revealed by single cell RNA-sequencing and cell type-specific FISH markers

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Insect hemocytes exhibit diverse morphologies and functions, yet their extent of functional differentiation remains poorly defined. To investigate this, we analyzed hemocyte transcriptomes from *Spodoptera exigua* larvae using single cell RNA-sequencing (scRNA-Seq). While four hemocyte types have been morphologically recognized, scRNA-Seq identified 24 transcriptional clusters. Functional annotation of highly expressed genes grouped these clusters into seven categories: protein synthesis, apoptosis, melanization, cell-shape modulation, antimicrobial peptide production, calcium homeostasis, and cell repair. Immune pathway components, including Toll and IMD signaling and oxylipin biosynthesis genes, were differentially expressed across clusters. Immune effectors such as apoptosis and melanization were confined to specific subsets. Cluster-specific marker genes enabled fluorescence *in situ* hybridization (FISH), revealing four novel hemocyte types in addition to the known four. Upon immune challenge, hemocyte clusters underwent dynamic transcriptional changes, and pseudotime analysis suggested three distinct differentiation lineages. These results highlight the functional diversity and plasticity of S. exigua hemocytes.

Key words: Single cell RNA-sequencing, Hemocyte, Trajectory analysis, FISH, Immunity

PG4

Role of Niemann-Pick type C2 protein as a sperm-binding protein in honeybees

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Niemann-Pick type C2 protein (NPC2) functions as a cholesterol modulator in the sperm membrane and enhances sperm physiological functions in mammals and prawn species. In insects, NPC2 is involved in lipid metabolism, immune response signaling, and chemical communication. This study identified a novel function of the *Apis mellifera* NPC2 protein (AmNPC2) as a sperm-binding protein. Immunoassays and binding assays using recombinant AmNPC2 protein and its specific antibody revealed that AmNPC2 is expressed in the testes of drones and is localized on the sperm surface as a sperm-binding protein. A reduction in AmNPC2 levels on the sperm surface decreased sperm viability. AmNPC2 also appears to play a protective role in maintaining sperm viability under both oxidative and temperature stress conditions. Our findings indicate that AmNPC2 is a sperm-binding protein that enhances the viability of honeybee sperm.

Key words: *Apis mellifera*, Lipid-binding protein, NPC2, Sperm, Seminal fluid, Testes

PG5

Molecular systematics of New Zealand Goniaceritae (Coleoptera, Staphylinidae, Pselaphinae) with ten new species

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New Zealand is known for its disharmonious insect fauna and high endemism. Especially, Batrisitae and Clavigeritae, two supertribes of Pselaphinae that are widely distributed across the Old World, are completely absent. In contrast, the majority of the plesiomorphic supertribe Faronitae has been recorded in New Zealand. Among the supertribe Goniaceritae, the tribe Brachyglutini is the only one present in New Zealand. The endemic genera *Eupinogitus* Broun, *Gastrobothrus* Broun, and *Physobryaxis* Hetschko were previously represented by one, four, and one species, respectively. A recent molecular phylogenetic study suggested that these three genera are paraphyletic, with only moderately supported nodes, probably because the dataset was limited to two genes (*COI* and *28S*). We report ten new species and provide illustrations of their diagnostic characters. Additionally, we conducted a molecular phylogenetic analysis based on a dataset including three mitochondrial genes (*COI*, *COII* and *16S*) and three nuclear ribosomal genes (*18S*, *28S* and *wingless*) from the above genera. According to the resulting trees we propose that the genera *Eupinogitus* and *Physobryaxis* be synonymized with *Gastrobothrus*.

Key words: ant-loving beetles, evolution, multi-gene phylogeny, synonym

PG6

The origin and evolution of genomic chimerism in the mealybug endosymbiont

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Genomic, metabolic, and cellular mosaicism shape the complexity, adaptability and innovation of organisms. *Tremblaya phenacola,* an obligate endosymbionts of mealybug, exhibits a mosaic genome resulting from the fusion of its genome with a γ-bacterial symbiont. However, the origin and evolution of this fanscinating symbiont chimerism remian poorly understood. Here, we newly sequenced 14 genomes of *T. phenacola*, half of which showed a chimeric genome. Using volume electron microscopy, we confirmed that the chimeric *T. phenacola* cells are localized solitarily within host bacteriocytes. Phylogenomic analysis of host insects suggested that the genome mosaicism of symbionts originated ~50 Mya. Furthermore, we found that the γ-proteobacterial homologs in the chimeric genome are highly regulated within the symbiotic organ of *T. phenacola*. In addition, we profiled horizontally transferred genes in host genomes, which are likely involved in maintaining the chimeric symbiont. Our results show the timing and order of genome chimerism events and subsequent genetic and physiological adaptations of both host and symbiont in this mosaic system.

Key words: Insect-microbe symbiosis, scale insects, *Tremblaya*

G1

A taxonomic review of the superfamily Gerroidea Leach (Hemiptera: Gerromorpha) from the Korean Peninsula

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The superfamily Gerroidea Leach is the largest taxon of the infraorder Gerromorpha, encompassing approximately 1,700 species and 132 genera worldwide. Among these, two families—Gerridae Leach and Veliidae Brulle—are distributed in Korean Peninsula. In previous study, a total of 25 species belonging to 10 genera had been reported from the Korean Peninsula. With the addition of three species newly recorded in this study, the Korean fauna of these two families now comprises 28 species in 12 genera. Herein, we conduct a taxonomic review of Korean Gerroidea, providing morphological diagnoses, along with a general introduction to each family.

Key words: Korea, semiaquatic bug, taxonomy, water strider

G2

Unveiling Sri Lankan Weevil Diversity (Coleoptera: Curculionidae, excl. Scolytinae & Platypodinae): First Comprehensive Survey

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Sri Lanka (Ceylon) has the highest recorded species density of vertebrates in Asia, yet its insect fauna, especially Coleoptera remains comparatively understudied. Although the Curculionidae is the largest beetle family, focused taxonomic research on Sri Lankan weevils has been scarce since the nineteenth century. To address this gap, we compiled data for a comprehensive survey of Sri Lankan Curculionidae (excluding Scolytinae and Platypodinae) using historical literature, the Junk catalogue series, recent publications, online resources, museum records and direct examination of specimens. 263 species in 119 genera across 10 subfamilies, of which about 175 species are endemic or potentially endemic are documented. Species richness is greatest in the Central Province, with the Nuwara Eliya District supporting the highest diversity (94 species). Two new species; *Sitophilus linearis* (Herbst) (Dryophthorinae: Rhynchophorini) and *Rhinoncus paganus* Gyllenhal (Conoderinae: Ceutorhynchitae: Phytobiini) are reported from Sri Lanka. This work provides the first modern, island-wide synthesis of Curculionidae diversity in Sri Lanka and establishes a foundation for future taxonomic, ecological, and conservation studies.

Key words: Ceylon, Curculionidae, comprehensive survey, occurrence data, species diversity

G3

Toward a stable DNA Barcode reference for Noctuidae with emphasis on cryptic diversity

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The family Noctuidae Latreille, 1809 is one of the most diverse families in Lepidoptera worldwide and includes serious agricultural pests and forest pests, such as *Spodoptera frugiperda*, *Helicoverpa assulta*, and *Acronicta rumicis*. Despite economic and ecological importance, their DNA Barcode reference for this family remains unstable. In the east asia, approximately 2000 species are recognized. In this study, we construct a more robust DNA Barcode reference for Noctuidae and evaluate the efficiency of the current public DNA Barcode library by applying the species delimitation analysis to explore potential cryptic diversity.

Key words: East Asia, noctuid moths, DNA barcoding, COI, specific divergence.

G4

Taxonomic study of the little known family Opostegidae (Lepidoptera: Nepticuloidea) Meyrick, 1893 from Korea

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The family Opostegidae (Lepidoptera: Nepticuloidea) is widely distributed across all biogeographic regions except Antarctica. However, the Opostegidae is comprised of only 200 species belonging to seven genera. The biology of Opostegidae also has yet to be fully explored and understood. It has been documented that certain species of larva have been observed to undertake the process of mining the cambium layer of their host plants. In contrast, other species have been identified as specialists in the mining of foliage or stems. The Opostegidae has received scant attention in Korea with only one species, *Opostegoides minodensis*, recorded by Park (1983).

This study represents the first extensive taxonomic research on the Korean Opostegidae including new species. Moreover, it furnishes essential data for subsequent phylogenic and biodiversity research.

Key words: Leaf miner, New record, Opostegidae, Korea, Taxonomy.

G5

Review of the genus *Pammene* Hübner, [1825] (Lepidoptera, Olethreutinae, Grapholitini) in Korea

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The genus *Pammene* Hübner, [1825] belongs to the tribe Grapholitini of the subfamily Olethreutinae. Adults of *Pammene* are small to medium-sized moths (wingspan 8–18 mm). The genus comprises 90 species distributed throughout the Holarctic Region. In Korea, only ten species of *Pammene* have been recorded to date.

In this study, we review the genus *Pammene* from Korea, including the description of a new species, *Pammene sterigmata* sp. nov., and a newly recorded species *P. grunini* (Kuznetzov, 1960). All available information, including distribution and images of adults and genitalia, is provided.

Key words: Grapholitini, *Pammene*, new species, Korea

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G6

Phylogenomics of the family Erebidae (Lepidoptera: Noctuoidea)

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The family Erebidae is the largest lepidopteran family, with about 25,000 recorded species. Considering their biological and economic importance, it might be uncommon that the relationship between their subfamilies is still unclear. The pioneering work by Zahiri et al. (2012) using eight genes and 18 subfamilies suggested the hypothesis about it, but their support values were too low to say it is clear. Here, we try to resolve erebid moths' remaining questions—clear relationships between 18 subfamilies, accurate positions of previously unplaced taxa, diverged timing, and several evolutionary trajectories—using about 800 genes.

Key words: AHE, erebid moths, phylogeny, taxonomy

G7

Mitogenomic phylogeny of *Eurytoma* (Hymenoptera: Eurytomidae) reveals conflicts with traditional species-groups and recurrent host-use transitions

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The genus *Eurytoma* is the most species-rich and taxonomically complex lineage in the family Eurytomidae, with >700 described species worldwide and a remarkable diversity of feeding strategies ranging from phytophagy to parasitism. More than half of all species occur in the Palearctic, yet internal classification remains unresolved due to morphological convergence, cryptic diversification, and reliance on superficial traits. To clarify species-group limits, we reconstructed a mitogenome-based phylogeny of Palearctic *Eurytoma* using ML/BI inference and ancestral-state reconstruction. Our sampling covers 16 of 19 historically defined species-groups, recovering 12 within *Eurytoma sense stricto*, and revealing several morphology- or host-defined units to be non-monophyletic. Comparative morphology is consistent with molecular boundaries (e.g. posterior head characters, ventral-shelf variation). Ancestral reconstructions indicate the repeated, independent shifts to phytophagy and multiple origins of gall-associated parasitism. These findings provide a robust framework for re-evaluating species-group limits and support an essential foundation for future revisions of group classification grounded in morphological evidence.

Key words: Chalcidoidea, morphology, parasitoid, phytophagous, systematics

G8

Molecular Phylogenetics of Apoditrysia: Preliminary Insights into Urodoidea and Galacticoidea

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Apoditrysia is the most extensive group within Lepidoptera, encompassing most moths and all butterflies. They are morphologically diverse, ecologically dominant, and a group of significant economic importance. While advances in molecular techniques have enabled extensive research on the phylogenetic positions and relationships of many taxa within the Lepidoptera group, studies on the internal taxonomic groups within Apoditrysia remain unclear.

This study conducted a preliminary phylogenetic analysis to determine the phylogenetic position of the major groups, Urodoidea and Galacticoidea within the Apoditrysian, which had not been previously tested, and to clarify the preliminary phylogenetics among their relationship by using multi genes.

Key words: Lepidoptera, Apoditrysia, Urodoidea, Galacticoidea, Phylogenetics

G9

Molecular Phylogeny and Insights into Evolution of Lachninae (Hemiptera: Aphididae)

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The subfamily Lachninae Herrich-Schaeffer, 1854 comprises about 400 species in 18 genera, primarily distributed across the Nearctic, Oriental, and Palaearctic regions, where they feed on both deciduous and coniferous hosts. We clarify the life cycle of *Pyrolachnus* and reevaluate its relationships with allied taxa, incorporating the taxonomic significance of ontogenetic morphological variation. Using multilocus phylogenetic analyses, we assess genus-level host associations and the adaptive evolution of morphological traits. Our results reveal a strong association between host use and trait diversification, emphasizing host-driven selection as a key driver of morphological evolution.

Key words: Aphids, host plant, morphology, phylogeny

G10

Morphological investigation of Lachninae (Hemiptera: Aphididae) in Korea

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The subfamily Lachninae Herrich-Schaeffer, 1854 comprises roughly 400 described species across 18 genera, with a distribution concentrated in the Nearctic, Oriental, and Palaearctic regions, where they feed on both deciduous and coniferous hosts. In this study, we present a comprehensive synthesis of the Lachninae fauna of the Korean Peninsula, integrating historical records with new data from extensive recent field surveys. Our work provides an integrative treatment of newly discovered and newly recorded species, as well as previously undocumented or poorly characterized morphs. Particular attention is devoted to clarifying their life cycles, including host alternation patterns, morph-specific morphological traits, and seasonal phenology.

Key words: Aphids, host plant, morphology, taxonomy

G11

Remote sensing applications in flower phenology detection

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Climate change has led to earlier plant blooming, disrupting the timing between plants and pollinators and causing temporal and spatial mismatches. Monitoring these shifts is crucial, and remote sensing has emerged as a powerful tool for tracking flowering periods across large areas. This study aims to fill that gap by summarizing research on remote sensing techniques used to analyze flowering phenology, especially in canola crops. We categorized remote sensing applications into four types: optical, Synthetic Aperture Radar (SAR), Unmanned Aerial Vehicle (UAV), and PhenoCam-based methods. Optical sensing captures detailed imagery of flowering events, SAR provides reliable all-weather monitoring, UAVs offer high-resolution site-specific data but face operational limits, and PhenoCams support long-term monitoring with limited spatial detail. Each method has unique strengths and weaknesses, highlighting the importance of integrated approaches for better phenology assessment and agricultural monitoring.

Key words: climate change, optical, PhenoCams, plants, pollination, Synthetic Aperture Radar, Unmanned Aerial Vehicle

G12

An Application of Bioclimatic Variables at High Spatial Resolution to Species Distribution Modeling of *Halyomorpha halys* (Hemiptera: Pentatomidae) in Soybean Fields

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The need for diverse climatic indicators to assess the impacts of climate change on agricultural ecosystems has been increasing. We constructed a time-series dataset of 19 bioclimatic variables at 270 m resolution (1981–2024) and applied it to species distribution modeling (SDM) of *Halyomorpha halys* in soybean fields. Trap survey data from 134 sites (2022–2024) were combined with climatic and static variables, and 13 environmental predictors were selected for MaxEnt modeling through SADIE analysis and correlation analysis. The model demonstrated reliable performance (AUC 0.71, TSS 0.40), and the variable importance analysis identified major environmental drivers. This study presents a case study of applying high spatial resolution bioclimatic data to SDM, suggesting its potential extension to future pest prediction under climate change, development of climate-adaptive indices, and establishment of agricultural pest management strategies.

Key words: *Halyomorpha halys*, Soybean Fields, BIOCLIM, SDM, pest distribution

G13

Application of time-series deep learning algorithm for developing species distribution model

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Species distribution models (SDMs) are widely utilized as a tool for predicting and understanding the spatial distribution patterns of species. Traditional machine learning-based models such as MaxEnt and Random Forest (RF) primarily focus on independently analyzing the relationship between species occurrence and single-point environmental variables (e.g., mean climate). In contrast, Mcfly offers a framework that integrates time-series data to account for dynamic environmental variability and automatically selects the optimal deep learning model to enhance species distribution predictions. Under this point of view, this study evaluated the applicability of a deep learning framework incorporating time-series climatic variables for species distribution modeling, using *Lycorma delicatula* as a case study. The results showed that model performance (accuracy: 0.66~0.98) were influenced by the spatial distribution of occurrence records as well as by the approach used to partition the training and test data sets. In conclusion, the results suggest that improving model performance with time-series deep learning requires appropriate preprocessing of occurrence records during the initial modeling stage.

Key words: deep learning, times series, spatial evaluation, species distribution model

G14

Dual species distribution modeling with soil microclimate for predicting potential distribution of *Pheidole megacephala*

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African big-headed ant (*Pheidole megacephala*) is a globally invasive ant species that poses serious threats to native invertebrates and agriculture, underscoring the need for early assessment of its potential distribution. In this study, we developed a dual species distribution model using CLIMEX and MaxEnt, incorporating soil temperature to capture the species' subterranean habitation in relation to climatic conditions. As a result, the ant species showed strong affinity for tropical and subtropical regions, including Southeast Asia, central and southern Africa, and the southeastern U.S. In South Korea, the inclusion of soil temperature data markedly expanded the predicted suitable range, particularly in southern and coastal regions, increasing from 65% to 95% across the national territory, with peak suitability occurring between April and October. This study emphasizes the importance of soil microclimate in predicting subterranean ant distributions and draws attention to the invasion risk posed by *P. megacephala.*

Key words: African big-headed ant, CLIMEX, MaxEnt, soil temperature, subterranean ant species

G15

Species and distribution of parasitoid wasp of *Spodoptera exigua* in field population

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Spodoptera exigua, established in southern Korea and recently expanding northward with climate warming, causes serious damage to major crops. Reliance on chemical insecticides raises concerns of resistance and environmental impacts. To assess sustainable alternatives, larvae were collected from nine regions and reared for parasitoid recovery. Morphological identification was supported by COI-based molecular analysis, with species boundaries refined using ABGD, ASAP, bPTP, and GMYC. Regional variation in parasitoid assemblages was evident, including three parasitoid wasps and one tachinid fly in Cheonan. A distribution map visualized occurrence patterns. These results provide baseline information for parasitoid-based biological control of *S. exigua* within integrated pest management.

Key words: korea, *Spodoptera exigua*, parasitiewasp, distribution, molecular identification

G16

Forest type differences in seasonal abundance of Collembola in temperate forests

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Despite the importance of seasonality on community structure, the seasonal dynamics of collembolan communities across varying types of temperate forests remain unclear. In this study, Collembola were sampled quarterly at spatially contiguous *Pinus*, mixed (*Pinus*-*Quercus*), and *Quercus* forests in Busan. Generalized linear mixed models indicated that total Collembola abundances was significantly higher in winter than in other seasons in *Pinus* (2.8×) and mixed (4.8×) forests, but not in *Quercus* forests. Indicator species analysis showed that *Protaphorura* sp. and *Ceratophysella denticulata* were significantly associated with winter in *Pinus* and mixed forests. Their abundances were significantly related to season and forest type; however, the forest type × season interaction was only significant for *Protaphorura* sp., which showed no significant seasonality in *Quercus* forests. This result suggests that winter condition is associated with a rapid increase in some collembolan taxa, with responses differing among forest types.

Key words: springtail, winter ecology, species coexistence, phenology

G17

Factors affecting insect pest density in orchards

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Insect pests in orchards cause direct damage to trees and fruit, resulting in economic losses. Since insect pests cannot be eradicated, continuous pest management is necessary. Estimating insect pest density is essential for effective pest management, so monitoring is crucial. However, monitoring is time-consuming and labour-intensive. Various approaches are needed to address these issues. There are mutual relationships between insect pests, fruit trees, and environmental factors, and monitoring of insect pests can be based on these relationships. Therefore, it is necessary to identify orchard factors closely related to insect pest density. To identify these factors, we use machine learning algorithms to learn patterns from input data and generate models. We have used these algorithms to identify factors affecting insect pests in orchards.

Key words: orchard, environmental factor, machine learning

G18

Multi-scale effects of farming systems on insect herbivores: contrasting species-specific responses at local and landscape scales in the rice-crayfish co-culture system

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While sustainable farming systems are being implemented and expanded globally, their multi-scale effects, particularly at the landscape scale, on the outbreak patterns of insect herbivores remain poorly understood, hindering the development of effective management strategies. This study investigated the effects of the rice-crayfish co-culture system (RC), a sustainable agricultural system that has rapidly developed in China in recent years, on three major rice pests—the white-backed planthopper (WBPH), rice leaf folder (RLF), and striped stem borer (SSB)—at both local and landscape scales in the Jianghan Plain, China, from 2018 to 2021. Our results revealed scale-dependent and species-specific responses to RC. Landscape-scale land-use changes resulting from RC expansion have more substantial effects on pest populations than local-scale management practices, likely due to the proximity of paired rice fields and the strong migration ability of pests. Moreover, increasing RC coverage within a 3.0 km radius increased the abundances of WBPH and RLF but decreased SSB abundance. These divergent responses were attributed to species-specific biological traits, including overwintering strategies and dispersal capacities. The elevated abundances of migratory pests (WBPH and RLF) in high-RC-coverage landscapes were associated with reduced pesticide pressure and enhanced habitat suitability, while the decreased SSB abundance was linked to the elimination of overwintering habitats through winter flooding practices. These results provide critical insights into the outbreak mechanisms of pests and highlight the importance of multi-scale, species-specific approaches in sustainable farming systems pest evaluation and pest management strategy development.

Key words: Sustainable farming system, Rice-crayfish co-culture, Multi-scale, Landscape scale, Rice pest, Species-specific

G19

Exploitation of fungal pathogen by the predatory mite *Stratiolaelaps scimitus*

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We investigated the effect of entomopathogenic fungus *Beauveria bassiana* AAD16 on the predatory mite *Stratiolaelaps scimitus* under laboratory conditions. Five bioassays were conducted in glass vials using oil-formulated fungus combined with two substrates and prey mites. First, in residual bioassay using fungus conidia, the survival of *S. scimitus* was not reduced. In an assay using oil-formulated fungus, the mite's survival even increased significantly. The survival further increased when oil-formulation was combined with rice husk as filling substrate for the predator compared to control (1.8 times in ST_{50}). When combined with rice husk and prey (with rice bran as a food substrate), oil-formulation significantly prolonged the survival compared to control (3.3 times in ST_{50}). Dose–response bioassay demonstrated concentration-dependent effect by showing highest survival at 1×10^8 conidia/mL while lowest at 1×10^5 conidia/mL. In conclusion, the predatory mite *S. scimitus* can feed on oil-formulated fungus, which serves as an alternative food source and extends its longevity. This novel finding highlights that integrating *S. scimitus* and *B. bassiana* can be a potential promising strategy in sustainable pest management systems.

Key words: oil formulation, compatibility, prey–pathogen interaction, probit-logit analysis

G20

Comparative analysis of life table between parthenogenetic and bisexual lineages of *Haemaphysalis longicornis*

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The Asian longhorned tick, *Haemaphysalis longicornis*, is the most abundant hard tick species in the Republic of Korea and is also known as a disease vector transmitting various pathogens, including severe fever with thrombocytopenia syndrome virus (SFTSV). The population of *H. longicornis* in nature is maintained by two reproductive strategies (parthenogenesis and bisexual), which can be distinguished by analysis of the 16S rRNA sequence. However, their fundamental biology, including the life table, remains unclear. In this study, we measured and compared the two reproductive lineages using various biological parameters, such as morphological traits, body weight, and periods of time for blood feeding, pre-molting/oviposition, and egg incubation. The idiosoma of parthenogenetic individuals was significantly larger than that of bisexual individuals. Replete parthenogenetic individuals at all stages were significantly heavier than bisexual individuals. Furthermore, parthenogenetic individuals required a significantly longer time for pre-molting/oviposition and egg incubation. Understanding the differences between two reproductive lineages may provide insight for assessing their ecological adaptability and vectorial capacity, particularly in regions where both populations coexist.

Keywords: *Haemaphysalis longicornis*, parthenogenetic, bisexual, blood feeding, pre-molting, pre-oviposition

G21

Exploring adaptive traits balancing symbiont acquisition and predator avoidance in *Riptortus pedestris* (Hemiptera: Alydidae) using an individual-based model

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Riptortus pedestris (Hemiptera: Alydidae) acquires its beneficial gut symbionts from soil during nymphal stages. Although no specific mechanism facilitating symbiont acquisition has been reported, field populations show up to 100% symbiont acquisition rates. In this study, we investigated how behavioral traits (walking activity and movement patterns) and physiological traits (length of the symbiont acquisition window) of *R. pedestris* assist symbiont acquisition through incidental contact with symbiont-harboring soil during nymphal stages while reducing predation risk. For this, we developed an individual-based model to examine variation in walking activity and length of symbiont acquisition window affect symbiont acquisition rate by the nymphs under different levels of symbiont-harboring soil cover. We further assessed whether the reduction in walking activity observed in *R. pedestris* after symbiont acquisition decreases predation risk from random encounters with predators while maintaining high symbiont acquisition rates. Our findings provide insights into the evolutionary trajectories shaping host–symbiont interactions in this system.

Key words: insect-microbe symbiosis, bean bug, *Caballeronia*

G22

How dietary protein and carbohydrate shape intake, performance, and body composition in the two-spotted cricket, *Gryllus bimaculatus* (Orthoptera: Gryllidae)

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Crickets are among the most widely farmed insects, yet their dietary requirements remain poorly defined. Using a nutrient landscape methodology, we examined the effects of dietary protein and carbohydrate on multiple nutritional traits in nymphs of the two-spotted cricket, *Gryllus bimaculatus.* Nymphs were reared on 24 artificial diets varying in protein and carbohydrate concentrations. Food intake increased with nutrient dilution, but compensatory feeding was incomplete. All performance traits were enhanced on nutritionally dense diets, but at different P:C ratios. Survival was highest at a strongly protein-skewed ratio of 3.86:1, whereas growth rates peaked at a carbohydrate-biased ratio of 1:1.47. When provided a choice, nymphs self-selected a P:C ratio of 1:1.82, closely matching the ratio that maximized growth. Body protein and lipid contents were maximized at 1.14:1 and 1:5.56, respectively. Our results provide insights into diet optimization strategies for improving the efficacy of cricket farming.

Key words: edible insect, *Gryllus bimaculatus*, macronutrient, nutritional geometry

G23

Differential Expression of Heat Shock Protein Genes under Environmental Stress in Collembola

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All living organisms possess physiological defense mechanisms to maintain homeostasis against environmental stresses such as limited nutrients and temperature fluctuations. Among these stress response systems, heat shock proteins (HSP) serve as molecular chaperones that prevent protein denaturation and repair damaged proteins. Due to their increased expression upon stress exposure, HSP are widely used as molecular biomarkers for biological stress. This study aims to investigate the molecular effects of environmental stress on living organisms. We analyzed differentially expressed genes (DEGs) in stressed individuals, with focus on HSP family gene expression patterns to identify stress-induced physiological changes. We conducted experiments to examine the effects of starvation and temperature stress on gene expression in Collembola. Initially, springtails were divided into experimental and control groups, where the experimental group underwent one-week fasting while the control group received normal feeding, followed by RNA extraction and de novo transcriptome sequencing. DEG analysis identified approximately 50 genes with significant expression changes under starvation stress, from which three HSP family genes (*hsp83*, *hsp70*, *hsp27*) were selected as target genes. Based on the obtained sequences, gene-specific primers were designed for subsequent qPCR analysis. Using these primers, expression changes of the selected HSP genes were then analyzed under both starvation and temperature conditions. For temperature stress, springtails were exposed to 20°C, 25°C, and 30°C for two weeks, with triplicate experiments conducted for each condition. qPCR analysis revealed different expression patterns depending on stress type. Under starvation stress, *hsp83* and *hsp70* were upregulated compared to controls, while *hsp27* was downregulated. Under temperature stress, all genes (*hsp83*, *hsp70*, *hsp27*) showed consistent upregulation with increasing temperature exposure. Our findings demonstrate that members of the HSP family exhibit distinct expression patterns in response to different environmental stressors.

Key words: Collembola, de novo sequencing, heat shock protein, starvation stress, temperature stress

G24

Pathogenicity Assessment of Newly Isolated *Bacillus thuringiensis* Strain Against Insect Pests

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Bacillus thuringiensis (Bt) is an insect-pathogenic bacterium that produces insecticidal δ-endotoxins during sporulation and is widely applied as a biopesticide. In this study, a new strain, Bt IPTL3, was isolated from soil in a *Cnidium officinale* field in Korea based on 16S rRNA sequencing and biochemical profiling. The new Bt strain exhibited strong insecticidal activity against five lepidopteran pests, including *Plutella xylostella*, *Spodoptera frugiperda*, *S. exigua*, *Ostrinia furnacalis*, and *Tuta absoluta*, while showing no pathogenicity to non-target insects such as *Apis* spp. (bees) and *Tenebrio molitor*. Virulence assessment revealed species-specific susceptibility: *P. xylostella* showed the highest sensitivity with the lowest LC_{50} (2.7×10^3spores/ml) and shortest LT_{50} (1.89 days), whereas *S. exigua* displayed relatively higher tolerance with LC_{50} (6.6×10^4spores/ml) and LT_{50} (3.21 days). Notably, the newly invasive quarantine pest *T. absoluta* also exhibited high susceptibility. These findings demonstrate that Bt IPTL3 is highly effective against major agricultural pests and safe for beneficial insects, suggesting its strong potential for sustainable pest management and resistance mitigation.

Key words: *Bacillus thuringiensis* IPTL3, Biopesticide, *Spodoptera frugiperda, Plutella xylostella, Tuta absoluta*

G25

Motion as a possible explanation for the persistence of imperfect mimicry

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In mimicry systems, mimics are predicted to be under selection for accurate mimics, yet motion can reduce the signal-to-noise ratio and interfere with mimetic signal recognition. As faster motion increases noise, predators may struggle to reliably distinguish undefended mimics from defended models. To test this, we developed a computer-based predator–prey game with human participants as predators. Players learned through trial and error to avoid two types of defended models and attack two types of mimics. Once learning was established, we measured prey survival at different movement speeds. Mimics exhibited higher survival when moving faster, suggesting that motion hindered discrimination between models and mimics. In contrast, model survival remained unchanged across treatments. These results show that motion can differently affect mimicry components, enhancing the success of mimics while not increasing the protective value of models.

Key words: imperfect mimicry, signal-to-noise ratio, motion

G26

Population genetic structure and gene flow of *Dioryctria abietella* Denis & Schiffermüller (Lepidoptera: Pyralidae) using EST-derived microsatellites

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Dioryctria abietella (Lepidoptera: Pyralidae) is a major cone-boring pest of *Pinus koraiensis* and has recently been reported damaging *Abies koreana*, an endangered conifer species. This study examines the population genetic structure and gene flow of *D. abietella* in Korea to assess the impact of geographic distance on genetic differentiation. A total of 123 individuals were collected from five locations using pheromone traps and genotyped with 10 EST-derived microsatellite markers. Pairwise F_{ST} values indicated moderate to high genetic differentiation, particularly between Jeju Island and mainland populations, suggesting restricted gene flow. Bayesian clustering analysis using STRUCTURE identified two genetically distinct groups, with further substructuring observed within the mainland populations. These clustering patterns were consistent with Principal Coordinates Analysis and Discriminant Analysis of Principal Components. The Mantel test showed a significant correlation between genetic differentiation and geographic distance, supporting an isolation-by-distance pattern. The distinct genetic structure of the Jeju population indicates that geographic barriers limit dispersal, leading to its genetic differentiation from mainland populations. This study enhances our understanding of *D. abietella*'s gene flow patterns and provides insights for effective region-specific pest control strategies.

Key words: *Dioryctria abietella*, microsatellite markers, population structure, gene flow, geographic barrier

G27

Pathogen dynamics of bisexual and parthenogenetic *Haemaphysalis longicornis* in the Republic of Korea

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Haemaphysalis longicornis, the predominant hard tick species in the Republic of Korea, serves as a major vector for various microbial pathogens and harbors a diverse array of microbial communities. In nature, *H. longicornis* ticks are maintained through both bisexual and parthenogenetic reproductive strategies; however, a comprehensive understanding of their microbiomes and pathogen profiles remains unclear. This study investigated the composition of the bacterial community and the prevalence of tick-borne pathogens. Analysis of the 16S rRNA gene (V3-V4 region) revealed 64 bacterial genera, with microbial communities clustering according to reproductive strategy rather than geographical distribution. The genus *Coxiella* predominated (>89%) in both reproductive lineages, whereas *Candidatus Rickettsia jingxinensis* exhibited higher abundance in bisexual female ticks. Furthermore, microfluidic real-time PCR revealed that 57.1% of the examined ticks harbored at least one microorganism among five pathogen species, which included *Ca. R. jingxinensis, A. bovis, A. capra, E. ewingii*, and *T. luwenshuni.* Notably, *Ca. R. jingxinensis* was the most prevalent and was present in all co-infected specimens. These findings reveal that composition of *Rickettsia* varies according to reproductive strategy and *Ca. R. jingxinensis* is the most prevalent microorganism in *H. longicornis* across the Republic of Korea.

Keyword: *Haemaphysalis longicornis*, reproductive strategy, bacterial community, tick-borne pathogen, microfluidic real-time PCR

G28

Influence of male accessory gland materials on female oviposition behavior in the beet armyworm, *Spodoptera exigua*

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Explosive potential of reproduction is one of the insect physiological characters for them to exist under various environmental changes for a long evolutionary history. A lepidopteran insect, *Spodoptera exigua*, is well known to evolve the resistance under exposure to various chemical insecticides with its high reproductive potential. A female possesses a pair of ovary, each of which consists of four ovarioles. Each ovariole contains almost 100 oocytes, which are divided into previtellogenic, vitellogenic, and choriogenic oocytes. The oocyte development begins as early as young pupae. At adult emergence, the ovary has fully developed ovarioles, which are filled with previtellogenic and vitellogenic oocytes. Choriogenesis appears to begin after adult emergence. In contrast, males are fully developed in their internal reproductive system at the adult emergence and ready to mate with females. During mating, males deliver their sperms and the male accessory gland (MAG) materials to the female spermatheca. The mating stimulates the egg-laying behavior of at least two days old virgin females after emergence. Interestingly, the organic extract of MAG alone stimulated the egg-laying behavior without mating. MAG extracts possessed prostaglandins from LC-tandem MS analysis. Injection of PGE_2 to the virgin females also stimulated the egg-laying behavior. FISH analysis showed that PGE_2 receptor was expressed in the oviduct and the central nervous system. Interestingly, the oviduct contraction rate increased with mating or the addition of PGE_2. These results suggest that PGs in the MAG are delivered to female during mating and stimulates the oviposition behavior by stimulating oviduct contraction rate in *S. exigua*.

Key words: Oviposition, Male accessory gland, Prostaglandin, Spermatheca, *Spodoptera exigua*

G29

Distinct physiological roles of dopamine and octopamine receptors in cuticle expansion during blood-feeding of *Haemaphysalis longicornis.*

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The blood feeding process of ixodid female ticks consists of four stages (attachment, slow engorgement, rapid engorgement, and detachment). The rapid engorgement phase occurs during the final 24 to 48 hours before detachment. During this period, female ticks ingest the majority of their total blood meal and undergo extensive morphological changes, including an approximately 100-fold increase in body mass. To accommodate these dramatic changes, the alloscutal cuticle must rapidly expand for engorgement. In *Haemaphysalis longicornis*, cuticle plasticization was regulated by biogenic amines: dopamine (DA) and octopamine (OA). This study investigated the physiological roles of DA receptors (D1 and InvD1L) and OA receptors (α, β, and tyramine) in blood feeding of *H. longicornis*. The RNAi of DA receptors delayed tick attachment and the blood feeding period by up to 24 hours. In contrast, knocking down OA receptors had no significant effect on blood-feeding behavior. Interestingly, the double knockdown of both DA and OA receptors, excluding the tyramine receptor, reduced the body weight of repleted ticks by about 100 mg (31%). These findings suggest that DA signals are essential for blood-feeding behavior, while both DA and OA signals contribute to cuticle expansion for successful engorgement.

Key words: *Haemaphysalis longicornis*, rapid engorgement, cuticle expansion, G protein-coupled receptor, RNA interference

G30

Identification and functional characterization of a microRNA involved in phosphine resistnace in *Tribolium castaneum*

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Phosphine (PH_3) is a fumigant widely used in quarantine. Due to the continuous use of phosphine, resistance has been increasingly reported, including in *T. castaneum.* MicroRNAs (miRNAs) are small RNAs of 18-22 nucleotides and have been reported to play important roles in insecticide resistance in insects. In this study, we identified miRNAs that are associated with phosphine resistance and examined their functional roles. A total of 219 miRNAs were identified, including 202 known miRNAs and 17 novel miRNAs. Of these, 60 miRNAs were upregulated and 25 miRNAs were downregulated in PH_3-R *T. castaneum.* Notably, *tca-miR-137-5p* was 1.7-fold downregulated, while its predicted target, *CYP346B3*, was 1.8-fold constitutively upregulated in PH_3-R *T. castaneum* compared with the PH_3-S *T. castaneum.* Following *tca-miR-137-5p* mimic injection, *CYP346B3* expression was reduced by approximately 50% at both 48 h and 72 h. Furthermore, under phosphine exposure, *tca-miR-137-5p* mimic-injected PH_3-R *T. castaneum* showed 20% higher mortality compared to the negative control. Our study provides novel evidence that miRNA-mediated regulation of CYP346B3 contributes to phosphine resistance, highlighting a potential molecular marker for resistance management strategies.

Key words: *Tribolium castaneum*, miRNA, phosphine resistance, CYP346B3, RNAi

G31

The microRNA-7322-5p/p38/Hsp19 axis modulates *Chilo suppressalis* cell-defenses against Cry1Ca

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Bacillus thuringiensis(*Bt*)-secreted crystal (Cry) toxins form oligomeric pores in host cell membranes and are a common element in generating insect-resistant transgenic crops. Although Cry toxin function has been well documented, cellular defences against pore-formation have not been as well developed. Elucidation of the processes underlying this defence, however, could contribute to the development of enhanced Bt crops. Here, we demonstrate that Cry1Ca-mediated downregulation of microRNA-7322-5p (miR-7322-5p), which binds to the 3' untranslated region of *p38*, negatively regulates the susceptibility of *Chilo suppressalis* to Cry1Ca. Moreover, Cry1Ca exposure enhanced phosphorylation of Hsp19, and *hsp19* downregulation increased susceptibility to Cry1Ca. Further, Hsp19 phosphorylation occurs downstream of p38, and pull-down assays confirmed the interactions between Hsp19 and Cry1Ca, suggesting that activation of Hsp19 by the miR-7322-5p/p38/Hsp19 pathway promotes Cry1Ca sequestration. To assess the efficacy of targeting this pathway in planta, double-stranded RNA (dsRNA) targeting *C. suppressalisp38* (ds*p38*) was introduced into a previously generated cry1Ca-expressing rice line (1CH1-2) to yield a single-copy *cry1Ca/*ds*p38*rice line (p38-rice). Feeding on this rice line triggered a significant reduction in *C. suppressalis p38*expression and the line was more resistant to *C. suppressalis* than 1CH1-2 in both short term (7-day) and continuous feeding bioassays as well as field trials. These findings provide new insights into invertebrate epithelium cellular defences and demonstrate a potential new pyramiding strategy for *Bt*crops.

Key words: Plant mediated-RNAi, Cry toxin, Cellular defence, MicroRNA- 7322-5p/p38/Hsp19 axis, Bt crops

G32

RNAi-Based Strategy for the Suppression of Nosemosis in *Apis mellifera* L.

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Nosemosis, caused by the microsporidian parasite *Vairimorpha* (=*Nosema*) *ceranae*, is a major threat to apiculture, leading to colony productivity loss and collapse. Although fumagillin B has long been used for control, resistance and host toxicity highlight the urgent need for safer alternatives. In this study, we applied RNA interference (RNAi) technology to develop a species-specific and environmentally friendly strategy. Eleven parasite-specific genes were targeted with double-stranded RNA (dsRNA), which was orally administered to infected worker bees. Quantitative PCR analysis based on the *V. ceranae* 16S rRNA gene showed that dsRNAs targeting *swp25*, *metap2*, and *spp* suppressed pathogen proliferation by 74.8%, 63.3%, and 57.2%, respectively. These findings suggest that RNAi can provide a promising platform for sustainable honey bee disease management and broader applications in industrial entomology.

Key words: Microsporidia, Nosema ceranae, RNA interference(RNAi), qPCR, Apicultural disease control

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G33

miRNA-mediated regulation of GPCR pathway genes influences CYP expression in chlorantraniliprole detoxification of *Spodoptera frugiperda* (Smith)

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The fall armyworm, *Spodoptera frugiperda* (Smith), has developed extremely high levels of resistance to chlorantraniliprole and other classes of insecticides. MicroRNAs (miRNAs) play crucial roles in various biological processes in insects, including regulation of insecticide resistance through gene expression. Studies have reported that the GPCR signaling pathway influences the expression of detoxification enzymes such as cytochrome p450s. In this study, we examined miRNA expression in response to chlorantraniliprole in *S. frugiperda*, and assessed the effects of miRNA mimics/inhibitors on insecticide susceptibility, CYP expression, and GPCR pathway target genes. Transcriptome analysis revealed significant changes in the abundance of miRNAs in *S. frugiperda* larvae following treatment with LC_{20} of chlorantraniliprole. A total of 196 miRNAs were predicted, with 12 miRNAs differentially expressed in response to chlorantraniliprole, compared to control. Notably, microinjection of miR-46 and miR-98 mimics significantly increased mortality of *S. frugiperda* larvae by 30.73% and 26.96%, while inhibitors of these miRNAs reduced mortality by 15.18% and 11.4% upon exposure to chlorantraniliprole. Furthermore, injection of the two mimics and inhibitors also resulted in changes in CYP expression levels. Additionally, we screened potential target genes of the differentially expressed miRNAs associated with GPCR pathway, which are likely to be involved in insecticide detoxification mechanism. These findings shed light on the molecular mechanisms underlying insecticide detoxification and highlight the potential of miRNAs as targets for developing new pest control strategies for *S. frugiperda*.

Key words: *Spodoptera frugiperda*, miRNA, Chlorantraniliprole, GPCR pathway, cytochrome *P450*

G34

Development of molecular diagnostic tools for species identification of four agricultural pests in the genus *Helicoverpa* (Lepidoptera; Noctuidae)

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Species of the genus *Helicoverpa*, including *H. armigera*, *H. punctigera*, *H. zea*, and *H. assulta*, are amongst the most destructive agricultural pests worldwide, causing significant economic losses across various crops. Owing to their high morphological similarity, conventional identification methods based solely on morphology are often unreliable. To overcome these limitations, we developed molecular diagnostic tools based on conventional PCR, loop-mediated isothermal amplification (LAMP), and high-resolution melting (HRM) analysis for rapid and accurate species identification. The LAMP assay allowed clear visual discrimination of species within 45 minutes, with optimal amplification achieved in 25 minutes at 62 °C upon the addition of loop primers. HRM analysis further enabled reliable species differentiation based on distinct melt curve profiles and difference plots. These molecular approaches provide rapid, sensitive, and robust diagnostic tools for species-level identification, supporting improved field monitoring and integrated pest management strategies to mitigate crop losses caused by *Helicoverpa* pests.

Key words: *Helicoverpa* species, Molecular diagnostics, LAMP assay, High-resolution melting analysis, Species identification, Integrated pest management

G35

Diallyl Trisulfide, an Active Substance from Garlic, Inhibits Female Oviposition by Decreasing the Expression of the *OCT* Gene, which is Highly Expressed in the Spermathecal Gland of *Sitotroga cerealella* (Oliver)

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Diallyl trisulfide (DAT) effectively inhibits the fecundity of *Sitotroga cerealella*. *Organic cation transporter (OCT)* was most highly expressed in the spermathecal gland of female moths and was significantly decreased after DAT fumigation. However, the function of OCT in insect reproduction has been rarely reported. In this study, after silencing *OCT* in female adults, the mating rate, oviposition, and number of sperm transferred to females were decreased significantly, and transfer time of sperm in the female was delayed. Meanwhile, the long and short waves formed during sperm movement became longer, which lead sperm to take a longer time to complete a movement cycle. Finally, 5-hydroxytryptamine (5-HT) was significantly increased. Conversely, triacylglycerol (TG) decreased significantly. The expression of the *5-HT 2A* receptor gene, which is highly expressed in the abdomen, was significantly decreased. The findings have provided a theoretical basis for explaining the inhibitory effect of garlic essential oil on the reproduction of *S. cerealella*.

Key words: Diallyl trisulfide (DAT), Organic cation transporter (OCT), Reproduction inhibition, Sperm transfer, *Sitotroga cerealella*

G36

Elucidating Cold Tolerance Pathways in *Spodoptera frugiperda*: Evidence for Roles of *Luciferin 4-Monooxygenase-Likeand Retinol Dehydrogenase 11-Like*

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The fall armyworm (*Spodoptera frugiperda*) is an invasive polyphagous pest worldwide. Its rapid resistance to insecticides underscores the urgent need for sustainable control strategies. In this study, we investigated the roles of *luciferin 4-monooxygenase-like* (*SfLUMO*) and *retinol dehydrogenase 11-like* (*SfRDH11*) in *S. frugiperda* via RNA interference (RNAi). Double-stranded RNA (dsRNA) targeting each gene was injected to sixth-instar larvae using chitosan nanocarriers. Quantitative PCR confirmed significant transcript knockdown compared with controls. Rapid cold-hardening assays showed the silencing of *SfLUMO* and *SfRDH11* reduced larval cold tolerance, while gene knockdown also disrupted developmental timing, decreased pupation weight, and increased mortality in dsRNA-treated groups relative to controls. This study provides the first functional characterization of *SfLUMO* and *SfRDH11* in *S. frugiperda*and demonstrates their potential as molecular targets for RNAi-based pest control.

Key words: *Spodoptera frugiperda*, *luciferin 4-monooxygenase-like*, *retinol dehydrogenase 11-like*, cold tolerance, RNA interference, pest management.

G37

Sublethal dose neonicotinoid pesticide exposure disrupts circadian rhythms and sleep behavior patterns in honey bee

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Honey bees (*Apis mellifera*), essential social pollinators in agricultural and natural ecosystems, rely on endogenous circadian clocks to regulate foraging and other behaviors. Recent studies have shown that chronic exposure to field-realistic doses of neonicotinoid pesticides can disrupt circadian rhythms in honey bees, leading to impairments in foraging performance. To examine circadian rhythm alterations in foragers exposed to sublethal neonicotinoid doses, bees were orally treated with acetamiprid or imidacloprid. Activity and sleep behaviors were recorded and analyzed using the EthoVision XT program at 5-minute bin intervals. Sublethal exposure to both neonicotinoids shifted the phase and entrainment of behavioral rhythms under light–dark conditions, thereby disrupting circadian rhythmicity and sleep architecture. These results suggest that neonicotinoid exposure may adversely affect the social behavior and colony functioning of honey bees.

Key words: honey bee, pesticide, behavior, circadian

G38

Comparison of insecticide responses of regional populations of *Metcalfa pruinosa* to insecticides

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The *Metcalfa pruinosa*, an invasive pest, is widespread across Korea and is a widespread agricultural and forest pest. Various chemical insecticides are used to control the pest in agricultural areas. Because *M. pruinosa* inhabits both agricultural and forest environments, populations with a history of pesticide exposure can enter forest ecosystems. In this study, the responses of *M. pruinosa* nymphs collected from trees in residential areas in 18 regions to five insecticides (cypermethrin, flonicamide, pirifluquinazone, sulfoxaflor, and thiamethoxam) were tested using a spray method. On the seventh day of treatment, cypermethrin and sulfoxaflor showed high mortality rates of 99.3% and 96.8%, respectively, across all *M. pruinosa* populations. In contrast, flonicamide showed a lower mortality rate of 63.8% on average, and thiacloprid showed a lower mortality rate of 76.4%. The insecticide response to each insecticide varied across the populations in each region.

Key words: Efficacy, regional difference, *Metcalfa pruinosa*, mortality, susceptibility

G39

Novel insecticidal activity of an insect resolvin analog against lepidopteran insects

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Epoxy**o**ctadeca**m**ono**e**noic acids (EpOMEs) are oxylipins known to suppress excessive immune responses in insects by antagonizing eicosanoid signaling and inducing apoptosis in hemocytes, suggesting potential insecticidal activity. In this study, we evaluated the immunosuppressive and insecticidal activities of four EpOME analogs. Immune assays revealed that all four analogs inhibited hemocyte spreading and nodule formation, in which a stereoisomer containing a propoxy side chain at the 12th carbon showed the strongest inhibitory effect. Toxicity bioassay was conducted against multiple insect species, including *S. exigua*, *Plutella xylostella*, *Culex pipiens*, and *Tenebrio molitor*. AS56 exhibited high toxicity against two lepidopteran insect pests. The toxicity was confined in oral application, but not to topical application. Behavioral analysis showed that the intoxicated larvae exhibited significant reduction in feeding-associated behaviors, which were dependent on the elapse time after the treatment. These results highlight the EpOME analog as a promising novel insecticidal candidate with strong immunosuppressive activity and selective toxicity toward lepidopteran pests.

Key words: EpOME analogs, lepidopteran pests, insect immunity, pest management.

G40

Metabolic basis of insecticide resistance in two deltamethrin-resistant strains of the common bed bug, *Cimex lectularius* (Hemiptera: Cimicidae)

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Bed bugs have resurged and spread worldwide since the late 1990s. While pyrethroid resistance is primarily due to reduced sensitivity of the voltage-sensitive sodium channel, metabolic mechanisms are increasingly recognized as major contributors. This study aimed to identify the key metabolic enzymes involved in deltamethrin resistance and cross-resistance to dinotefuran in two deltamethrin-resistant strains. Synergistic bioassays demonstrated that cytochrome P450 monooxygenases (P450s) and esterases (ESTs) are major metabolic factors underlying both resistance types. Comparative expression profiling of 42 P450 and 24 EST genes across multiple sample types revealed that several P450s are consistently and strongly overexpressed in resistant strains, suggesting a broad role in resistance. In contrast, EST genes were markedly upregulated in the cuticle of resistant strains, indicating that ESTs may primarily act at the cuticular barrier as a first line of defense against insecticides. Further functional validation will be required to clarify their precise role in resistance mechanisms.

Key words: Common bed bug, *Cimex lectularius*, insecticide resistance, insecticide synergist, P450, Esterase

G41

Nanopesticide Clothianidin@MON delays the evolution of insecticide resistance in *Nilaparvata lugens*

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The brown planthopper, *Nilaparvata lugens* (Stål), is a major rice pest whose rapidly evolving insecticide resistance threatens global food security and sustainable agriculture. Conventional chemical control is increasingly ineffective, highlighting the urgent need for innovative resistance management strategies. Here, we report a mesoporous organosilica-based nano-delivery system (Clothianidin@MON) with uniform morphology, high dispersibility, and efficient pesticide loading. Compared with Clothianidin, Clothianidin@MON exhibited enhanced insecticidal activity and greater biological efficacy. Resistance risk assessments further revealed that *N. lugens*developed resistance to Clothianidin@MON much more slowly than to Clothianidin. Importantly, ecological safety evaluations indicated negligible impacts on natural enemies and pollinators such as honeybees. Overall, Clothianidin@MON provides dual advantages of enhanced potency and delayed resistance evolution while maintaining environmental compatibility. This work highlights the potential of nanopesticide delivery systems to advance sustainable pest management and offers a promising framework for integrating nanomaterials into modern crop protection.

Key words: *Nilaparvata lugens*, Insecticide resistance, Clothianidin@MON, Nanopesticide delivery system, Sustainable pest management

G42

Functional conservation of insecticide resistance-associated AChE1 mutations in the AChE2 paralog

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Insects possess two acetylcholinesterase (AChE) genes. In most pest species, AChE1 functions as the principal catalytic enzyme, whereas in a few species, such as the honey bee and the fruit fly, AChE2 serves as the primary enzyme. Previous studies have identified several conserved AChE1 mutations (G119S, F290V, F331H, F331W, and L452S) that confer resistance to organophosphate (OP) and carbamate (CB) insecticides. To examine whether these resistance-associated mutations are functionally conserved between AChE1 and AChE2, we introduced the five AChE1 mutations into two model AChE2s (AmAChE2 from honey bees and DmAChE2 from fruit flies) and compared substrate specificity and inhibitor kinetics of the recombinant enzymes. IC_{50} values from inhibition assays were positively correlated between AmAChE2 and DmAChE2 for most substitutions, with F290V showing the strongest correlation ($R^2 = 0.8782$). In contrast, the L452S mutation showed the weakest correlation ($R^2 = 0.0811$), with reduced OP and CB insensitivity observed in AmAChE2 but not in DmAChE2. These results suggest that the resistance function of AChE1 mutations is largely conserved in AChE2, reflecting evolutionary conservation of resistance mechanisms between the two paralogous enzymes, albeit with notable exceptions.

Key words: Acetylcholinesterase, Resistance, AChE1, AChE2, Mutations, Functional conservation

G43

Synergistic effects of azole fungicides with diamide insecticides in *Spodoptera exigua*

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Spodoptera exigua is a well-known pest in many countries worldwide, including South Korea. Recently, high levels of resistance to diamide insecticides have been reported, with the primary mechanism identified as the overexpression of *CYP9A40*. Inhibiting cytochrome P450 detoxification functions, such as those mediated by *CYP9A40*, has been proposed as a potential strategy for managing diamide resistance. Therefore, we investigated the synergistic effects of azole fungicides, which are known to inhibit P450 activity. To assess the current level of diamide resistance in Korea, we used chlorantraniliprole as a reference insecticide. Resistance to chlorantraniliprole was confirmed in most surveyed areas. Moreover, combined treatments with azole fungicides enhanced insecticidal activity, resulting in up to a 60% increase in mortality compared to insecticide-only applications. Although this approach raises concerns regarding pollinator safety and environmental residues, our findings suggest that azole fungicide–insecticide formulations may offer a promising resistance management strategy against lepidopteran pests.

Key words: *Spodoptera exigua*, Azole fungicides, Synergism, Insecticide resistance, IRM

G44

RNAseq-based molecular insights into three insecticide resistances in *Laodelphax striatellus*: the detoxification role of CYP6ER2

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To elucidate resistance mechanisms of the small brown planthopper (*Laodelphax striatellus*, SBPH), we conducted bioassays, RNA-seq, qRT-PCR, and *in silico* structural analyses. *CYP6ER2* was overexpressed 35.5-fold in the imidacloprid-resistant strain compared with the susceptible strain, and its expression levels were positively correlated with resistance ratios across resistant strains. Structural characterization revealed that *CYP6ER2* has a salt-bridge density of 4.70, higher than typical generalists but still relatively low, indicating enhanced conformational flexibility while maintaining sufficient stability. Docking analyses with structurally diverse insecticides consistently showed favorable binding affinities, with multiple predicted substrate oxidation sites positioned within 2.9–4.8 Å of the heme Fe atom. Collectively, these results highlight the pivotal role of *CYP6ER2* in imidacloprid resistance and support its characterization as a metabolic generalist.

Key words: *Laodelphax striatellus*, Insecticide resistance, *CYP6ER2*, RNA-seq, Molecular docking

G45

Survey of insecticide resistance with *kdr* and *ace-1* genes in *Culex tritaeniorhynchus* in Korea

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Culex tritaeniorhynchus, the primary vector of Japanese Encephalitis, is the main target of the surveillance program in South Korea due to its high density. Against the two most commonly used insecticides, pyrethroids and organophosphates, the *kdr* and *ace-1* genes show resistance mutation, respectively. However, mutation frequency has only been confirmed in limited regions in Korea. In this study, *Cx. tritaeniorhynchus* from a laboratory in KDCA and five different regions were analyzed. 33 and 51 specimens were genetically analyzed for the *kdr* and *ace-1* genes. 9.1%(3/33) showed L1014F mutations in the *kdr* gene. Each of the three specimens was from Busan, Sejong, and Daegu. While, 100%(51/51) showed F331W mutations in the *ace-1* gene. These results indicate *Cx. tritaeniorhynchus* developed a higher frequency of resistance mutations for organophosphates than pyrethroids. In addition, further survey across the country is needed for effective vector control.

Key words: mosquito, resistance status, pesticide, susceptible

G46

Survey of Species Distribution and Insecticide Resistance Genes of *Aedes* mosquitoes in Pakistan

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The Korea Disease Control and Prevention Agency (KDCA) conducts international collaborations to investigate vector-borne diseases. In this study, 146 alcohol-preserved adult mosquitoes were obtained from the University of Agriculture Faisalabad (UAF), Pakistan. PCR-based identification confirmed 40 specimens of *Aedes aegypti* (27.4%) and 106 specimens of *Aedes albopictus* (72.6%). Insecticide resistance mutations in the *kdr* (S989P, V1016G, F1534C) and *ace*-1 (G119S) genes were analyzed. *Ae. albopictus* exhibited no mutations at any of these sites. In *Ae. aegypti*, one specimen carried a mutation at S989P and no mutations were detected at V1016G. In contrast, 34 specimens (97.1%) carried mutations at F1534C. Both species showed no mutation at the ace-1 gene (G119S). These findings provide baseline data on insecticide resistance in mosquito populations in Pakistan. Furthermore, they inform strategies to prepare for the potential introduction of invasive species, such as *Aedes aegypti*, to Korea.

Key words: Mosquito, Insecticide, Resistance, Mutation

G47

Honey bees are more vulnerable to amitraz under organophosphate insecticide exposure

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Honey bees are increasingly threatened by multiple stressors, and pesticides, especially from agricultural insecticides and in-hive acaricides, has become a major concern on bee health. This study investigates the synergistic effects of insecticides when combined with amitraz, a widely used acaricide for *Varroa* control. Co-exposure to organophosphates and amitraz significantly reduced survival compared to single-compound treatments, suggesting a synergistic interaction. To realize the underlying physiological effects, we analyzed the expression of key detoxification, immune-related, and oxidative stress-related genes, as well as vitellogenin. Results showed gene-specific and treatment-dependent expression patterns, with co-exposure groups generally exhibiting stronger disruptions. Vg and stress genes were downregulated, while detoxification and immune gene expression increased across several treatments, particularly under mixture exposures. These findings emphasize the need for integrative risk assessments that reflect the real multi-chemical exposures faced by foraging bees.

Key words: Honey bee, organophosphate insecticides, amitraz, synergistic effects

G48

Arsenophonus decreases detoxification metabolism in *Nilaparvata lugens*

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Bacterial symbionts play a pivotal role in modulating insecticide susceptibility of their host pests, and elucidating the underlying mechanisms is crucial for developing effective crop protection strategies. Here, we investigate the molecular mechanism by which *Arsenophonus* enhances sensitivity to neonicotinoid insecticides in *Nilaparvata lugens.* The susceptibility of *N. lugens* to a range of neonicotinoid insecticides (nitenpyram, imidacloprid, thiamethoxam, and dinotefuran) was significantly increased by *Arsenophonus* infection, which concomitantly suppressed P450 gene expression and elevated folate levels in the host. Remarkably, folate supplementation alone was sufficient to recapitulate the *Arsenophonus*-induced phenotype, resulting in increased insecticide sensitivity and suppressed expression of detoxification genes. Further investigation revealed that both *Arsenophonus* infection and folate supplementation elevated global DNA 5-methylcytosine (5mC) levels in *N. lugens*. Critically, treatment with a DNA methylation inhibitor reversed these effects, reducing insecticide sensitivity and restoring detoxification gene expression. Collectively, our findings demonstrate that *Arsenophonus* enhances neonicotinoid susceptibility in *N. lugens* by modulating host folate metabolism, which in turn promotes DNA 5mC methylation to suppress the expression of key detoxification enzymes. This study uncovers a previously unrecognized epigenetic pathway through which a bacterial symbiont regulates host detoxification, offering valuable insights for the design of future pest management strategies.

Key words: Insecticide resistance, Symbiotic bacteria, *Arsenophonus*, detoxification metabolism

High School Students

H1

Phototransduction Protein Concentration and Wavelength-Dependent Positive Phototaxis in *Tenodera sinensis*

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본 연구는 전 세계적으로 널리 분포하는 왕사마귀(*Tenodera sinensis*)의 주광성 반응을 정량적으로 규명하고, 이를 기반으로 농업 현장에서의 친환경적 대안인 생물학적 해충 방제 기술을 위한 왕사마귀 유인 기술 개발 가능성을 탐색하고자 하였다. 380~780nm 파장 범위에서 25마리 왕사마귀의 주광성을 측정하였다. 실험 과정에서 사마귀의 음성 주지성을 고려해 자체 제작 장치를 반복적으로 개조하고, 역치 회복 시간을 측정하여 데이터의 신뢰도를 높였다. 또한 사마귀 눈에서 시각 단백질을 추출·분석하여 파장별 활성 정도를 정량적으로 비교함으로써 행동 실험과 생리학적 결과를 연계하였다. 실험 결과, 사마귀는 연속적인 파장 조건에서 평균 492.85nm 부근을 선호했으며, 불연속적인 파장 조건에서 녹색과 청색에서 가장 높은 선호도를 보였다. 이는 정량적 실험 결과와 연관지었을 때, 청색광에서 활성화된 시각 소체가 전체의 58.03%를 차지한 반면 적색광(650 nm)에서 활성화된 시각 소체는 3.38%에 불과했기 때문으로 분석된다. 본 연구는 기존 사마귀의 시각 감광성에 대한 보고를 행동 실험과 연결함으로써, 특정 파장의 광원이 사마귀 유인에 효과적으로 활용될 수 있음을 제시하였다. 이는 곤충의 시각 생리학 이해를 확장하는 동시에, 사마귀를 농경지로 선택적으로 유인하여 친환경 해충 방제에 활용할 수 있는 기초 자료를 제공한다는 점에서 차별성을 가진다.

검색어: 왕사마귀, 시각, 유인, 친환경적 해충 방제, 생물학적 방제, 양성 주광성, 시각 정보 전달 단백질

H2

A New Record of Isopoda: Oniscidea (Trachelipodidae, Trichoniscidae, Agnaridae) from South Korea, Including CO1 Data and Scanning Electron Microscope Data

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본 연구는 한국 생물다양성의 사각지대에 놓인 육상 등각류의 분포 조사를 통해 국내 미기록종을 확인하고 그 생태적 특성을 파악하고자 수행되었다. 2023년 4월부터 2025년 10월까지 서울, 부산, 인천, 충남, 제주 등 전국 각지에서 총 150회 이상의 현장 조사를 진행하였으며, 표본들을 채집하였다. 채집된 표본은 99% 에탄올에 보존하였고, 광학현미경과 주사전자현미경(SEM)을 통해 외부 형질 및 동정을 하였다. 또한 CO1 염기서열 시퀀싱을 통한 분자생물학적인 분석을 함께하였다. 추가로 채집 표본 내 종 간 비율, 월별 채집 개체 수, 한국에서의 생태적 특징 등을 연구하였다.

그 결과 유럽 원산의 *Haplophthalmus danicus*, 평택항 및 미군 기지를 통해 유입된 것으로 추정되는 *Trachelipus rathkii*, 인천을 통해 중국에서 유입된 *Mongoloniscus sinensis*, 일본에도 서식하는 *Mongoloniscus katakurai* 등 7종이 지속적으로 관찰되었으며, 모두 한국 미기록종으로 확인되었다. 추가로, 신종으로 추정되는 *Mongoloniscus sp.* 두 종과 *Exalloniscus sp.* 도 발견하였다.

현재 해당 종들에 대한 정식 보고를 위해 논문을 준비 중이다. 본 연구는 20년간 진행되지 않았던 등각류 모니터링을 재개하는 계기를 마련하였으며, 유입종의 확산 가능성과 국내 생태계에 미치는 영향을 평가하는데 기초 자료를 제공한다. 후에는 분기별 모니터링을 통해 추가 유입의 정착 여부 및 생태적 영향을 지속적으로 조사할 예정이다.

Key words: Isopoda, Oniscidea, CO1, SEM, ecology, *Trachelipus rathkii, Mongoloniscus sinensis, Haplophthalmus danicus, Mongoloniscus katakurai, Mongoloniscus sp.*

H3

A new species of the Genus Alloclubionoides (Araneae: Agelenidae) from Korea.

Jung Moo Heo
Areum High school

본 연구에서는 대한민국 세종특별자치시 전월산에서 채집된 Alloclubionoides속의 신종을 신체 계측과 형태 삽화를 통해 본 종을 묘사하였다. 새롭게 발견된 세종가게거미(가칭)는 세종시를 중심으로 금남면을 따라 공주등에도 분포하는것으로 나타났다. 또한 본 연구는 첫 발견인 2024년 3월부터 2025년 10월까지 진행하였으며 조사는 직접 진행하였다. 채집된 모든 개체는 99.5% 에탄올에 액침하였으며 자세한 형질 분석을 위해 일부 생식기를 적출하여 광학현미경을 통해 관찰하였다. 또한 월별 채집을 통해 세종가게거미의 번식습성을 추정하였고 서식생태를 조사하였다.

검색어: 가게거미, 신종, 분포, 형태분석, 삽화

H4

Isolation and Evaluation of Bioactive Peptides with Antidiabetic Potential from *Gryllus bimaculatus*

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식용곤충은 생리활성 펩타이드 등 다양한 기능성 성분을 함유하고 있어 건강기능식품 및 신약 개발 소재로 주목받고 있다. 최근 연구에서 곤충 추출물이 항당뇨 활성을 가질 수 있음이 보고되었으나, 대부분은 추출물 수준의 효능 확인에 그쳐 구체적인 활성 펩타이드의 규명과 검증 연구는 부족한 실정이다.

본 연구는 쌍별귀뚜라미(*Gryllus bimaculatus*) 추출물로부터 항당뇨 활성을 지닌 펩타이드를 발굴하고, 그 구조와 기능을 규명하는 것을 목표로 한다. 이를 위해 α-amylase, β-amylase, α-glucosidase 억제 분석을 통해 항당뇨 활성을 평가하고, 용매 분획 및 Prep-HPLC 정제를 통해 활성 분획을 확보하였다. 확보된 분획은 LC–MS/MS 기반 질량분석으로 펩타이드를 동정하고, 아미노산 서열을 확인하였다. 이어 합성 펩타이드의 생리활성을 동일한 효소 저해 분석으로 검증하고, 농도–반응 곡선을 통해 정량적 활성을 평가하였다.

본 연구는 기존 곤충 추출물 연구를 넘어 실제 활성 펩타이드의 분리와 동정까지 수행한다는 점에서 차별성을 가진다. 이를 통해 식용곤충 유래 항당뇨 펩타이드의 과학적 근거를 제시하고, 기능성 식품 및 차세대 항당뇨 치료제 개발에 활용될 수 있는 잠재적 후보 물질로서의 가능성을 제안한다.

검색어: 식용곤충, 생리활성 펩타이드, 효소억제, 질량분석법

H5

Screening of Gut Microbiota from *Trypoxylus dichotomus* Larvae for Thermostable Cellulase Activity

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고온에서도 활성이 유지되는 셀룰레이스를 생산할 수 있는 세균을 탐색하여, 바이오에탄올 생산 효율 향상에 기여하고자 하였다. 목질성 먹이를 섭취하는 장수풍뎅이유충을 선정하였다. 장수풍뎅이는 목질성 먹이를 섭취해서 장내에 셀룰로오스 분해능을 지닌 미생물이 풍부할 것으로 추정된다. 또한 사육이 용이하고 비용이 저렴하여 연구 소재로서 경제성이 크다. CMC agar plate assay를 통해 셀룰레이스 활성을 보이는 균주를 선별하였다. 선별된 균주는 온도별 CMC agar plate assay와 DNS assay를 통해 효소 활성을 정량적으로 분석하였다. 그 결과 일부 균주는 50 ℃ 이상의 조건에서도 활성이 유지되었으며, 실제 목질성 기질(톱밥)에서도 당화를 유도하는 능력을 보였다. 본 연구는 장수풍뎅이 장내 미생물을 활용한 새로운 셀룰레이스 생산원 탐색을 시도했다는 점에서 차별성을 가진다.

검색어: 장수풍뎅이 유충, 셀룰레이스 분해, CMC agar plate assay, 효소

H6

New Distributional Records of non-parasitic Bark Lice (Psocoptera) Using Citizen Science in South Korea

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다듬이벌레류는 복합적인 생태특성을 가지고 있으며 일반적인 조사 방법으로 많은 개체수를 채집하는 것이 난이도가 있다. 이에, 대체적인 조사 방법으로 시민과학 자료를 활용하여 현장조사와 비대면조사를 병행한 하이브리드 조사를 통해 한반도산 다듬이목 종 목록을 새로이 정리하였다. 지금까지 한국산 다듬이벌레는 23개 과에서 66종이 알려져 있다. 2012년부터 2025년까지 온라인 시민과학 플랫폼 iNaturalist, 곤충 사진가들의 블로그 등에 축적된 관찰 데이터를 바탕으로 형태동정을 진행하여 한국에 알려지지 않은 총 6과 1족 5속 7종의 다듬이벌레를 확인하였다. 본 연구는 시민과학 기반 데이터를 활용하여 자료가 부족한 분류군의 분포와 생태를 연구, target sampling하는 방법으로 향후 곤충학 조사에 시민과학 플랫폼을 적극적으로 이용할 필요성을 제시한다.

검색어: 다듬이목(Psocoptera), 시민과학(Citizen science), 미기록분류군(Undescribed taxon)

Oral Presentation
Non-Competition

G49

Development of a forecast system for apple leafminer occurrence to determine its management timings

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Apple leafminer, *Phyllonorycter ringoniella*, is a major pest feeding on apple leaves. In the past, population dynamics models simulating developmental stages of the pest were constructed and integrated into pest management systems to determine pesticide application timings. Due to unpredictability of *P. ringoniella* occurrence under unprecedented variations of weather conditions, however, we need to reduce uncertainty in predicting possible occurrence of the pest. In this study, a location-based forecast system was developed using machine learning techniques in order to occurrence data of *P. ringoniella* at 366 locations in 27 regions during 2013-2023 using pheromone traps in apple orchards were collected from the National Crop Pest Management System of Rural Development Administration. Weather data at corresponding locations were obtained from the Korea Meteorological Administration. Cumulative degree days (CDD) with the base temperature of 6.7 - 7.1°C according to its developmental stages were calculated from the weather data using the sine wave method. The machine learning model developed in this study was able to predict the timing of its adult emergence based on CDD. The model well explained the variation of data (F = 2123.4, df = 11, 3935, P < 0.001; R^2 = 0.86). Its predictive accuracy was validated against 2024 field data, showing an average deviation of 5.5 days between the observed and predicted occurrences of the pest. Finally, a website was developed as a platform integrating automatically collecting new weather data, generating updated models, and suggesting adjusted optimal management timings for insecticide applications.

Key words: apple, apple leafminer, machine learning, phenology model, optimal management timing

G50

The role of the black soldier fly gut microbiome in enhancing waste bioconversion and frass efficiency

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Microbial communities of the Black Soldier Fly (BSF, (*Hermetia illucens* L.)) are likely to influence both the efficiency of organic matter conversion and the quality of frass, yet their manipulation for improved outcomes remains largely unexplored. I will present an overview of a current project aiming to investigate the microbial dynamics associated with BSF larvae and strategically optimising them to enhance bioconversion performance of New Zealand-based organic waste. By focusing on the functional role of gut bacteria, we seek to improve both the degradation of organic waste and the agronomic value of frass. Through this work, we expect to generate new insights into insect-microbe interactions and demonstrate how microbial manipulation can elevate BSF-based bioconversion systems and BSF frass utilization and efficiency.

Key words: black soldier fly, bioconversion, endosymbionts

G51

Temperature-dependent fecundity of *Delia platura* (Meigen) (Diptera: Anthomyiidae) and life table parameters in the laboratory

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Understanding the thermal sensitivity of *Delia platura* (Meigen) (Diptera: Anthomyiidae), a widespread polyphagous pest, is crucial for predicting its population dynamics and improving pest management strategies. We investigated the temperature-dependent reproductive and developmental traits of *D. platura* under five constant temperature regimes (15, 19, 23, 27, and 30°C). Adults showed relatively long lifespans with considerable inter-individual variation, contributing to the observed diversity in oviposition schedules-particularly at 19°C and 23°C, where fecundity patterns were highly dispersed and multimodal. Fecundity peaked at 27°C (98 eggs), while oviposition at 30°C declined rapidly and no pupae survived to adulthood, indicating a critical upper limit for population persistence. Life table parameters showed clear temperature dependence. The intrinsic rate of increase (r_m) remained low at cooler temperatures (0.019 at 15°C and 0.020 at 19°C), but increased substantially at warmer temperatures, reaching 0.033 at 23°C and peaking at 0.039 at 27°C. At 30°C, no viable development was observed, preventing life table estimation. Our findings provide the first integrative dataset for temperature-dependent fecundity and development of *D. platura* and support its application in mechanistic modeling for seasonal forecasting and climate risk assessment.

Key words: Seed corn maggot, Fecundity, Longevity, Survival rate, High temperature

G52

Introduction of a Decision-making System, Digital Pest Control Calendar, for Crop Pest Control

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Farmers still face difficulties in pest and disease control because those occurrence varies with a range of factors: environmental conditions such as local weather, geography, and vegetation, cultivation practices, times and types of pesticides used, and so on. To address this, a decision support system for pest and disease control is being developed. Based on meteorological factors observed in the field, it predicts crop growth and the occurrence of diseases and pests, estimates the optimal time for control, and recommends the most suitable pesticides according to the disease and pest situation expected at each optimal timing. In line with the government's digital transformation policy, and to emphasize the digitization of the existing control calendar, this system has been named the "Digital Crop Protection Calendar" (디지털방제력). The concept is currently being implemented as a program for peppers and peaches, which uses synoptic meteorological data from the Korea Meteorological Administration and the Rural Development Administration to predict growth stages such as flowering, fruiting, and harvest and, by forecasting the periods when major diseases and pests inflict damage, it recommends optimal control timings and pesticides. Going forward, by comparing its outputs with field data on weather, diseases/pests, and control practices, the accuracy of the prediction models for crops, diseases, and pests, as well as the algorithms for optimal control timing and pesticide recommendations, will be improved.

Key words: Decision making, Digital transformation, Disease, Pest, Control

G53

Application of Sex Pheromones for Monitoring and Mating Disruption of Major Pests of *Hibiscus syriacus*

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Rehimena surusalis (점노랑들명나방) and *Rusicada privata* (왕붉은잎밤나방) are major lepidopteran pests of *Hybiscus syriacus* (무궁화). To enable control by mating disruption, forecasting the occurrence of *R. surusalis* was considered essential. Therefore, the occurrence of *R. surusalis* was monitored using its sex pheromone over a two-year period in Suwon and one-year in Seojong. The moth exhibited two flight peaks, one in early July and another from late August to late October. However, its population density was too low to evaluate the efficacy of mating disruption agents. In addition, field experiments on the efficacy of mating disruption against *R. privata* were conducted over a three-year period in Suwon and one-year in Sejong, and the results will be presented.

Key words: *Rehimena surusalis*, *Rusicada privata*, Efficacy

G54

Mitochondrial genome and large-scale beetle phylogeny

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Building large-scale phylogenies is important for understanding global diversification patterns, trait evolution, and related processes. Given the vast scale of biodiversity, this endeavor requires not only technical advances but also community-wide standards that ensure data compatibility across taxa, regions, and time. We argue that organelle genomes represent the next-generation candidate for standardization in molecular systematics following barcodes. We emphasize both the sociotechnical and scientific advantages of organelle genomes, which have been largely overlooked in recent phylogenetic contexts.

To demonstrate feasibility, we assembled a large-scale reference for Coleoptera by generating 2,366 new mitochondrial genomes from tropical sites in Panama and Malaysia, reannotating ~3,000 public datasets under unified criteria, and constructing a phylogenetic tree of 5,518 species using 80 nodal constraints derived from a BUSCO backbone tree. This resource not only improves taxonomic resolution in the world's most diverse metazoan order but also illustrates how organelle genomes can anchor disparate datasets into a more inclusive Tree of Life.

Key words: Large-scale phylogeny, biodiversity standards, organelle genomes, mitochondrial genomes, Coleoptera, Tree of Life

G55

A Neglected Primitive Insect Lineage, Archaeognatha in Korea: Current Status and Research Gap Since 2002

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Archaeognatha, one of the most primitive insect orders, represents the earliest lineage of insects on Earth. In Korea, a total of 12 species, classified into five genera and one family have been recorded since the first record by Silvestri (1943). Nevertheless, research on Korean Archaeognatha has been extremely limited. The most recent study was conducted by Choi (2002). Subsequent to this, no further studies have been carried out for a period exceeding two decades, resulting in a paucity of available data and a consequent challenge in species identification. This study represents the first comprehensive research on Korean Archaeognatha after two decades. Consequently, six previously recorded species were validated, and three new species were identified. therey establishing an updated foundation for taxonomic and ecological research.

Key words: Archaeognatha, Korea, identification, New species

G56

The Family Heliodinidae (Lepidoptera) New to Korea

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The family Heliodinidae, one of the small, beautiful, and diurnal moths, was discovered from Korea for the first time. This family comprises 13 genera and about 70 species, distributed mainly in Neotropics of the New World. In contrast, only two species are recognized in the Palearctic region.

In May 2025, one species of the family, *Epicroesa chromatorhoea* Diakonoff & Arita, 1979 was collected on Mt. Chiak, Gangwon Province. This species was previously known only from Japan and represents the first record from mainland Eurasia.

Adults of *E. chromatorhoea* have brilliant metallic patterns on their forewings. The larvae feed on leaves of *Kalopanax septemlobus* (Araliaceae), skeletonizing the underside of the leaves.

In this study, adult, genitalia and DNA barcode sequence of the species are provided.

Key words: microlepidoptera, Heliodinidae, sun moth, new record, Korea

G57

TYLCV induces the biosynthesis of insect resolvin, EpOME, to facilitate the viral multiplication in the viral vector, *Bemisia tabaci*

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Tomato yellow leaf curl virus (TYLCV) is a monopartite single-stranded DNA begomovirus transmitted by the whitefly *Bemisia tabaci* through a circulative pathway. In insects, oxylipins act as antagonistic regulators of antiviral responses: C20 oxylipins (eicosanoids) suppress viral proliferation, whereas C18 oxylipins (EpOMEs) promote it. TYLCV infection triggered intestinal apoptosis in *B. tabaci*, with stronger responses induced by the more virulent strain, and apoptotic intensity correlated positively with viral titer. Pharmacological assays showed that eicosanoids inhibited apoptosis, while EpOMEs enhanced apoptosis and viral load. TYLCV suppressed expression of eicosanoid biosynthetic genes (PLA_2, PGES) but induced EpOME biosynthetic genes, leading to elevated EpOME levels in viruliferous whiteflies, confirmed by LC-MS/MS. RNAi screening of TYLCV genes identified C2 as essential for the proviral activity of EpOMEs. Additionally, EpOMEs upregulated defensin, PGPR, and cathepsins, while eicosanoids suppressed them. These results reveal a novel strategy by which TYLCV manipulates EpOME metabolism to enhance transmission.

Key words: *Bemisia tabaci,* TYLCV, EpOME, eicosanoid, apoptosis

G58

Molecular mechanism of gustatory receptor *NlGR28b* regulating MAPK signaling phosphorylation to mediate insecticide resistance in *Nilaparvata lugens*

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Chemosensory systems enable insects to perceive environmental cues, yet their direct roles in insecticide resistance remain largely unexplored. In the rice pest *Nilaparvata lugens*, we identify the gustatory receptor *NlGR28b* as a key mediator of resistance to the neonicotinoid insecticide nitenpyram. Functional analyses show that *NlGR28b* senses the insecticide and activates the MAPK signaling cascade, resulting in enhanced phosphorylation of ERK and JNK. Both transcriptional and protein levels of NlERK and NlJNK are elevated in resistant strains and inducible upon nitenpyram exposure. Silencing *NlGR28b* or pharmacological inhibition of MAPK significantly reduces the expression of P450 detoxification genes, including *NlCYP6ER1*, *NlCYP302A1*, and *NlCYP6AY1*. These findings reveal a receptor-mediated MAPK signaling pathway that links chemosensory detection to transcriptional activation of detoxification genes, providing new insights into the molecular basis of insecticide resistance. Overall, this study not only highlights potential molecular targets for the management of resistant pests but also advances our understanding of the role of gustatory perception in metabolic adaptation.

Key words: Gustatory system, Insecticide resistant, MAPK phosphorylation, Transcription regulation

G59

Creation of nanosynergists targeting resistance key genes of *Nilaparvata lugens*

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As a major pest of rice production, *Nilaparvata lugens* (Stål) has caused severe economic losses to the rice industry in Asia. At present, chemical control is still the main means to control *N. lugens*, but the long-term large-scale irrational use of chemical pesticides has led to an increasingly serious problem of *N. lugens* resistance, and *N. lugens* has developed different degrees of resistance to a variety of insecticides, which has seriously affected the safe and stable production of rice. Therefore, there is an urgent need to develop effective resistance management strategies based on the molecular mechanisms of *N. lugens* resistance. Herein, the CeO_2-based nanohybrid MON@CeO_2 was designed as a reactive oxygen species (ROS) inhibitor to effectively improve the susceptibility of insect pests to insecticides. MON@CeO_2 was fabricated by intercalating CeO_2 into mesoporous organosilica nanoparticles (MONs). The obtained MON@CeO_2 showed a regular spherical shape with an average particle size of 45.4 nm, good mono dispersity, and a negative surface charge (-14.6mV). Bioassay results showed that MON@CeO_2 significantly enhanced the toxicity (more than 2-fold) of nitenpyram, sulfoxaflor, and clothianidin against laboratory insecticide-resistant and field strains of *Nilaparvata lugens*. In particular, MON@CeO_2 orchestrated host detoxification metabolism via downregulating ROS-dependent P450 gene expression, thus reducing host detoxification enzyme activities to overcome insecticide resistance. Furthermore, MON@CeO_2 restrained host insecticide resistance in the notorious agricultural pests *Aphis gossypii*, *Spodoptera frugiperda*, and *Sogatella furcifera*. Therefore, MON@CeO_2 could be used as abroad-spectrum nanosynergist against insecticide resistance, which would be a novel strategy for sustainable pest management.

Key words: *Nilaparvata lugens*, MON@CeO_2, Reactive·oxygenspecies·(ROS), Nanosynergist, Resistance management

Poster Presentation Competition

P1

Comparative Analysis of Blowfly (Diptera: Calliphoridae) Succession and Carcass Weight Loss Between Exposed and Suitcase-Enclosed Remains

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Blowflies (Diptera: Calliphoridae) are among the earliest colonizers of animal remains and serve as crucial indicators for postmortem interval (PMI) estimation in forensic investigations. In practice, however, corpses are often discovered within enclosed containers such as suitcases, where colonization and decomposition may differ from those of exposed carcasses. To address this gap, we performed a comparative field experiment in Asan, Korea (May 8–June 5, 2025), comparing blowfly succession and carcass weight loss between an exposed carcass and one enclosed in a suitcase under identical environmental conditions. In the exposed carcass, *Lucilia sericata* first appeared approximately one day after deposition (May 9), followed by *Chrysomya megacephala*, *Lucilia illustris*, and *Calliphora lata*. Until the carcass reached the dry stage, *L. sericata* accounted for 7EA (out of 585) of all calliphorids collected, while *Ch. megacephala* represented 121EA. and *C. lata* and *L. illustris* each comprised 3 and 97 individuals. The carcass weight decreased from 30.0 kg at deposition to 9.5 kg after 26 days (June 3), representing a 68.3% reduction. In contrast, in the carcass enclosed in a suitcase, the first colonization occurred three days after deposition (May 11) by *L. sericata* and *Ch. megacephala*. Until the carcass reached the dry stage, *Ch. megacephala* reached 43EA (out of 246) of the total calliphorids, while *L. sericata* and *L. illustris* represented 6 and 63EA, respectively. The carcass weight decreased from 38.5 kg at deposition to 23.1 kg after 26 days, corresponding to a 40.0% reduction. These results clearly demonstrate that suitcase enclosure delayed the onset of blowfly colonization, reduced relative abundance, and slowed decomposition, even under identical conditions. The findings underscore the importance of systematically accumulating succession data from concealed or container-associated remains to refine PMI estimation and improve the reliability of forensic entomological applications.

Key words: Medico-legal Entomology, Postmortem interval (PMI), Blowfly, Carrier-encolosed remains

P2

Evaluation of natural products as attractants against *plautia stali* Scott (Hemiptera: Pentatomidae): electrophysiological responses and field tests

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Plautia stali causes damage to a wide range of crops, reducing their commercial value. *P. stali* has a highly developed olfactory system, which makes it suitable for semiochemical-based pest management strategies. In this study, we focused on natural compounds as potential semiochemicals, and evaluated their effects using electroantennogram (EAG) recordings and field experiments. In EAG screening of fifteen natural compounds, four compounds (*A*, *B*, *K*, and *M*) exhibited significant EAG responses at a 1 mg dose in both male and female adults of *P. stali*. In the field experiments, the behavioral responses of nymphs and adults of *P. stali* to the EAG-active compounds (500 mg dose) were evaluated in combination with the aggregation pheromone methyl (2*E*,4*E*,6*Z*)-decatrienoate (MDT), and compared with MDT alone (positive control) and a blank control (negative control). Compound *A* increased trap catches of *P. stali* adults and nymphs by 55.1% and 141.7%, respectively, compared to the positive control, while compound *K* increased nymph catches by 208.3%. These results demonstrate the potential of specific natural compounds to serve as eco-friendly and commercially viable repellents or attractants, supporting the development of a push–pull strategy for the sustainable management of *P. stali.*

Key words: olfactory, semiochemical, methyl (2*E*,4*E*,6*Z*)-decatrienoate, eco-friendly

P3

Comparison of non-bee pollinator assemblages between pan traps and blue vane traps

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Non-bee pollinators defined as pollinators except on honeybees (*Apis* spp.) and other bees beloning to Anthophila. They play a crucial role in crop production and ecosystem stability, providing an insurance effect against land-use changes and honeybee declines. Despite their importance, sampling methods for non-bee pollinating insects remains limited both domestically and internationally. Therefore, this study aimed to investigate effective sampling methods for non-bee pollinators. From April to May 2025, we sampled non-bee pollinators using three colored pan traps and blue vane traps in four different habitat types with various exposure periods, and found that the use of both trap types will be essential to monitoring non-bee pollinating insects effectively.

Key words: insect diversity, sampling protocol, monitoring, conservation

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P4

The beetle fauna of Bito Island (Sacheon-si, Gyeongsangnam-do)

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An insect fauna survey of the order Coleoptera was performed in Bito Island (Sacheon-si, Gyeongsangnam-do) The sampling carried out three times from May 28 to August 8, 2025 by using netting, manual collecting, sweeping, sifting, flight interception trap, and pit-fall trap methods. A total of 4,445 individuals representing 357 species within 55 families were collected. The family Staphylinidae showed the highest species diversity with 124 species, followed by Curculionidae (35 species), Chrysomelidae (26 species), and Carabidae (19 species). The families with high abundance of individuals were Staphylinidae (1,460 individuals), Carabidae (950 individuals), and Corylophidae (397 individuals). The flight interception trap collected the greatest species diversity (227), and sifting yielded the highest number of individuals (2,150).

Key words: Coleoptera, beetle fauna, insect collecting

P5

Molecular Approach to the Taxonomic Resolution of *Chrysoperla nipponensis*

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Family Chrysopidae (green lacewings) is one of the representative groups of natural enemies and is also a highly useful group as a biological control agent. However, despite this ecological importance, this family includes complex groups that are extremely difficult at the species identification. Among them, *Chrysoperla nipponensis* is one of the most prevalent species of fhe family in eastern Asia. It belongs to the *Chrysoperla carnea*-group, a highly cryptic species complex that can only be reliably distinguished by substrate-borne courtship songs. Previous attempts to construct haplotype trees using mitochondrial genes of *Chrysoperla nipponensis* have resulted in paraphyletic groupings with other species, suggesting that mitochondrial genes alone are not an reliable molecular marker for this taxon.

In this study, we conducted a comparative analysis of the COI gene—well-known for its high utility in species identification—and the CAD gene, a single copy nuclear protein coding gene which showed potential for identifying certain taxonomic groups within Coleoptera, a closely related taxa to Neuropterida to enable more accurate and rapid species identification for the species.

Key words: Chrysopidae, Cryptic species, *Chrysoperla nipponensis*, CO1, haplotype, CAD

P6

First Record of *Cinara tujafilina* (Hemiptera: Aphididae: Lachninae) in Myanmar

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The genus *Cinara* Curtis, 1835 (Hemiptera: Aphididae: Lachninae) is a large, conifer-associated lineage comprising 256 described species worldwide, primarily on hosts in the Cupressaceae and Pinaceae. In this study we report *Cinara* (*Cupressobium*) *tujafilina* (Del Guercio, 1909) from Myanmar for the first time. In addition to this new country record, we provide: (1) a morphological diagnosis of the apterous viviparous female, (2) COI-based DNA barcoding to confirm species identity, and (3) population-genetic analyses.

Key words: Aphids, exotic species, COI, distribution

P7

New distribution record of the genus *Stethynium* (Hymenoptera: Mymaridae) from Korea associated with tea green leafhopper *Empoasca onukii* (Hemiptera: Cicadellidae)

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The genus *Stethynium* (Hymenoptera: Mymaridae) comprises of approximately 50 species worldwide, with two species recorded from the Palearctic region. In this study, we report *Stethynium empoascae* as the first record of the genus from Korea, collected from tea fields in the southern region of the country. During the survey, the green tea leafhopper, *Empoasca onukii* (Hemiptera: Cicadellidae), a major pest of tea plants throughout the major tea-producing regions of East Asia, was also observed at the collection sites. The tea plants were brought to the lab and maintained until the adults of *S. empoascae* were eclosed. Based on previous studies and known host associations, we infer the parasitoids from the tea field eclosed from *E. onukii* individuals. This poster presents general information on *S. empoascae* along with brief biological and distributional data, contributing to a better understanding of its distribution and potential host associations in Korea.

Key words: Biodiversity, Host-parasitoid association, Potential biological control, Natural enemy

P8

Taxonomic corrections on the genus *Plautia* (Hemiptera: Pentatomidae) from Korea, with discussion on its morphological variation and parasitoid

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The pentatomine bug genus *Plautia* Stål, comprises 28 species reported worldwide, primarily across the Palearctic region (mostly East and Southeast Asia) and Australia. Among them, several species are significant agricultural pests. Our recent survey recognized two *Plautia* species, *P. stali* and *P. himechabane*. *Plautia splendens* was excluded from the Korean list based a the review of previous references and examination of the Korean population. Images of dorsal habitus and genitalic structures of both sexes are presented for two Korean *Plautia*, with figures for observable variation in coloration and genital structure. We also describe two newly recognized associated mites of *Plautia*, with detailed figures and discussion.

Key words: Pentatomidae, *Plautia*, variation, parasitoid

* This work was supported by NIBR, NRF and SNUR&D grant

P9

A newly recorded species of the genus *Roeslerstammia* Zeller, 1839 (Lepidoptera: Roeslerstammiidae) from the Koreabased on Morphological and Molecular analysis

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The genus *Roeslerstammia* Zeller, 1839, is the type genus of the family Roeslerstammiidae, which currently includes four species distributed globally. In this study, we report a newly recorded species of this genus from Korea. In addition, we review the taxonomic history of the family Roeslerstammiidae and *Roeslerstammia.* A taxonomic key and molecular analysis based on the COI gene are also conducted.

Key words: Taxonomic review, Gracillarioidea, distribution map, Korean fauna, COI.

P10

First record of the genus *Burmophora* (Diptera: Phoridae) from Korea

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The genus *Burmophora* is a small group within subfamily Phorinae consisting of six species, characterized by male both surstyli separated from epandrium and female proboscis greatly elongated. In this study, specimens of *Burmophora* collected in South Korea are morphologically examined and *B. angustifrons* and *B. multiseta* are newly described from Korea, which are previously recorded from Japan and Russian Far East. Also, *B. multiseta* is seemed to be associated with ants, based on the observation of the adults hanging around the nest of *Lasius spathepus*. Photographs of the Korean *Burmophora* species and a revised key to world species are provided.

Key words: *Burmophora*, Korea, new record, scuttle fly, taxonomy

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P11

Three *Psychoda* species (Diptera: Psychodidae) new to science from Jeju Gotjawal Provincial Park

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Psychoda, the type genus of the family Psychodidae, is one of the largest genera within the family, exhibiting remarkable morphological homogeneity that makes their identification rather challenging. In this study, three species new to science were discovered from Jeju Gotjawal Provincial Park in Jeju Is., *viz*., *Psychoda epaulettifera* sp. nov., *P. gotjawalensis* sp. nov., *P. ochani* sp. nov. These species can be easily recognized by unique male genitalic character, especially in aedeagal structures and/or unique wing ornament. The type localities are well-protected areas in Jeju Is. possessing unique fauna and flora, exhibiting quite dissimilar habitats comparing ones in Korean Peninsula. This discovery highlights the necessity of exploring a broader spectrum of habitats for a better understanding of this taxon.

Key words: *Psychoda*, moth fly, new species, gotjawal, taxonomy.

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P12

New family records of spiders (Arachnida: Araneae) from Korea

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During nearly 120 years of Korean Arachnological history, currently more than 970 species belonging to 45 families have been recorded in Korea. As a result of new discovery from several field surveys and nomenclatural changes made by recent phylogenetic studies in family-level, seven spider families, *viz*, Argyronetidae, Cicurinidae, Desidae, Dolomedidae, Lathyidae, Pimoidae, and Synotaxidae, have been recorded for the first time in Korea, and species belonging to two genera, *viz*, *Argenna* (Argyronetidae) and *Tekellina* (Synotaxidae) were newly discovered in the country. Brief introductions for these newly recorded families and species are provided, with lists of included species in Korea and a remark on new combinations of pimoid species.

Key words: Argyronetidae, Cicurinidae, Desidae, Dolomedidae, Lathyidae, Pimoidae, Synotaxidae, Korea

P13

Redescription of *Belisana amabilis* (Araneae: Pholcidae) from Korea

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The genus *Belisana* is the second most diverse group of cellar spiders (Araneae: Pholcidae), containing 171 species mainly distributed in Indo-Malayan and Australasian regions. Currently only a single species, *Belisana amabilis* (Paik, 1978), has been known in Korea, described using only female specimens from Seogwipo and Mt. Hallasan, Jeju Island and Gimcheon, and no additional study on this species has ever been conducted after the original description. In this study, *B. amabilis* is redescribed based on type series and recently collected materials from Gotjawal Provincial Park, with the first description of male and notes on its identity and distribution.

Key words: Araneae, *Belisana*, cellar spider, Gotjawal, redescription, taxonomy

* The authors are grateful to Gotjawal Provincial Park for the permission of specimen collection. This work was supported by a grant from the National Institute of Biological Resources, funded by the Ministry of Environment of the Republic of Korea.

P14

Discovery of a new species of *Chilobrachys* (Araneae: Theraphosidae) from Phang Nga Province, Thailand

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Chilobrachys is a genus of spiders belonging to the family Theraphosidae, distributed mainly in Oriental region. These spiders are widely sold in the pet trade under the common name “tarantulas” and are very popular among hobbyists. Through detailed morphological examination using specimens collected from Phang Nga Province in southern Thailand, we discovered the species being sold under the name *Chilobrachys* sp. “Southern Thailand Blue” which was found to be an undescribed species. Currently, only three species of *Chilbrachys* are recorded from Thailand which are clearly separated by ecological niche (habitat) from this new species. In this study, we provide a detailed description and habitat information as well as an identification key to *Chilobrachys* from Thailand.

Key words: *Chilobrachys,* tarantula, Theraphosidae, new species, Thailand, taxonomy.

P15

Newly recorded species of *Antispila* Hubner, 1825 (Lepidoptera: Heliozelidae) from Korea

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Heliozelidae are small monotrysian moths with a near global distribution, currently comprising fewer than 150 described species in 13 genera, motst of which are concentrated in North America and Australia. The larvae are generally considered leaf miners, cutting an elliptical case from the host plant's leaf in which they pupate. This characteristic has earned them the common name "shield-bearing moths". In this study, we firstly reported the *Antispila* species in Korea. Illustrations of adult and genitalia are also provided.

Key words: Leaf miner, New record, Heliozelidae, Korea, Taxonomy.

P16

A little known genus *Pseudopostega* Kozlov, 1985 (Lepidoptera: Nepticuloidea) from Korea

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Opostegidae is one of the microlepidopteran family (Lepidoptera: Nepticuloidea) including 200 species belonging to 7 genera worldwide. Among them, the genus *Pseudopostega* is distributed worldwide and is the most species rich, comprising about 120 of the 200 described species of Opostegidae. However, it has not yet been recorded from Korea and its diversity in Northeast Asia is relatively low with only two species known from China and two from Japan. In this study, we firstly reported the genus *Pseudopostega* based on two new species. Illustrations of adults and genitalia are also provided.

Key words: Leaf miner, New record, Opostegidae, Korea, Taxonomy.

P17

Genetic diversity of *Pterotopteryx spilodesma* (Lepidoptera: Alucitidae) in Korea

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The family Alucitidae, comprising approximately 280 species in 20 genera worldwide, is a rare group of moths with a distinctive plume-like wing morphology. However, their ecology and genetic characteristics remain poorly understood, and studies on this family remain scarce. *Pterotopteryx spilodesma* is the most widespread Alucitidae species in Korea, yet molecular and ecological studies on this species remain scarce. In this study, we aim to investigate the genetic divergence within the species, *P. spilodesma* based on COI analysis.

Key words: Lepidoptera, Alucitidae, Many-plumed moths, Haplotype, Genetic diversity

P18

First record of myrmecophilous clown beetle, *Eucurtiopsis ohtanii* (Histeridae: Chlamydopsinae) from Korea

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A new record of a myrmecophilous histerid species is recognized from Korea: *Eucurtiopsis ohtanii* (Sawada, 1994). A single specimen was collected by sifting the mass of a *Pheidole fervida* colony from Jeju Island. Herein, we present the morphological diagnosis, photographs of the adult, and ecological information.

Key words: Taxonomy, Histeridae, *Eucurtiopsis*, first record, Korea

P19

Molecular Identification and Morphology of Immature Stages of *Monochamus* (Coleoptera: Cerambycidae)

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The genus *Monochamus* Dejean, 1821 includes major vectors of the pine wilt nematode, such as *M. alternatus* and *M. salturarius*. Their larval and pupal morphology provides critical insights into taxonomy, evolution, and pest management. However, accurate identification of their immature stages remains challenging and often results in misidentification, making molecular approaches essential. In this study, we applied COI-based molecular identification to immature stages of *Monochamus*. Based on molecularly identified specimens, we present high-resolution photographs of larvae and pupae of all five *Monochamus* species occurring in Korea. We also provide a preliminary key to species, and biological information including host plants and larval feeding habits.

Key words: *Monochamus,* molecular identification, DNA barcoding, larvae, pupae, Cerambycidae

P20

Taxonomic review of *Oxyscelio* Kieffer, 1907 (Hymenoptera: Scelionidae) in Korea, with two new records

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The genus *Oxyscelio* Kieffer belongs to the subfamily Scelioninae, with c.a. 200 valid species known worldwide, 97 species from the Palearctic and Indo-Malayan region, but only one species, *Oxyscelio mollitia* Burks, 2013 recorded in Korea. This genus is clearly differentiated from other genera by pronounced frontal depression on the head, posteriorly rounded vertex, fore wing submarginal vein being distant from wing margin, very short marginal vein, virtually absent postmarginal vein, and distinct metascutellum.

In this study, two species, *Oxyscelio arvi* Burks, 2013 and *Oxyscelio aureamediacritas* Burks, 2013, are newly recognized in Korea. Key to Korean species, diagnoses and photos of diagnostic characteristics are provided.

Key words: *Oxyscelio*, new record, *Oxyscelio arvi*, *Oxyscelio aureamediacritas*, Scelioninae, Korea

P21

DNA barcoding of 41 species of the subfamily Boletobiinae and allied taxa (Lepidoptera, Erebidae) in Korea

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The subfamily Boletobiinae comprises moths of various sizes, with a wingspan ranging from 5 to 30 mm. This group has undergone considerable taxonomic changes in its systematic placement. Leaves, deciduous trees, and lichens are known as host plants, although the hosts of most species remain unknown. Additionally, the distribution patterns of different Boletobiinae species vary between Europe and Asia. Therefore, it is necessary to establish DNA barcodes and conduct phylogenetic studies of this group in Korea.

In this study, we obtained and analyzed the DNA barcodes from 126 specimens of 41 species in the subfamilies Boletobiinae and Hypenodinae. Among them, we obtained 105 specimens of 33 species belonging to Boletobiinae and 21 specimens of 8 species belonging to Hypenodinae, respectively. Based on these results, we constructed Neighbor-Joining (NJ) trees for these two subfamilies and analyzed their taxonomic positions at both the genus and species levels. We further provide a comprehensive dataset, including the barcoding species list, photographs, and other research outputs obtained in this study.

Key words: Lepidoptera, Boletobiinae, DNA barcode, Identification

* This work was supported by the Korea National Arboretum (Project No. KNA1-1-20-16-1).

P22

A new species and one newly recorded species of the genus *Bucculatrix* Zeller, 1839 (Lepidoptera: Bucculatricidae) from Korea

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The genus *Bucculatrix* Zeller, 1839 of the family Bucculatricidae is known to comprise over 300 species worldwide. Among them, more than 30 species are recognized in the Palearctic region. In Korea, only five species have been reported to date.

In this study, we report a new species and one newly recorded species of the genus *Bucculatrix* for the first time in Korea: *Bucculatrix* sp. nov.1, *B. comporabile* Seksjaeva, 1989. All available information, host plants, DNA barcode and images of adults and genitalic structures for species is provided.

Key words: Bucculatricidae, Bucculatrix, leafminer, taxonomy, Korea

* This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBRE202501).

P23

Revised Taxonomic Keys for Stored Grain Pests in Plant Quarantine Inspection

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Since the inception of plant quarantine in South Korea, a total of 39,793 cases of stored grains have been reported. From 2010 to 2025, 11,627 cases of stored grain pests interceptions were recorded, but only 9,740 cases were identified to the species level, representing 9 orders, 78 families, and 259 species, indicating that about 17% remained unidentified at the species level.

While international references provide comprehensive descriptions of all developmental stages and systematic management strategies, domestic protocols still rely on pre-2017 documents and offer identification keys only at the genus and species levels. To address this gap, we presents species level identification keys organized by order, including Coleoptera, Acaridae, Lepidoptera, and supplemented with higher level diagnostic keys.

Key words: stored grain pests, identification, quarantine

P24

Application of genetic analysis of red imported fire ants (*Solenopsis invicta* Buren) collected in Taiwan

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In 2025, ants (n = 92) were collected from two sites in northern Taiwan. DNA was extracted, and species identification using cytochrome c oxidase subunit I (*COI*) sequences confirmed them as *Solenopsis invicta*. *COI* amplification for matrilineal haplotype analysis identified Haplotype 22. Analysis of colony social organization using *Gp-9* genotypes provides essential ecological information for elucidating the species' dispersal and establishment strategies. Since 2017, we have conducted microsatellite-based analyses of the genetic structure of domestic and foreign specimens and have sought to obtain populations from diverse source regions to secure reliable data. The northern Taiwan samples obtained here provided an important opportunity to compare genetic differences with samples collected in 2020 through international collaboration. These efforts are expected to expand the genetic reference for future studies on the invasion pathways and spread of the red imported fire ant.

Key words: *Solenopsis invicta*, red imported fire ant, *COI* barcode, haplotype analysis, *Gp-9*, Taiwan, molecular epidemiology

P25

A newly recorded species of genus *Apodesmia* (Hymenoptera: Braconidae: Opiinae) from South Korea

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The subfamily Opiinae comprises approximately 2,000 species distributed worldwide. Members of this subfamily are koinobiont endoparasitoids, with parasitism typically culminating in the eventual mortality of the host. Due to this biological characteristic, members of Opiinae have been utilized species as resources for the biological control of agricultural pests in some countries. The genus *Apodesmia* was regarded as a subgenus of *Opius*, but was raised to genus level based on differences in the form of the occipital carina. We report the first occurrence of *Apodesmia incisula* Fischer, 1963 in South Korea. In addition, descriptions, diagnoses and photographs of the diagnostic characters are provided.

Key words: faunistic record; natural enemy; parasitoid wasps; species distribution; systematics; taxonomy

P26

First report of the genus *Coleolaelaps* (Acari: Laelapidae) on the endangered *Polyphylla laticollis manchurica* (Coleoptera: Scarabaeidae) in Korea

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The genus *Polyphylla* comprises relatively large-sized beetles, comprising 85 species worldwide, with a record of *P. laticollis manchurica* in Korea. According to the collection records, this beetle was widely distributed across the Korean Peninsula. However, they have been designated as a highly endangered species (class I) in Korea in 1993, since their specific habitat, riverbanks, were disturbed by urbanization and pollution. Many terrestrial beetles serve as carriers for mites, which usually live either on the hosts' bodies or within their nests. These mites are generally known as scavengers of the nests, but sometimes, they can feed directly on the hosts' eggs. In the case of *Polyphylla* beetles, the genus *Coleolaelaps* is known to be associated with them, however, only their host–phoretic relationship has been reported, with no information on their ecological behavior. In this study, we report a new mite species and their behavior that may be a threat to the conservation of the endangered *Polyphylla* beetle.

Key words: Acari, endangered species, Mesostigmata, new record, phoresis

P27

The first record of *Falsomordellina luteoloides* (Coleoptera: Mordellidae) in Korea

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The tribe Mordellistenini (Coleoptera: Mordellidae) is the largest group in the family Mordellidae, comprising more than 1,200 species within 40 genera worldwide, including over 450 species in 20 genera from the palaearctic region. Members of this tribe are characterized by a long pygidium and well-developed long hind legs with plural lined spines on tibiae and tarsi. In Korea, four genera (*Falsomordellistena*, *Gilpostenoda*, *Mordellina*, and *Mordellistena*) and 14 species have been recorded to date. During a taxonomic study of Korean Mordellistenini, *Falsomordellina luteoloides* (Nomura, 1961) was discovered. This represents the first Korean record of the genus *Falsomordellina*. We provide illustrations of the habitus and diagnostic characters of this species to facilitate identification.

Key words: Coleoptera, Mordellidae, Mordellistenini

P28

Review on the *lewisii*-group (Coleoptera: Ptiliidae: *Acrotrichis*), with redescription of Korean *Acrotrichis lewisii* and descriptions of two new species from Taiwan

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The genus *Acrotrichis* is divided into four subgenera; however, the subgeneric classification remains ambiguous. The '*lewisii*-group' is one of five species groups proposed in 2002 for Japanese *Acrotrichis*. This group includes three species previously placed in the subgenus *Flachiana*. In Korea, a single species, *A. lewisii* is known to be distributed on Jejudo Island. In this study, we examined species of *lewisii*-group from Korea, Taiwan and Japan. We report *A. latipedes* as new to Korea, and discribe two additional new species from Taiwan. A redescription of the *A. lewisii* and *lewisii*-group, along with illustrations of their habitus and diagnostic characters, a distribution map, and a key to the species of the *lewisii*-group, are also provided.

Key words: featherwing beetles, Korea, East Asia, taxonomy

P29

Taxonomic review of the family Corylophidae (Coleoptera: Cucujoidea) from Korea

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The family Corylophidae LeConte (Coleoptera: Cucujoidea) is a cosmopolitan group, comprising 28 genera and approximately 300 species. In Korea, three genera and six species have been recorded to date. Here, we provide redescriptions of six previously known species, describe three new species, *Arthrolips* sp. 1, *A.* sp. 2, and *Clypastraea* sp. 1, and report *Sericoderus brevicornis* Matthews, 1890 as a new record for Korea. Illustrations of habitus and genitalia, diagnostic characters, and a distribution map are provided.

Key words: minute hooded beetles, new species, new record, Korea, taxonomy

P30

Revision of the New Zealand genus *Plectomorphus* Rafrray (Coleoptera: Staphylinidae: Pselaphinae: Euplectitae)

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The genus *Plectomorphus* Raffray is endemic to New Zealand. This genus previously comprises 11 species: *P. insignis* Broun, *P. trisulcicollis* (Broun), *P. spinifer* (Broun), *P. munroi* (Broun), *P. laminifer* Broun, *P. optandus* Broun, *P. anguliferus* Broun, *P. scitiventris* Broun, *P. collinus* (Broun), *P. brevicornis* Broun, and *P. egenus* Broun. In this study, four species, *P. laminifer* Broun, *P. optandus* Broun, *P. anguliferus* Broun, and *P. collinus* (Broun), are transferred as new combinations and five species, *P. spinifer* (Broun), *P. munroi* (Broun), *P. scitiventris* Broun, *P. brevicornis* Broun, and *P. egenus* Broun, are synonymized. As a result, this genus is currently consisted of two species: *P. insignis* Broun and *P. trisulcicollis* (Broun).

Key words: new combination, synonym, taxonomy, New Zealand

P31

Using the Lucid Program to Develop Skills in Generating and Utilizing Taxonomic Keys in an Insect Systematics Class

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곤충분류학 실험 및 실습에서 중요한 부분이 검색표를 활용할 줄 알고, 내게 주어진 곤충들로 객관적 지표에 의해 배타적 분류 키를 만들 줄 아는 능력을 키우는 것이다. 오랫동안 사용해 오던 책에 나오는 검색표를 이용하는 수준의 수동적 접근에서 벗어나 멀티미디어를 이용하는 보다 최신의 방법을 활용하고 스스로 검색표를 제작하고 활용할 줄 알게 하기 위하여 이미 오래 전 개발된 Lucid 프로그램을 활용하였다. 이의 효과적 활용을 위해 영어로 된 프로그램 내 용어 및 설명을 모두 한글화하는 작업을 해두었으며, 최근 몇 년간의 활용을 통해서 나타난 교육적 성과는 기대 이상이었다. 한글패치 파일은 개인적으로 Lucid 본사에 제공해 주었기에 요청 시 추가하여 이용할 수 있다(개인적 이익관계 전무함). 비록 약간의 구매 비용이 들지만 팀플로 운영 시 큰 무리 없이 활용할 수 있기에 추천하고자 한다.

Key words: Lucid, taxonomic key, insect systematics

P32

Insect Dobble Game for teaching insect orders using the gamification method

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곤충의 다양한 목에 대한 교육용으로 게임을 적용하는 방식(gamification)을 도블 게임에 적용하여 프로그램을 만들었다. 도블 게임은 일종의 보드게임인데, 원래는 곤충을 대상으로 제작되었다가, 이후 정식 판매용 도블게임은 카드 당 8개의 간단한 이미지를 활용하였다. 도블게임은 나름 고도의 수학적 원리가 적용되는데, 약 30가지 곤충 목의 다양한 형태적 특징을 여기에 적용하여 실제로 하나의 카드에 6개 서로 다른 이미지를 넣되 모든 임의의 두 장의 카드에는 단 한 가지의 동일한 이미지만 나오도록 하였다. 카드는 곤충 30개 목용 카드와 비곤충 절지동물 1개 카드이다. 실물을 떠나 컴퓨터용으로 구축하기 위해 MIT에서 개발된 스크래치 프로그램을 활용하였다. 그리고 누구나 이용할 수 있도록 충북대 식물의학과 홈페이지 내 연구 > 조수원_곤충계통생물정보학실험실 페이지에 embedding해 두었다.

Key words: insect dobble game, gamification, Scratch

P33

Comparative analysis of insect antennae types suggested by various LLMs

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곤충의 더듬이 종류를 구분함에 있어 곤충학 관련 교재 및 주요 LLM (large language model) 챗봇들로부터의 정보들을 비교, 분석하였다. 이 과정에서 최근 몇 년간 주목받고 있는 대표적인 거대언어모델들(ChatGPT , Claude, Copilot, Gemini, Grok)을 통해 곤충의 더듬이 종류에 대한 정보를 요청하였고, 이를 통해 얻어진 답변을 비교하면서 제시되는 문제점과 오류를 확인하였다. 추가적인 더듬이 유형에 대한 정보도 비교하였으나 공통적으로 적용할 만한 유형은 한두 가지 외에는 보이지 않았다. 이번 분석을 통해 더듬이의 유형을 일차적으로 제시한다.

Key words: Insect antennae, LLM, ChatGPT , Claude, Copilot, Gemini, Grok

P34

Provision of the latest classification systems for some orders through an open knowledge platform

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개방형 지식 플랫폼(open knowledge platform)을 분류체계 업데이트에 활용하는 것은 전문가는 물론, 대중과의 공유폭이 넓어짐과 함께, 분류군별 전문가의 견해가 수시로 반영, 조정될 수 있다는 장점이 있다. 학계에서 명칭의 확정 등이 이루어지기 전에 활발한 논의가 가능하고, 확정 이후에는 바로 수정도 가능하기 때문이다. 이에 최근 곤충 및 관련 절지동물의 분류체계 중 특히 분류체계 정리의 필요성을 느끼는 곤충전체, 나비목, 파리목, 거미목, 및 응애아강에 대하여 최신 또는 최선의 분류체계를 반영한 정보를 개방형 지식 플랫폼인 위키백과에 제시하였다. 이를 통해, 변화하는 분류체계와 분류군의 명칭 등이 정리 또는 안정화되는 계기를 만들고, 이와 함께 미정 상태의 명칭에 대해 비전문가적 신칭이 인터넷 상에 난립되는 문제가 어느 정도 정리될 수 있을 것으로 기대한다.

검색어: 위키백과, 곤충분류체계, 나비목 분류 체계, 파리목 분류 체계, 거미목 분류 체계, 응애아강 분류 체계

P35

The genus *Acylomus* Sharp (Coleoptera: Phalacridae) new to Korea

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The family Phalacridae Leach (Coleoptera: Cucujoidea) includes 52 genera and nearly 650 species within two subfamilies distributed worldwide. Most phalacrids are fungivores, but some species feed on flower heads. A total of 16 genera and 104 species of Phalacridae have been recorded in the Palaearctic region. The genus *Acylomus* Sharp includes 94 species worldwide, but it has not previously been recorded in Korea. In this study, the genus *Acylomus* and two unrecorde species, *Acylomus orientalis* and *Acylomus* sp.1, are documented for the first time from Korea. Illustrations of their habitus, diagnostic characters and male genitalia, distribution maps, and an identification key to the Korean *Acylomus* species are provided.

Key words: *Acylomus*, new record, Palaearctic, Phalacridae, shining flower beetles

P36

Additions, corrections, and bibliographic issues on the Heteroptera fauna of Korea (Insecta: Hemiptera)

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We address issues on faunistic studies on Korean true bugs (Hemiptera: Heteroptera) and critically revise the literature records on recently (2011–2024) reported species. Furthermore, 17 species in 10 families are newly reported from Korea, of which five species are recorded based on photographic evidence. Eleven species are excluded from the Korean fauna based on revision of literature records. Three species are reconfirmed from Korea.

Key words: new records, true bugs, the Korean Peninsula, Palaearctic Region

P37

Temporal analysis of COI gene variations in *Spodoptera litura* populations from Gyeongnam Province in 2025: a comparison with the 2024 nationwide survey

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The tobacco cutworm (*Spodoptera litura*) is a major agricultural pest whose occurrence has increased under recent climate change. In 2024, we conducted the first nationwide survey in Korea to analyze spatial genetic variation based on *cytochrome C oxidase I* (*COI*) sequences. This study focused on temporal variation of *COI* sequences of *S. litura* adults, which are collected in Gyeongnam Province during 2024-2025. The analysis showed no major differences in haplotype distribution or single nucleotide polymorphism (SNP) patterns between the two years. Most individuals exhibited a C→T substitution at position 406, while a subset carried a substitution at position 407, consistent with the previous survey. These results indicate that *S. litura* populations in Gyeongnam maintain a stable genetic structure despite short-term environmental changes. Such stability provides valuable baseline data for population genetics and supports long-term predictions of pest occurrence and the development of effective management strategies.

Key words: *Spodoptera litura, cytochrome C oxidase I*, Single nucleotide polymorphism, haplotype, climate change

P38

The origin and invasive pathways of the oriental fruit fly, *Bactrocera dorsalis*, using mitochondrial COI

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The oriental fruit fly (*Bactrocera dorsalis*) is a significant agricultural pest infesting more than 400 plant species, including crops and fruits. Native to Southeast Asia and Taiwan, it has recently expanded its geographical range to Japan and China, prompting concerns regarding its potential invasion into new regions. The mitochondrial cytochrome c oxidase subunit I (COI) gene was utilized to examine the genetic diversity and dispersal patterns of *B. dorsalis*. Flies were collected from multiple Southeast Asian countries, including Thailand, Taiwan, Vietnam, Cambodia, and the Philippines. Additionally, mitochondrial COI sequences in GenBank database were incorporated to understand the regional characteristics of *B. dorsalis* in Asia. The results revealed substantial haplotype diversity both within and among populations, with distinct genetic patterns identified in certain island populations, including Philippines, Papua New Guinea, Indonesia, and Malaysia. Notably, the major haplotypes were commonly shared among all sampled populations, except for the Philippines and Papua New Guinea. These findings provide mitochondrial COI-based insights into the genetic structure of *B. dorsalis* in Southeast Asia, highlighting both the geographical differentiation of Island populations and the extensive sharing of genetic variation across continental populations.

Key words: *Bactrocera dorsalis*, population genetics, mitochondrial gene, Southeast Asia

P39

Phylogeny and biogeography of the two subfamilies, Alysiinae and Opiinae (Hymenoptera: Braconidae)

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Alysiinae and Opiinae are species-rich in Braconidae but their phylogeny remains largely unexamined in an integrative framework. We analyzed five markers (*COI, COII, Cyt b, ND1, 28SD2*; total 1,865 bp) for 175 taxa using maximum-likelihood and Bayesian inference. Phylogeny with the preferred topology recovers Opiinae as a strongly supported lineage nested within Alysiinae, rendering Alysiinae paraphyletic, which does not support the monophyly of the traditional tribes Alysiini and Dacnusini. In light of these results, we refine subtribal limits within Alysiini by recognizing Aspilotina and proposing Asobarina subtrib. nov. Relaxed-clock molecular dating places the origin of the combined Alysiinae–Opiinae clade in the Late Cretaceous (~112 Ma), with accelerated diversification across the Paleocene–Eocene transition. Biogeographic reconstruction supports a Western Palearctic origin followed by subsequent dispersal. Collectively, these findings motivate targeted taxonomic revision and clarify the evolutionary history of these economically important parasitoid wasps.

Key words: Biogeography, new subtribe, new to science, parasitoid wasp, taxonomy

P40

Establishing a Genetic Resource Database of Intercepted pests during Plant Quarantine Inspection (2021-2025)

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With the increase in climate change and agricultural trade, international quarantine negotiations have become more frequent, emphasizing the need for greater expertise and accuracy in the quarantine process. In this study, conducted from 2021 to 2025, DNA barcode sequences of major quarantine pests—including insects, arthropods, and mollusks were analyzed to obtain genetic information, using specimens collected from quarantine inspection(via aircraft, vessels, and passenger baggage) and from domestic and international sources. A total of 25 orders, 179 families, and 2,300 specimens were analyzed, with Lepidoptera accounting for the largest proportion (32 families, 888 specimens), followed by Hemiptera (36 families, 426 specimens). To improve species identification accuracy, a comprehensive database was established, incorporating images, country of origin and associated commodities, primers, and DNA sequences. The results of this study are expected to serve as foundational data for developing precise diagnostic systems and advancing molecular identification techniques for quarantine pests.

Key words: plant quarantine, DNA barcode, invasive pests, molecular biological identification

P41

Phylogeographic relationships of the wild silkmoth, *Bombyx mandarina* (Lepidoptera: Bombycidae), using mitochondrial genomes

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The wild silkmoth, *Bombyx mandarina* (Lepidoptera: Bombycidae), the presumed ancestor of *B. mori*, has long been studied to understand genetic relationships among geographic populations. In this study, we sequenced 100 mitochondrial genomes of *B. mandarina* collected from 13 regions in South Korea and four regions in Japan. Our results showed that *B. mandarina* from South Korea is genetically closest to those from northern China and southern China, while the Japanese population formed the most distinct group. We discovered one individual from Inje in northeastern South Korea to have a lengthy A+T-rich region sequence and structure that is highly similar to those observed in all Japanese individuals. Moreover, all individuals sampled from Jeju Island formed a separate genetic group from the South Korean inland populations, reflecting the biogeographic history that separated the island after the last glacial maximum. These findings reveal interaction of *B. mandarina* among eastern China, South Korea, and Japan during its range expansion.

Key words: *Bombyx mandarina*, mitochondrial genome, phylogeny, population structure, biogeographic

P42

Multigene-based phylogenetic study of Aphidiinae (Hymenoptera: Ichneumonoidea: Braconidae) from South Korea

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The subfamily Aphidiinae consist of 52 genera and 702 species worldwide excluding fossil, with 19 genera and 71 species being recorded in South Korea. In this study, we used 20 genera and 81 species including collections from other countries, and analyzed using three nulcear regions (*28SD2*, *EF-1α*, *wingless*) with four mitochondrial fragments (*COI*, *COII*, *Cytb*, *ND1*). We inferred partitioned maximum-likelihood (ML) and Bayesian (BI) phylogenies from seven loci, and applied these trees to test monophyly as well as to resolve relationships within Aphidiinae. We then performed divergence-time estimation on a time-calibrated tree, and compared diveregence times of the parasitoids with published dating/fossil times of major aphid lineages. Finally, we reconstructed ancestral host associations (multi-states characterized by aphid subfamily) from extant host-use records to evaluate host-switching patterns and their co-evolutionary implications.

Key words: natural enemy, parasitoid wasps, taxonomy, systematics

P43

Complete mitochondrial genome of *Meganola major* (Hampson, 1891) (Lepidoptera: Nolidae)

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The complete mitogenome of *Meganola major* is reported and its phylogenetic placement within the family is evaluated. The circular genome is 15,237 bp and comprises 37 genes, including 13 PCGs, 22 tRNAs, and 2 rRNAs, together with an A+T rich region. Most PCGs begin with ATN, whereas *cox1* begins with CGA and *cox2* with GTG. Gene order matches the typical lepidopteran arrangement without rearrangements, and base composition falls within the range observed in other nolids. Phylogenetic analyses of *M. major* and 20 Nolidae species recovered the following relationships: Nolinae as sister to Risobinae, *Blenina* as an independent lineage consistent with recognition of Bleninae, and *Meganola* and *Nola* as reciprocally monophyletic with strong support, clearly separating *M. major* from *Nola* species. The mitogenome presented here extends the reference set for Nolidae and provides a molecular framework for generic delimitation within Nolinae, as well as a resource for species identification and monitoring in applied contexts such as pest management.

Key words: tuft moth, Nolidae, *Meganola*, phylogeny, crepe myrtle pest

P44

STEP buffer: a rapid method for gDNA release and molecular diagnostics of minute arthropods

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Obtaining sufficient quality gDNA is essential for downstream molecular analyses. Due to their simplicity and speed, gDNA release methods are sometimes preferred over conventional extraction procedures. In this study, we developed a newly formulated buffer, named STEP, for rapid gDNA release from minute arthropod specimens. We tested specimens with limited gDNA, including whole bodies of *Dermatophagoides pteronyssinus*, first-instar nymphs and exuviae of *Cimex lectularius*, and a single leg of *Aedes albopictus*. The performance of STEP was compared with water and the alkaline-based DAPE buffer, yielding greater gDNA release efficiency than water and comparable or higher amount than DAPE. Furthermore, unlike DAPE, which markedly alters reaction pH, STEP was suitable for colorimetric loop-mediated isothermal amplification (LAMP) as well as PCR and conventional LAMP. This makes STEP particularly useful for on-site diagnostics.

Key words: gDNA release, PCR, LAMP, qPCR, molecular diagnostics, on-site diagnostics

P45

Characterization of Digestive Alpha-Amylase Isoforms in *Spodoptera*

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Insects cause a significant impact on global food security, so characterizing their digestive enzymes is crucial for understanding feeding efficiency and identifying molecular targets for pest control. Alpha-amylases, key enzymes in carbohydrate metabolism, occur in multiple isoforms that may contribute to dietary adaptation and developmental processes in lepidopteran pests. In this study, three alpha-amylase isoforms of *Spodoptera frugiperda* mined from NGS analysis and each isoform was investigated through molecular and evolutionary analyses with a focus on their activation patterns and expression across larval tissues and developmental stages. Our findings highlight potential isoform specialization and emphasize their relevance as prospective targets for sustainable pest management strategies.

Key words: *Spodoptera frugiperda*, digestive enzymes, alpha-amylase, isoforms, pest management

P46

Metabolite changes induced by carbonyl sulfide treatment in *Tribolium castaneum* (Coleoptera: Tenebrionidae)

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Tribolium castaneum, a major stored-grain pest, contributes to substantial global food losses and degrades product quality. Fumigants are currently the primary means of controlling stored-grain pests. However, ozone depletion caused by methyl bromide and the spread of phosphine resistance have increased the need to develop alternative fumigants. Carbonyl sulfide (COS) has drawn attention as a promising alternative fumigant due to its high insecticidal activity and broad efficacy. Prior work has shown that COS exposure impairs mitochondrial function in *T. castaneum*. Nevertheless, the metabolite-level changes induced by COS remain insufficiently characterized. In this study, we conducted comparative metabolomic profiling of *T. castaneum* following COS exposure to define metabolite-level changes and to elucidate the associated toxic mechanisms and physiological responses. LC–MS/MS analysis detected a total of 284 metabolites in positive-ion mode and 321 in negative-ion mode across COS-treated and control samples (raw union). Based on the detected metabolites, enrichment analysis revealed pronounced class-level shifts, particularly in carboxylic acids and derivatives, organonitrogen compounds, and keto acids and derivatives. Subsequently, pathway analysis indicated pronounced changes in alanine, aspartate and glutamate metabolism as well as glycerophospholipid metabolism, valine, leucine and isoleucine biosynthesis, and nicotinate and nicotinamide metabolism. Notably, metabolites associated with mitochondrial function, including 2-oxoglutaramic acid and nicotinamide, showed significant changes in the COS-treated group relative to controls. These results suggest that COS may disrupt mitochondria-associated metabolic processes in *T. castaneum*. This study provides a metabolomic framework for understanding COS toxicity and supports its evaluation within integrated strategies for stored-grain pest control.

Key words: Carbonyl sulfide (COS), *Tribolium castaneum,* Comparative metabolomics, Mitochondria-associated pathways, Stored-grain pest control

P47

Within- and between-generation effects of temperature on life-history traits in two coexisting species of *Drosophila*

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Comparative studies of within-generation responses have suggested that *D. melanogaster* and *D. simulans* differ in thermal sensitivity, which leads them to occupy distinct thermal niches and thus facilitates their coexistence. However, the role of trans-generational effects in shaping coexistence remains unexplored. We conducted two experiments to test how temperature influences life-history traits within and between generations in these two sibling species. In the first experiment, offspring from parents reared at 23°C were raised at three developmental temperatures (17, 23, 29°C) to investigate within-generation plasticity. In the second experiment, parental flies were reared at three temperatures (17, 23, 29°C), and their offspring were raised at 23°C to examine trans-generational effects. In both experiments, we measured larval life-history traits and found significant species × temperature interactions, mainly driven by reduced performance of *D. simulans* at 29°C. Taken together, our results demonstrate that both within- and between-generation effects shape species-specific thermal responses, possibly faciliating niche differentiation and coexistence in nature.

Key words: coexistence, *Drosophila*, life-history traits, temperature, transgenerational effects

P48

Transcriptomic profiling of the brain in *Spodoptera frugiperda* under cold stress

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Cold stress is a critical environmental factor affecting the physiology and survival of insects. To investigate the molecular mechanisms underlying cold tolerance in *Spodoptera frugiperda*, we performed transcriptomic analysis of brain tissue following exposure to 4 °C. A total of 266,051 unigenes were assembled, and 6,917 genes were identified as differentially expressed under cold stress. Overall, down-regulated genes outnumbered up-regulated genes. Functional annotation revealed cold-responsive genes related to protein stabilization and structural protection (*HSPs*), membrane stability (*PEDS1*), water transport (*AQP*), energy metabolism (*Tret1*), circadian rhythm (*DYW*), and transcriptional regulation (*RN7SK*). Among these, *HSP*s and *PGPEP1* were strongly induced (>50-fold), whereas *RN7SK* exhibited a marked 175-fold down-regulation. These findings provide new insights into the molecular basis of cold adaptation in insects and highlight potential molecular markers for studying cold resistance and developing pest management strategies.

Key words: Brain, Cold stress, DEG, Transcriptome, *Spodoptera frugiperda*

P49

Scent of a Fig: Host Volatiles Driving Fig Weevil Antennal Responses

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The fig weevil (*Aclees taiwanensis* Kôno) is an invasive pest that causes severe damage to fig cultivation in Korea. To explore potential chemical cues involved in its host association, we collected volatile compounds from different parts of the fig tree (*Ficus carica*) and evaluated their electrophysiological activity on adult antennae. Headspace volatiles were obtained from leaves, fruits, young shoots, and whole plants, and analyzed by GC–MS. Selected compounds were further tested in electroantennography (EAG) assays with both sexes across multiple concentrations. Some compounds elicited clear antennal responses, with sex-related differences observed only at specific concentrations. These findings suggest that host volatiles play an important role in the chemosensory ecology of *A. taiwanensis*. The identified candidates provide a basis for behavioral assays and semiochemical-based monitoring tools, and may also serve as synergists to enhance pheromone-based trapping once the aggregation pheromone of this species is identified.

Key words: *Aclees taiwanensis,* fig tree volatiles, electroantennography, semiochemical, invasive pest

P50

Mapping the Sensory Landscape: Antennal Morphology and Sensilla of the Fig Weevil Revealed by SEM and TEM

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The fig weevil (*Aclees taiwanensis* Kôno) is an invasive pest causing substantial damage to fig cultivation in Korea. Antennae are essential sensory organs that house a variety of sensilla responsible for chemical, mechanical, and other environmental cues. This study investigated the morphology and ultrastructure of antennal sensilla in *A. taiwanensis* using scanning and transmission electron microscopy. Both male and female antennae were examined, revealing multiple types of sensilla with distinct morphologies and distributions. Subtle sexual differences were noted, and cross-sectional views provided insights into their potential sensory roles. These results offer the first comprehensive overview of antennal sensilla in *A. taiwanensis*, establishing a structural foundation for linking antennal morphology with chemosensory function. This morphological framework complements electrophysiological studies on host volatiles and supports ongoing efforts to elucidate the chemical ecology of this invasive pest.

Key words: *Aclees taiwanensis*, antennal sensilla, SEM, TEM, sensory morphology

P51

Impact of elevated developmental temperatures on gut microbial communities in bumblebee (*Bombus terrestris*) workers

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Bumblebees are essential pollinators in agriculture and ecosystems, but climate change is contributing to their decline. While previous studies have shown ecological and physiological changes due to climate stress, the effects of elevated developmental temperatures on gut microbiota remain poorly understood. In this study, we analyzed the gut microbial communities of bumblebee workers reared at optimal (27 °C), moderately high (32 °C), and high (35 °C) temperatures. Alpha and beta diversity analyses revealed significant shifts in microbial composition. At the phylum level, elevated temperatures reduced Firmicutes and increased Proteobacteria. At the genus level, higher temperatures significantly decreased *Bombilactobacillus* and increased *Gilliamella* (at 32 °C) and *Snodgrassella* (at 35 °C), likely due to enhanced intestinal colonization. These results suggest that elevated developmental temperatures, such as those driven by climate change, alter the gut microbiome and may lead to dysbiosis, potentially affecting bumblebee health.

Key words: *Bombus terrestris*; bumblebee workers; developmental temperature; gut microbiome

P52

Effects of field-realistic doses of thiamethoxam and flupyradifurone on *Apis mellifera* (Hymenoptera: Apidae) foraging behavior as determined by RFID

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Despite efforts to minimize off-target effects, pesticide residues in pollen, nectar, and wax continue to pose potential risks to the western honey bee, *Apis mellifera*. Thiamethoxam (Thmx), a widely used neonicotinoid, and flupyradifurone (FPF), a newer butenolide insecticide, are highly systemic and can be translocated into pollen and nectar following crop treatment. This study examined the effects of field-realistic doses of these two systemic insecticides on honey bee foraging behavior. Colonies were provisioned with pollen bread and sugar syrup containing field-realistic doses, based on previous researches, while access to external pollen sources was restricted. Newly emerged, pesticide-exposed workers were attached with radio frequency identification (RFID) tags, and their foraging activity was monitored from 12 days after emergence. The pesticide significantly reduced the age of first foraging (Control: 21.5±5.7 days; Thmx: 19.0±4.0 days; FPF: 18.7±3.6 days), but had no effect on the total average foraging time (Control: 50.1±33.1 min; Thmx: 48.5±31.4 min; FPF: 49.6±30.1 min).

Key words: *Apis mellifera*, Foraging behavior, pesticide, field-realistic dose, RFID system

P53

Identification of salivary miRNAs in the parasitic mite *Varroa destructor* (Mesotigmata: Varroidae)

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Varroa mite, *Varroa destructor,* is the major ectoparasite of Western honey bees. This host–parasite association has developed within the past century following the mite's host shift from the Asian honey bee to *A. mellifera*, making it a valuable model for studying recently established interactions. During such interactions, hosts and parasites exchange diverse molecules, including microRNAs (miRNAs), which may alter each other's physiology to gain adaptive advantages. In this study, we investigated miRNAs potentially transferred through direct fluid exchange between the host and parasite. A total of 161 miRNAs were detected in each of the whole-body and salivary gland (SG) samples of *Varroa* mites. Among these, six SG-specific miRNAs were identified, each showing more than 1,000 reads per million (RPM) in SG samples, at least 4-fold higher RPM than in whole-body samples, and linked to host-parasite interaction-related GO/KEGG pathways. Some of candidates were also detected in the saliva of *V. destructor*. This study examined the potential involvement of miRNA in host-parasite interactions and identified varroa-derived candidate miRNAs. Further studies will focus on screening host-derived miRNAs, and elucidating the functional roles of these candidates.

Key words: miRNA, *Apis mellifera*, *Varroa destructor*, Host-parasite interaction

P54

Cross-Species microRNA Exchange Between Humans and Body lice

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Host–parasite interactions are increasingly recognized to involve cross-species molecular communication, including transfer of microRNAs (miRNAs). The body louse, an obligate ectoparasite of humans, provides a unique model for investigating these processes. In this study, time-course analyses of louse tissues following blood feeding revealed persistence of 125 human-derived miRNAs. In parallel, we identified 98 salivary gland-specific and 66 saliva-specific louse miRNAs potentially transferable to the human host. Based on the structural features of human blood- and louse saliva-derived miRNAs, we selected candidates most likely to remain stable after interspecies transfer. Subsequent pathway analyses revealed their potential involvement in major physiological processes. Taken together, these results provide the first integrative view of miRNA exchange with potential functional implications in the human-insect ectoparasite system.

Key words: body louse, miRNA, cross-species interactions, parasite

P55

16S rRNA metagenomic analysis of blood from wild rodents in Jeonbuk, Korea

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Wild rodents are recognized as natural reservoirs and vectors of various pathogens, including *Leptospira* spp., due to their frequent contact with ticks and mites. However, most studies on rodent-borne pathogens have focused on human-pathogenic agents, and 16S rRNA metagenomics has been applied mainly to fecal samples. In this study, we analyzed the bacterial composition of blood from 24 rodents collected in Jinan, Jeonbuk, during 2024 and the first half of 2025, using 16S rRNA metagenomics based on next-generation sequencing(NGS). The results showed that Haemotropic *Mycoplasma* spp. and *Bartonella* spp. constituted a significant proportion of the bacterial communities. In addition, leukocyte-associated pathogens such as *Anaplasma phagocytophilum* and *Ehrlichia chaffeensis* were detected. Although the pathogens have not been designated as legal communicable disease in Korea, our findings provide important baseline data to inform preparedness for potential transmission risks in the wild.

Key words: wild rodents, blood microbiome, 16S rRNA metagenomics, next-generation sequencing(NGS)

P56

Acaricidal efficacy of Korean native *Sophora flavescens* root extracts against the two-spotted spider mite (*Tetranychus urticae*)

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Sophora flavescens is a potential source of natural pesticides, but its application in Korea is limited by the lack of established extraction methods and efficacy data. This study aimed to optimize the extraction of insecticidal alkaloids from the roots of Korean native *S. flavescens* and evaluate the extract's efficacy against major agricultural pests. Ethanol extractions were conducted at 25°C and 65°C, and the primary alkaloids, matrine and oxymatrine, were quantified using LC-MS. The insecticidal and acaricidal activities were tested against the green peach aphid (*Myzus persicae*), diamondback moth (*Plutella xylostella*), and two-spotted spider mite (*Tetranychus urticae*). The results showed that extraction temperature significantly influenced alkaloid composition. Extraction at 25°C yielded approximately 4,600 ppm of total matrine alkaloids, with oxymatrine comprising over 95% of the total. In contrast, extraction at 65°C yielded about 2,000 ppm, with matrine being the predominant form (>95%). In bioassays, the extract exhibited low mortality (<40%) against *M. persicae* and *P. xylostella* at a 50-fold dilution. However, it demonstrated high acaricidal activity, causing approximately 90% mortality in *T. urticae* when applied at a 200-fold dilution (40 ppm total matrine). Interestingly, this potent acaricidal effect was not significantly different between the 25°C and 65°C extracts. These findings indicate that Korean native *S. flavescens* extract is a promising candidate for developing a natural acaricide for the control of *T. urticae*.

Key words: *Sophora flavescens*, Matrine, Oxymatrine, Extraction temperature, *Tetranychus urticae*, Natural acaricide

P57

First Report of *Sarcoptes scabiei kdr* mutations Conferring Permethrin Resistance in Korea

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Scabies is a contagious skin disease caused by infestation with the mite, *Sarcoptes scabiei.* Recently, an increasing number of patients have exhibited poor therapeutic response to repeated topical applications of permethrin, which has been the standard first-line treatment for scabies in Korea. To investigate the underlying cause, we elucidated the gDNA sequence of the mite *voltage-sensitive sodium channel* and subsequently identified *kdr* mutations associated with resistance from 30 patient-derived skin scrapings. To our knowledge, this is the first report of permethrin-resistant scabies mite in Korea. These findings highlight the urgent need to introduce alternative therapeutic agents for scabies, including oral ivermectin and topical spinosad.

Key words: *Sarcoptes scabiei*, permethrin, kdr-mutaion, resistance, Neglected tropical disease

P58

Development of new efficacy testing methods for metofluthrin-based mosquito coils under semi- and outdoor conditions

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According to Consumer Chemical Products and Biocides Safety Control Act, biocidal products must demonstrate acceptable levels of efficacy and safety before being distributed in consumer markets. Mosquito coils are commonly used in outdoor conditions due to smoke generation; however, previous tests were conducted in a closed indoor environments. In the first test, we examined insecticidal activity of metofluthrin-based mosquito coils against laboratory-susceptible strains of *Aedes* and *Culex* mosquitoes in a semi-open chambers (18 and 33 m^3) with one side open. Mortality showed wide variety based on the position of mosquitoes in the chamber. In the second test, repellency was examined using a two-choice design, where two small tents (>10 m apart) were equipped with BG-Sentinel traps as attractants. Repellency ranged 68–87%, with an average of 53 mosquitoes collected in the untreated control tents. The newly designed repellency testing methods may serve as standardized approaches for evaluating the efficacy of mosquito coils.

Key words: mosquito coil, *Aedes albopictus*, *Culex pipiens*, repellency

P59

Risk of Biodegraded Mulch Film-Insecticide Mixtures: Synergistic Toxicity and Sublethal Effects in Non-Target Species, *Folsomia candida* and *Stratiolaelaps scimitus*

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Biodegradable mulch films such as PBAT (polybutylene adipate-co-terephthalate) blended with PLA (polylactic acid) are increasingly used as sustainable alternatives to conventional plastics, yet the impacts of their degradation products on soil-dwelling invertebrates remain poorly understood. Importantly, these byproducts are rarely encountered in isolation; instead, they often co-occur with soil-applied insecticides such as abamectin, cyantraniliprole, sulfoxaflor, and thiamethoxam, raising the potential for synergistic interactions that enhances the risks. Here, we investigated the biodegradation profile of PBAT-PLA films under ISO-17556 standard soil, assessing physicochemical changes (degradation rate, film thickness, soil pH) and the ecotoxicological effects of the resulting degradation products. We tested their mixture toxicity with the above insecticides on two non-target arthropods, the springtail, *Folsomia candida* and the predatory mite, *Stratiolaelaps scimitus*, in soils subjected to up to 8 weeks of film degradation. Degradation products alone were not toxic. However, when combined with LC_{20} of insecticides, synergistic toxicity was identified in *F. candida* with abamectin (2- and 7-day exposures) and with sulfoxaflor and thiamethoxam (7-day exposure only), while cyantraniliprole showed no synergy. No synergistic effects were detected in *S. scimitus*. Predation assays on western flower thrips, Frankliniella occidentalis, revealed that both degradation products and sublethal insecticide concentrations (except cyantraniliprole) impaired predation rates, but without synergistic interaction under the Bliss independence criterion. These results highlight the need to consider mixture exposures and sublethal endpoints when assessing risks of biodegradable mulching films, and demonstrate species-specific patterns of synergistic toxicity in soil invertebrates.

Key words: biodegradable mulch film; environmental risk assessment; mixture toxicity; springtail; predatory mite

P60

Development of Field-Deployable Molecular Diagnostic Kit for *Monochamus saltuarius* (Coleoptera: Cerambycidae) using Recombinant Polymerase Amplification

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Effective management of pine wilt disease requires rapid and accurate identification of its vector insects, yet no field diagnostic kits currently exist—especially for immature stages like larvae and pupae, which are difficult to distinguish visually. This study developed a high-sensitivity molecular diagnostic kit for *Monochamus saltuarius*, a major vector, using Recombinant Polymerase Amplification (RPA) and Lateral Flow Detection (LFD). Primers and probes targeting Cytochrome c oxidase subunit I (COI) genes showed 100% specificity and detected as low as 0.01 pg and 1 copy of target DNA. Field tests demonstrated 97.14% sensitivity and 95.24% specificity. This is the first kit for vector detection and is expected to aid in preventing disease spread.

Key words: *Monochamus saltuarius*, Molecular Diagnostic Kit, Recombinant Polymerase Amplification – Lateral Flow Detection, Cytochrome c oxidase subunit I gene, Pine Wilt Disease

P61

Dietary effects on the development and survival of *Spodoptera exigua* (Hübner) under laboratory conditions

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Spodoptera exigua (Lepidoptera: Noctuidae) is a polyphagous pest causing significant economic damage to vegetable and field crops worldwide. Understanding its nutritional ecology is essential for designing cost-effective mass-rearing systems and improving pest management strategies. We evaluated the biological attributes of *S. exigua* when reared on different diets: cabbage leaf (CL), artificial diet (AD), artificial diet supplemented with cabbage extract (ADC). Larval development significantly differed across treatments, with the longest on AD 25.1 days) compared to CL (15.5 days). Female pupae were heavier than males, with the highest mean pupal weight on CL (90.1 mg) and the lowest on ADC (67.1 mg). Larval mortality was lowest on ADC. These findings suggest that adding cabbage extract in artificial diet can enhance larval survival. The underlying cause will be assessed in future studies.

Key words: artificial diet, cabbage extract, survival, pupal weight, life table

P62

Evaluation of the effectiveness of seven registered pesticides against *Tetranychus urticae* using leaf dip and foliar spray methods

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The two-spotted spider mite (*Tetranychus urticae*) is a major pest that rapidly develops resistance owing to its short life cycle and high reproductive capacity. This study evaluated the efficacy of seven pesticides registered in Korea—amitraz (IRAC 19), bifenazate (20d), chlorfenapyr (13), cyflumetofen (25a), fenazaquin (21a), fluxametamide (30), and propargite (12c)—using two bioassay methods, leaf-dip and foliar spray. After 72 hours, all pesticides achieved more than 90% control at the recommended concentrations, but LC_{50} values varied between the two methods. These results demonstrate that the choice of bioassay can influence efficacy interpretation and underscore the need for selection criteria tailored to pesticide characteristics and research objectives. The LC_{50} values obtained provide essential baseline data for resistance monitoring, the development of new pesticides, and the implementation of resistance management strategies.

Key words: *Tetranychus urticae*, Pesticides, Efficacy, Leaf-dip, Foliar spray

P63

Control of the pine wilt nematode, *Bursaphelenchus xylophilus*, with dsRNA specific to *vATPase-B*

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The pine wilt nematode, *Bursaphelenchus xylophilus*, is native to North America and has spread to Asia and Europe through infested timber and human activity. It causes a serious damage to pine trees causing rapid wilting, browning of needles, reduced resin flow, and eventual tree death. The nematode is transmitted by pine sawyer beetles (*Monochamus* spp.), which carry it from infected trees to healthy ones during feeding or egg-laying. Management strategies include removing infected trees, applying chemical treatments, and monitoring timber movement to prevent further spread. This study aims to develop an effective dsRNA insecticide against *B. xylophilus*. Three candidate genes were selected from potent dsRNAs with high mortalities against plant parasitic nematodes from previous studies: arginine kinase, pectate lyase, and vATPase-B. Their orthologous genes were determined from *B. xylophilus* genome. Expressions of these genes were confirmed by RT-PCR. Bioassay used a bacterial growth plate by treating dsRNA along with the diet bacteria. All three dsRNAs gave significant mortalities to the nematode. Notably, dsRNA specific to *vATPase-B* was highly potent. Using FISH, the expression of *vATPase-B* was observed in the control but its expression was markedly decreased in the dsRNA treatment. These results suggest an application of the dsRNA specific to *vATPase-B* to control *B. xylophilus*.

Key words: dsRNA, nematicide, vATPase-B, FISH, *Bursaphelenchus xylophilus*

P64

Effect of host plant on the insecticidal effect of the *Metcalfa pruinosa*

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The *Metcalfa pruinosa* is an invasive pest introduced into Korea in the mid-2000s. In Korea, it is a polyphagous pest that feeds on 345 plant species, and insecticides are registered against it for various crops. However, registered insecticides for trees in forests and residential areas are insufficient. Therefore, this study conducted a field test to evaluate the efficacy of flonicamid, cypermethrin, sulfoxaflor, pyrifluquinazone, and thiacloprid, which are registered crop insecticides for the control of the *M. pruinosa,* on trees that are vulnerable to the *M. pruinosa* but for which no registered insecticides exist. The results showed that efficacy varied depending on the pesticide species and test site. Cypermethrin and sulfoxaflor showed mortality rates of 83.2 to 100% on the third day and over 90% on the seventh day, but pyrifluquinazone showed a relatively low mortality rate, and thiacloprid showed a mortality rate of 79.9 to 92.8% on the seventh day after insecticide treatment.

Key words: Efficacy, host plant, insecticide, *Metcalfa pruinosa*

P65

Drug response to acetamiprid in local populations of the *Hyphantria cunea* in Korea

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The *Hyphantria cunea*, an invasive pest, is a representative polyphagous pest that occurs in groups not only in agricultural fields but also in street trees, landscape trees, and forests, causing serious damage to various host plants. This study was conducted to determine differences in efficacy of acetamiprid, registered for the control of the *H. cunea*, among regional strains of the *H. cunea*. In the first-year experiment targeting third instars, there were differences in efficacy among regional strains of the *H. cunea*. In the second-year experiment targeting second and fourth instars, there were also differences in efficacy among regional strains. The mortality for all regional populations of the *H. cunea* were 8.3-48.3% for third instars, 35.7-80.0% for second instars, and 3.3-85.0% for fourth instars, showing an overall mortality rate of less than 90%.Further research is needed to determine whether the differences in insecticide responses among regional populations are due to the development of resistance or low efficacy.

Key words: acetamiprid, efficacy, *Hyphantria cunea*, living area trees, resistance

P66

Study on the effects of chitin synthesis inhibitors and formulation preferences of *Reticulitermes speratus* for application of termite baiting systems

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The subterranean termite, *Reticulitermes speratus*, causes extensive damage to wooden structures and cultural heritage sites in Korea, with the threat expected to intensify under climate change. Conventional fumigation, chemical treatment, and trapping methods are limited in effectiveness and persistence, making baiting systems a promising alternative. This study evaluated the insecticidal effects of four chitin synthesis inhibitors (CSIs) and the feeding preferences of *R. speratus* among different formulations to optimize an effective baiting system in Korea. Three CSIs (CSI I, II, III) achieved 94.5–98.7% mortality at 10 weeks, while CSI IV reached only 55.3%. In feeding tests, termites consumed the least from formulation A and more from formulations B, D, and E. These findings provide useful information to develop CSI-based baiting systems, contributing to environmentally friendly and cost-effective termite management strategies to safeguard wooden structures and cultural heritage in Korea.

Key words: baiting system, chitin synthesis inhibitor, feeding preference, mortality, termite control

P67

Evaluation of *Beauveria bassiana* ARP14 against *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae)

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The brown marmorated stink bug, *Halyomorpha halys* (Stål), native to East Asia, has become an important polyphagous pest of fruit crops worldwide. As a potential mycoinsecticide, we compared the virulence of a native entomopathogenic fungus, *Beauveria bassiana* (Balsamo) Vuillemin ARP14 with a commercial GHA strain against *H. halys*. Topical application method was used in the laboratory with a concentration of 1×10^8 conidia/ml. The median survival time (ST_{50}) value of the ARP14 strain was not statistically different from that of the GHA strain for either the nymphal or adult stages. However, Mycosis rates in 3rd and 5th instar nymphs were not different between the ARP14 (up to 52 and 50%, respectively) and GHA (up to 36 and 16%, respectively). In adults of *H. halys*, a higher mycosis rate was found in ARP14 strain (up to 90%) than in GHA strain (up to 58%) during the period of 12 to 14 days after treatment. These findings indicate that the native *B. bassiana* ARP14 strain is a promising candidate for development as a mycoinsecticide for managing *H. halys*.

Key words: biological control, entomopathogenic fungus, mycoinsecticide, mortality, mycosis rate.

P68

Integrating Soil-drenching and Foliar Applications of Neem Oil: A Strategy for Managing *Tuta absoluta* (Lepidoptera: Gelechiidae)

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Tomato (*Solanum lycopersicum* L.) is a globally significant vegetable crop that suffers substantial economic losses due to insect pests, notably the tomato leafminer *Tuta absoluta* (Lepidoptera: Gelechiidae). *T. absoluta* has become a significant pest worldwide, impacting greenhouse and open-field tomato production. Due to the resistance development of synthetic pesticides, neem oil, a plant-derived natural pesticide as an alternative option, has been widely used for sustainable pest management. This study evaluated the effects of neem oil at 0 to 20 ppm concentration on plant growth and damage per plant, number of larvae per plant, eclosion rate, and damage reduction (%) compared to the control. Results indicated that the neem oil soil-drenching treatment has no adverse effects on plant growth. Compared to the control, the combined application method significantly decreased the number of larvae, damage caused by larvae, and eclosion rate on treated plants. The results of this study may lead to an easier and more effective neem oil treatment method to maximize the control of *T. absoluta.*

Key words: azadirachtin, neem, tomato leaf miner, invasive species, tomato, biopesticides

P69

Efficacy and Safety Assessment of Sulfuryl fluoride and Ethyl formate Fumigation in Scale-up Trials against *Rhyzopertha dominica*

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In Korea, methyl bromide(MB) has long been used for wood quarantine fumigation, but its ozone-depleting properties, and reported neurological effects on workers have led to increasing restrictions. This study evaluated sulfuryl fluoride(SF) and ethyl formate(EF) as alternative fumigants through scale-up tests($0.5m^3$), focusing on efficacy against *Rhyzopertha dominica* and worker safety during aeration. Experiments were conducted at 23°C using SF at a dose targeting eggs and EF at doses against larvae, pupae, and adults. Scale-up tests achieved complete mortality of all developmental stages of *R. dominica*. After fumigation, concentrations of both fumigants dropped below their TLV within 30 minutes, and below the limit of detection within 1 hour. These results provides data for establising phytosanitary treatment standards to replace MB.

Key words: combined treatment, sulfuryl fluoride, ethyl formate, *Rhyzopetha dominica*

P70

Evaluation of synergistic efficacy of Sulfuryl fluoride and Ethyl formate against egg and pupal stage of *Sitophilus zeamais*

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Wood pellets are widely traded biofuels, but they are frequently exposed to infestation during international transport. In Korea, methyl bromide and phosphine have been applied as standard fumigants; however, MB is being phased out due to its ozone-depleting property and toxicity. Thus, alternative fumigation strategies are urgently needed. In this study, the synergistic effect of combination treatment with sulfuryl fluoride and ethyl formate against *Sitophilus zeamais* was evaluated, based on the results of single-fumigant treatment from previously studied. According to earlier findings, eggs are most tolerant stage to sulfuryl fluoride, whereas pupae are most tolerant stage to ethyl formate. Therefore, this study focused on evaluating synergistic efficacy at egg and pupal stage. However, no significant synergistic effects was observed at either stage. Nevertheless, effective concentrations for controlling all developmental stages were determined through the combination treatment.

Key words: wood pellets, stored product insect, fumigation, maize weevil

P71

Comparative Analysis of Predation Rates of Four Predatory Mite Species on *Frankliniella occidentalis* and Their Susceptibility to Insecticides

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The western flower thrips, *Frankliniella occidentalis*, causes severe economic damage to pepper production through direct feeding and by transmitting tomato spotted wilt virus (TSWV). Chemical control has become less effective due to insecticide resistance, highlighting the need for alternative management strategies within IPM. We evaluated four predatory mite species (*Gaeolaelaps aculeifer*, *Stratiolaelaps scimitus*, *Neoseiulus barkeri*, and *N. californicus*) for their predation rates on *F. occidentalis*. In addition, we assessed the compatibility of five insecticides (neem oil, clothianidin, spinetoram, bifenthrin, and broflanilide) by testing their lethal effects on the predatory mites. Soil-dwelling predatory mites (*G. aculeifer* and *S. scimitus*) exhibited 2–5 times higher predation rates than foliar-dwelling species (*N. barkeri* and *N. californicus*) in a plastic cup assay. In terms of side effects, the relative toxicity ranking of insecticides to predatory mites was: neem oil < clothianidin (IRAC group 4A) < spinetoram (5) < bifenthrin (3A) < broflanilide (30). Neem oil had little effect on predatory mites, whereas broflanilide caused 100% mortality. These findings suggest that combining predatory mites with selective insecticides such as neem oil or 4A compounds could enhance the efficacy of thrips management while maintaining natural enemy populations, thereby supporting sustainable IPM programs in pepper cultivation.

Key words: Biologyical control, Resistance management, Predeatory mite, Eco–friendly pesticide, IPM

P72

Monitoring of honey bee pathogens and evalutaion of potential miticide toxicity to *Aethina tumida* in South Korea

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Aethina tumida, the small hive beetle (SHB), is an invasive pest that infests honey bee colonies, transmits various pathogens, and causes serious damage to apicultural activities. In 2016, SHB was first detected in Miryang, Gyeongsangnam-do, South Korea. Nevertheless, public awareness and scientific research on SHB remain limited in Korea. This study aimed to investigate the presence of 14 honey bee pathogens in SHB specimens collected from Miryang and Jinju during 2024 and 2025. PCR analysis confirmed the presence of Acute bee paralysis virus and *Aspergillus flavus* in Jinju, whereas none of the 14 screened pathogens were detected in Miryang. Pathogen screening revealed that SHB primarily carried honey bee pathogens. The study also evaluated the toxicity of three chemicals commonly used to control *Varroa destructor* (Amitraz, Coumaphos, and Fluvalinate) against both adult and larval stages of SHB. Toxicity assays demonstrated that adult SHBs were more sensitive to the insecticides than larvae. This study presents baseline information on the prevalence of honey bee pathogens and the insecticide sensitivity of SHB in South Korea, offering insights for improved pest control and honey bee health protection.

Key words: honey bee; small hive beetle; invasive pest; honey bee virus; insecticides

P73

Research on dsRNA-Based Pest Control and Stability Enhancers for Managing Diamondback Moth(*Plutella xylostella*)

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dsRNA 기반 작물보호제는 RNA 간섭(RNAi) 기술을 활용하여 특정 해충의 유전자 발현을 차단함으로써, 해충의 생리적 기능을 방해하는 혁신적인 방법이다. dsRNA를 활용한 작물보호제는 화학농약에 비해 환경에 미치는 영향이 적고, 기존 화학농약에 대한 교차저항성이 없다는 장점이 있다. 또한, 방제를 하고자 하는 해충에만 선택적으로 작용하기 때문에 유용곤충 및 미생물에 대하여 안전하다는 점에서 농업 분야에서의 시장 가능성이 높다.

본 연구는 십자화과 작물에 피해를 주는 주요 해충인 배추좀나방(*Plutella xylostella*)을 RNA 간섭을 이용하여 방제하는 목표로 수행되었다. 시험을 위한 공시충은 서울대학교로부터 분양받아 실내 사육조건(온도 24℃, 상대습도 60%, 광주기 16L:8D)하에 계대 사육하였고, 방제활성 평가는 배추좀나방 유충을 이용하여 leaf disc 방식으로 진행하였다. 시험결과 dsRNA를 단독으로 처리하였을 때에는 배추좀나방의 중장에 dsRNA를 분해시키는 dsRNAase와 강염기성 구조로 인해 dsRNA의 충분한 방제 효과를 얻기 어려운 문제점을 확인할 수 있었다. 따라서 dsRNA의 안정성 확보를 목적으로 문헌조사를 통해 보조제(A, B, C)를 선발할 수 있었고, 보조제 혼합 조건에 따른 방제효과를 평가하였다. 평가결과 dsRNA와 각 보조제를 이중 또는 삼중 혼용 처리하였을 때, 기대이하의 살충활성을 나타낸 반면, dsRNA와 각 보조제를 모두 혼합한 사중 혼용 처리 군에서는 96.6%의 우수한 방제가를 나타내어 dsRNA의 적용가능성을 확인할 수 있었다.

이러한 결과를 통해 나비목 해충에 대한 dsRNA와 보조제 혼용을 통해 효과적인 방제가 가능함을 시사 하였다. 향후 연구에서는 dsRNA의 안정성에 대한 추가적인 연구와 제형화에 대한 실험이 필요하다.

검색어: RNAi, dsRNA, *Plutella xylostella*

P74

Regional insecticide susceptibility and detection of target-site mutations in *Tuta absoluta* population from South Korea

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The tomato leafminer, *Tuta absoluta*, a major pest of tomato production worldwide, was first reported in South Korea in 2023 and has since spread rapidly. Its management largely depends on chemical insecticides, raising concerns about resistance development, yet studies on resistance monitoring in South Korea remain limited. We evaluated six registered insecticides (metaflumizone, cyantraniliprole, spinetoram, emamectin benzoate, fluxametamide, and pyridalyl) through bioassays on the Gwangju population collected in 2025 and analyzed mutations at six insecticide target sites from ten regional strains. In bioassay results, Fluxametamide, spinetoram and cyantraniliprole showed the highest performance, causing complete mortality (100%) at the recommended concentrations, whereas pyridalyl, metaflumizone and emamectin benzoate exhibited reduced performance at the recommended concentrations, with mortality rates of 63.3%, 74.4% and 86.7%, respectively, in the Gwangju population. Mutation screening from ten regional strains detected known mutations in Ace1 (A201S), VGSC (M918T, T929I, L1014F), and RDL (A301S), whereas no mutations were detected in RyR, nAChR, and GluCl. These results provide the first baseline of insecticide susceptibility and target site mutations in *T. absoluta* throughout South Korea and will support the development of resistance management strategies. Further insecticide bioassays and mutation screening throughout regions are being conducted.

Key words: Tomato leafminer, Insecticide resistance, Bioassay, Target-site mutation

P75

Mitochondrial Dysfunction and Redox Imbalance Induced by Carbonyl Sulfide in *Tribolium castaneum*

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Carbonyl sulfide (COS) has emerged as a promising alternative to phosphine for controlling stored-product pests, yet its toxicological mechanism remains unclear. We investigated COS action in *Tribolium castaneum* using bioassays, transcriptomic profiling, RNA interference, ultrastructural analysis, and biochemical assays. COS exhibited comparable toxicity against both phosphine-susceptible and resistant strains, and functional assays confirmed that carbonic anhydrase 3 is essential for COS activity. Transcriptomic analysis revealed broad changes in detoxification and mitochondrial genes. Transmission electron microscopy showed mitochondrial damage, including matrix rarefaction and vacuolization. Biochemical assays demonstrated complex III inhibition, compensatory increases in complexes II and IV, ATP depletion, elevated ROS, and increased NAD^+ levels without significant changes in the NAD^+/NADH ratio. Antioxidant assays further indicated impaired hydrogen peroxide detoxification due to suppressed catalase activity. These findings suggest that COS disrupts mitochondrial energy metabolism and redox homeostasis, leading to oxidative stress and cellular dysfunction, and highlight its potential as an effective fumigant.

Key words: Carbonyl sulfide, Carbonic anhydrase, Mitochondrial dysfunction, Oxidative stress, *Tribolium castaneum*

P76

Development of a forecasting model and decision-making system for *Chilo suppressalis* at farm level

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Unpredictable and rapid changes in local weather caused by continuous climatic change increase the variability of crop pest occurrence. Therefore, it is required that a pest decision-making system can reflect real-time weather conditions at each farm level. Even though one of major pests, *Chillo suppressalis*, has caused serious economic damage in rices, its forecasting models has been shunned by Korean farmers due to its low prediction accuracy. Thus, this study was conducted to develop a forecasting model of *Chillo suppressalis* by applying AI techniques, and suggest optimal management timings based on the developed model. The forecasting model was developed with its occurrence data at 167 observation points from 2016 to 2022 and its corresponding weather data by using machine learning techniques. From the developed local model, the information of its occurrence and optimal management timings for *Chillo suppressalis* will be provided to farmers at each farm level by using installed automatic weather system and weather forecasting system of Korean Meteorological Administration. For this system, an integrated system was constructed to control the quality and missing data of automatic weather systems, auto-update the forecasting system, and reflect real-time weather data. This system would increase the management efficiency for *Chillo suppressalis*, and ultimately contribute to stable production of rices in Korea.

Key words: *Chillo suppressalis*, forecasting model, AI-model, rice, optimal management timing

P77

Analysis of Achievements in the Field of Insect and Phytosanitary Treatment of the Plant Quarantine Technology R&D Project by APQA

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To improve the efficiency of the Plant Quarantine Technology R&D Project by APQA, we analyzed achievements from 2020~2024. Average annual budget was 5.1 billion KRW; contract research (55%) exceeded APQA own research (45%). Universities accounted for the largest share (42%). Among four fields, insect & phytosanitary treatment received the highest budget (7.887 billion KRW, 31%). Achievements included 50 papers, 154 presentations, 9 patents, 15 policy proposals, and 10 books. Patent applications and registrations per 100 million KRW were 0.08 and 0.04, below national R&D project. Publications per 100 million KRW were 0.53, 3.1 times higher, with mrnIF 64.03, indicating comparable quality to national R&D project (67.04). To strengthen both scientific and technical outcomes, long-term, large-scale projects should be expanded to promote industrialization and practical application.

Key words: Plant Quarantine Technology R&D Project, achievement, efficiency, insect & phytosanitary treatment

P78

Selection for insecticides in *Riptortus pedestris* with low toxicity for honey bees (*Apis mellifera*)

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Insect growth regulators (IGRs) are chemicals that inhibit the growth of larva during their molting process and lead to their death with less toxic for adult honey bees (*Apis mellifera*) than other insecticides. This study was conducted to evaluate the susceptibility of *Riptortus pedestris* nymphs to six IGRs (3 benzoylureas, buprofezin, 2 diacylhydrazines), as well as the spray toxicity and leaf residual toxicity of 6 insecticides against *A. mellifera* adults. Among all the tested insecticides against *R. pedestris* nymphs, benzoylureas (lufenuron, novaluron, flufenoxuron) showed 100% mortality at 12 day after treatment (DAT). However, the toxicities of buprofezin, methoxyfenozide, tebufenozide were not observed until 30 DAT. Additionally, No significant differences in acute and residual toxicity tests on *A. mellifera* adults were found between the experimental and control groups.

Key words: insect growth regulators, *Riptortus pedestris*, honey bee, *Apis mellifera*

P79

Regional Assessment of Imidacloprid Resistance in *Nilaparvata lugens* (Korea, 2024)

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벼멸구(*Nilaparvata lugens* Stål, 1854)는 해마다 열대 및 아열대 지역에서 저기압 기류를 타고 국내로 유입되어 벼에 피해를 준다. 벼멸구 방제를 위해 농약의 반복 사용으로 약제 저항성이 세계적으로 심화되고 있으며, 특히 이미다클로프리드에 대한 저항성이 확대되고 있다. 본 연구는 2024년 충남 태안, 서천, 전남 진도, 고흥, 경남 고성 등 5개 지역에서 채집한 야외계통과 감수성계통(국립농업과학원 분양)을 대상으로 이미다클로프리드에 대한 저항성 수준을 평가하였다. 농도별 처리 후 사충률을 확인하고 프로빗 분석으로 반수치사농도(LC_{50}, mg/L)를 추정한 결과, 감수성계통은 1.11 mg/L, 야외계통은 46.4~74.6 mg/L였으며, 감수성계통 대비 저항성비(RR)는 41.8~67.2로 나타났다. 이는 이미다클로프리드 저항성을 지닌 집단이 국내로 유입되고 있으며 지역 또는 연도에 따라 이미다클로프리드 저항성 수준에 차이가 있을 가능성을 시사한다. 효과적인 벼멸구 방제를 위해 지역별 저항성 감시를 기반으로 한 맞춤 방제 전략과 지속적인 저항성 관리가 필요하다.

검색어: 벼멸구, 약제 저항성, 이미다클로프리드, 방제, 저항성관리

P80

Insecticide susceptibility of *Myzus persicae* (Hemiptera: Aphididae) populations collected from kimchi cabbage fields in South Korea

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Myzus persicae (Hemiptera: Aphididae) is a destructive pest for agricultural crops worldwide. In this study, we assessed the susceptibility of *M. persicae* to eight insecticides using aphids collected from kimchi cabbage fields in 15 regions in South Korea from 2022 to 2024; a laboratory population was used as a reference strain. For this, lethality at the recommended concentration (RC) of each insecticide and resistance ratio (RR; LC_{50} ratio beween field and laboratory populations) were evaluated. At RC, deltamethrin was the least effective, showing <35% lethality in all field populations. In contrast, sulfoxaflor, spirotetramat, and thiacloprid achieved high lethality (>85%) at RC. However, sulfoxaflor showed an average RR of 7.7, with four populations having >10 of RR, suggesting on-going resistance development despite the high efficacy. Imidacloprid and flonicamid showed the largest variability in lethality at RC, varying by >50% among populations. These results highlight the need for continuous monitoring of insecticide resistance to develop effective management strategies for *M. persicae*.

Key words: insecticide resistance, green peach aphid, pesticide, resistance monitoring, pest management

P81

Monitoring and Proteomic Analysis of Acaricide-Resistant Field Populations of a Two-Spotted Spider Mite, *Tetranychus urticae* (Acari: Tetranychidae), in Korea

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The two-spotted spider mite, *Tetranychus urticae* Koch, is a serious agricultural pest that has developed resistance to many pesticides. In this study, we evaluated the levels of pesticide resistance by comparing the susceptibility of *T. urticae* eggs and adults collected from seven fields (CG, GJ, HS, SJ, OC, PT1, and PT2) with that of a laboratory-susceptible (S) strain. Substantial variation of acaricide resistance were observed among eggs and adults. A proteomic approach combining 2D-PAGE with MALDI-TOF/TOF was used to analyze protein synthesis profiles in *T. urticae*. Forty-five differentially expressed protein spots were identified between the S strain and field populations. In conclusion, our findings provide new insights into the molecular mechanisms underlying acaricide resistance in the two-spotted spider mite.

Key words: *Tetranychus urticae*, acaricide, resistance, proteomics

P82

Investigation of phosphine resistance in *Tribolium castaneum* collected by rice processing complex in South Korea, 2021-2025

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Aluminum phosphide is a common pesticide used to control grain pests in rice processing complex(RPC). However, increasing use of aluminum phosphide caused the occurrence of phosphine-resistant pests globally. In this study, we investigated the occurrence of phosphine-resistance by conducting FAO No. 16 test and Dihydrolipomaide dehydrogenase (DLD) test on *Tribolium castaneum* collected from RPC at 2021 to 2025. Tested pests were collected from 52 regions in South Korea, and phosphine-resistance was confirmed in Eumseong and Jincheon by FAO No. 16 test. As a result of DLD test, 4 regions showed strong resistance (5~87.5%), with Eumseong being the most resistant at 87.5%. These results indicate that continuous inspection of grain storage is required to inhibit the widespread of resistant pest.

Key words: Phosphine, Resistance, Rice processing complex, FAO test, DLD test

P83

Evaluating the Efficacy of RNAi-Mediated Knockdown for Controlling the Pine Wood Nematode

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The pine wood nematode (PWN), *Bursaphelenchus xylophilus*, is the causative agent of pine wilt disease, which inflicts severe ecological and economic damage on global forest ecosystems. Consequently, the development of eco-friendly control agents is a critical priority. This study investigates RNA interference (RNAi) as a sustainable method for PWN control. We conducted a large-scale screening by synthesizing double-stranded RNA (dsRNA) molecules targeting approximately 200 genes. These dsRNAs were delivered to second-stage juvenile PWNs via a soaking method, for which we optimized buffer conditions to maximize uptake efficiency. The nematicidal activity screening successfully identified a significant number of candidate genes. These findings validate that dsRNA-mediated RNAi is a highly effective strategy for precisely targeting PWN, underscoring its potential as a next-generation, environmentally safe alternative to conventional nematicides.

Key words: Pine wilt disease, Pine wood nematode, RNA interference, Gene silencing, Double stranded RNA

P84

Isolation and Purification of a Nematicidal Compound from *Burkholderia*

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Plant-parasitic nematodes pose a significant threat to global food security, creating an urgent need for novel, eco-friendly control agents. This study investigated the nematicidal properties of *Burkholderia* sp. JB-2, whose culture filtrate exhibited high mortality (>80%) against the root-knot nematode *Meloidogyne* sp.. Through a bioassay-guided fractionation strategy, the primary active compound was isolated. Its chemical structure was determined using LC-MS and subsequently confirmed unequivocally by HPLC co-analysis with a commercial standard. The purified compound demonstrated significant, dose-dependent nematicidal activity against *M. incognita*, with notable efficacy observed at a concentration of 1 mM. This research identifies a specific natural product responsible for the potent nematicidal activity of *Burkholderia* sp. JB-2, highlighting its considerable potential as a lead compound for developing next-generation bio-nematicides.

Key words: Plant parasitic nematode, Root-knot nematode, Nematicidal activity, Biological control, *Burkholderia*

P85

Analysis of Invasive ants (Hymenoptera: Formicidae) in Imported Lumber and Plants from Southeast Asia and Central America

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We analyzed ants collected from specific regions in several countries in Southeast Asia and Central America, where imports of plants and lumber are increasing during plant quarantine inspection. There are 52 species (6 subfamilies, 28 genera) including genus *Carebara*, *Dolichoderus*, *Oecophylla*, *Solenopsis* in Thailand and Vietnam, and 26 species (7 Subfamilies, 23 genera) including genus *Lepisiota*, *Platythyrea*, *Solenopsis*, *Wasmannia* in Panama, making a total of 75 species (7 subfamilies, 40 genera). In the present study, we provide a rapid key to the subfamilies of high-potentional invasive ant species collected in the above countries for use in plant quarantine inspection.

Key words: invasive species, identification manual, pest, quarantine

P86

Camelliasaponin A1 and A2 extracted from camellia (*Camellia japonica* var. *japonica*) seeds are key antifeedant compounds against the larvae of diamondback moth (*Plutella xylostella* L.)

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Plutella xylostella (diamondback moth) is a major pest of cruciferous crops, causing substantial global economic losses. Therefore, this study aims to isolate natural antifeedant compounds from *Camellia japonica* seeds and evaluate their bioactivity against third-instar larvae of *P. xylostella*. The ethanolic extract of *C. japonica* seeds exhibited strong antifeedant activity, with a 50% antifeedant concentration (AFC_{50}) of 128 ppm. LC-MS/MS analysis of the extract identified major constituents, including disaccharides (17%), kaempferol glycosides (12%), camelliasaponin A1 (10%), camelliasaponin A2 (11%), and other triterpenoid glycosides. Subsequent medium-pressure liquid chromatography (MPLC) fractionation of the extract produced five fractions, one of which showed antifeedant activity at 125.0 ppm. This active fraction contained high levels of camelliasaponins A1 (5,031 ± 286 ppm) and A2 (6,053 ± 185 ppm). Authentic camelliasaponin A1 and A2 also showed potent antifeedant activity against *P. xylostella* larvae, with AFC_{50} values of 5.4 ppm and 3.6 ppm, respectively, both lower than that of neem-derived Azadirachtin (AFC_{50} = 12.4 ppm). These findings confirm that camelliasaponin A1 and A2 are the principal active antifeedant constituents in *C. japonica* seed extracts. Overall, the findings highlight the potential of camellia seed extracts for development into environmentally friendly formulations for integrated pest management targeting lepidopteran larvae.

Key words: Antifeedant activity, *Camellia japonica*, Camelliasaponin, *Plutella xylostella*

P87

Seasonal Surveillance of Tick-Borne Pathogens in Yeongam and Gunsan, Republic of Korea (May to July 2025)

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Ticks (Ixodidae) are important hematophagous vectors of pathogens including severe fever with thrombocytopenia syndrome virus (SFTSV), *Rickettsia*, *Borrelia*, and *Bartonella*. This surveillance was from May to July 2025, during which adult ticks were collected once a month from four environments (grassland, mountain road, copes, grave) at Yeongam and Gunsan, Republic of Korea (ROK). The collected ticks were morphologically identified, pooled (≤ 5 ticks per pool), extraction to nucleic acid for pathogen detection using real-time polymerase chain reaction (PCR) and calculated for minimum infection rate (MIR). A total of 431 ticks were collected, of which 106 pools contained *Haemaphysalis longicornis* (376 ticks, 87.24%), the dominant species. The highest number of ticks was collected in May from grassland in Gunsan (*H. longicornis*, 75 ticks, 15 pools). All samples were negative for SFTSV, *Borrelia*, and *Bartonella*; however, *Rickettsia* was detected in 39 pools. The overall MIR for *Rickettsia* was 9.05%, with a maximum MIR of 46.15% observed in May at Yeongam. This study provides baseline data on regional and environmental differences in tick populations as well as their associated pathogens. This information is expected to inform future tick surveillance and vector control strategies in ROK.

Key words: tick, minimum infection rate, pathogen, rickettsia, seasonal surveillance

P88

First report of parasitism of *Orthaga olivacea* (Lepidoptera: Pyralidae) by *Phanerotoma flava* (Hymenoptera: Braconidae)

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Orthaga olivacea (Warren, 1891) (Lepidoptera: Pyralidae) is a major pest of *Machilus thunbergii* and *Cinnamomum camphora* (Laurales: Lauraceae). Its shelter-building behavior reduces the efficacy of insecticides, making management difficult. Accordingly, alternative control methods are needed to overcome the limitations of chemical control. This study identified a newly discovered parasitoid from *O. olivacea* and investigated the emergence rate of the host moth, the parasitism rate of the parasitoid, and its emergence patterns.

The parasitoid was identified as *Phanerotoma flava* Ashmead, 1906 (Hymenoptera: Braconidae) based on morphological characteristics and COI DNA barcode analysis. In 2024, the emergence rate and the parasitism rate were 47.2% and 18.7%, respectively, whereas in 2025 the rates decreased to 16.9% and 2.4%. Adult host moths emerged from mid-June to early August in both years, with peak abundance observed in early to mid-July. The parasitoid emerged about 3-10 days later than the host, occurring from late June to early August. These findings suggest that *P. flava* has potential as a biological control agent against *O. olivacea* and provide fundamental information for establishing pest management strategies for *M. thunbergii*.

Key words: *Machilus thunbergii*, *Orthaga olivacea*, *Phanerotoma flava*, parasitoid, DNA barcode

P89

Survey of flying insect diversity in vineyard under organic conversion

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Organic grapes in South Korea are expected to have increasing economic value in the future, as the organic market continues to grow annually and grapes are one of representative export agricultural products of South Korea. In organic farming, pest management relies on ecosystem services derived from on-farm vegetation management, which increase biodiversity of the farm. Although pest management through biodiversity is important, related studies remain limited. We surveyed flying insects in three vineyards undergoing conversion to organic farming. Insects captured using sticky traps were identified and counted, and comparisons were made according to the environmental conditions and cultivation practices of each vineyard. The diversity of flying insects differed among the three vineyards, which was likely influenced by differences in cultivation practices and the varying potential for external insect influx between greenhouse and field cultivation.

Key words: organic vine, biodiversity of organic farming, flying insect fauna

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P90

Effects of organic cultivation environment of floury rice fields on the community structure and ecological function of benthic macroinvertebrates

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Benthic macroinvertebrates play ecologically important roles in rice paddy ecosystems. This study aimed to evaluate how the cultivation environment of organically grown floury rice affects the community structure and ecological function of benthic macroinvertebrates. Field surveys were conducted twice in July 2024 at the experimental rice paddies of the National Institute of Agricultural Sciences using a D-frame net. We analyzed the community characteristics and functional traits of benthic macroinvertebrates collected from these sites. In the community analysis, the diversity index was significantly higher in plot A4 during the first survey. However, the lowest richness and evenness indices were recorded in plot A1 during the second survey. Functional group analysis revealed distinct distributions of ecological functions depending on the cultivation environment. These results indicate that the organic cultivation environment for floury rice significantly influences the composition and ecological function of benthic macroinvertebrate communities.

Key words: benthic macroinvertebrate, ecological function, floury rice, organic farming, rice field

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P91

A Trade-off Between Beetle & Weed Diversity and Management Costs in Agricultural Land

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Agricultural expansion and chemical inputs have degraded air, soil, and water, driving biodiversity loss. To mitigate these impacts, eco-friendly farming has been promoted as an alternative to conventional systems. We examined beetle and non-crop weed communities on Jeju Island across two farming systems (eco-friendly vs. conventional) and land-use types (arable fields vs. orchards). Eco-friendly farming supported higher beetle richness (+50%) and abundance (+78%), along with greater weed richness (+54%) and coverage (+94%). Both farming system and land use significantly shaped species richness, abundance, and community composition. However, increased weed cover and the presence of certain pest species suggest higher management costs. These results underscore trade-offs in eco-friendly farming, where biodiversity gains must be balanced against economic sustainability.

Key words: agriculture, beetle, eco-friendly, trade-off, weed

P92

Temperature-Dependent Development Model and Seasonal Occurrence of *Spodoptera litura* (Lepidoptera : Notuidae)

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Spodoptera litura (Fabricius, 1775) (Lepidoptera: Noctuidae) is a representative polyphagous pest widely distributed in temperate and subtropical regions of Asia and Australia, causing serious damage to various crops, vegetables, and ornamental plants. Damage has been reported on more than 140 plant species, and its high resistance to insecticides makes it one of the most difficult pests to control. In this study, developmental experiments of *S. litura* were conducted under five constant temperature conditions (15, 20, 25, 30, 35 ± 1°C; 60 ± 5% RH; 16L : 8D), and seasonal adult occurrence was monitored using sex pheromone traps. The results showed that the lower developmental threshold was 11.7°C, and the effective accumulated temperature was 625.0 degree-days (DD). Field monitoring in Wanju, Jeonbuk Province, revealed that the first occurrence of adults was on May 7 in 2023 and on May 6 in 2024, while peak occurrences were observed on September 2 and August 29, respectively.

Key words: *Spodoptera litura*, Lepidoptera, Lower developmental threshold, Degree day

P93

Volatile organic compounds of four Lamiaceae species and oviposition host preference of *Pyrausta panopealis* Walker(Lepidoptera: Crambidae)

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In this study, four representative Lamiaceae plants commonly cultivated or used as ornamentals in Korea-perilla, basil, rosemary, and lavender-were selected to investigate factors influencing host selection of Pyrausta panopealis. Volatile organic compounds(VOCs) emitted from each plant were analyzed using GC–MS to identify chemical cues associated with oviposition preference. Host suitability was further evaluated through no-choice tests with single-plant treatments, while dual-choice assays were conducted to classify plants as primary hosts, secondary hosts, or non-hosts. The results provide insights into the role of plant-emitted VOCs in oviposition site selection by female P. panopealis and offer a basis for developing effective pest management strategies.

Key words: volatile organic compounds, oviposition host preference, *Pyrausta panopealis*

P94

A Novel Data-Driven Phenology Modeling for an Invasive Longhorn Beetle Using Citizen-Science Records

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Accurate timing of insect emergence, especially for invasive pests, is critical for surveillance and timely interventions. Yet, many species lack experimental developmental data required for traditional phenology models. Here, we present an empirical, binary logistic regression model that predicts the first adult emergence of the invasive beetle *Anoplophora horsfieldii* using citizen-science occurrence data (iNaturalist) and degree-day accumulation. To balance sensitivity to early emergence and biological realism, we developed a dual-binning strategy: 10 DD bins for emergence onset and 20 DD bins to estimate saturation thresholds, with full emergence scores beyond identified saturation points. The estimated logistic model of slope = 0.0146 and intercept = -14.471 yielded a 50% emergence probability at 990.0 DD and demonstrated robust fit (Likelihood Ratio = 214.2 with P <0.0001, c-statistic (AUC) = 0.994). The model was validated using independent field observations from Jeju Island (2024 and 2025), which fell within the early transition zone (21.8 % emergence probability). In validation using independent 2025 citizen-science data, ROC analysis yielded an AUC (Area Under the Curve) of 0.990, indicating excellent discriminatory ability of the model. Our results highlight that meaningful emergence predictions can be achieved from fragmented, presence–absence data, offering a data-driven tool for early detection and biofix estimation of non-native pests. This framework is applicable across taxa and geographies, enabling scalable, real-time phenology forecasting in data-limited contexts.

Key words: *Anoplophora horsfieldii*, Phenology model, degree-days, early detection, dual-bin strategy

P95

Molecular identification of *Inostemma seoulis* and *Platygaster matsutama*, parasitoid wasps of the pine needle gall midge (*Thecodiplosis japonensis*)

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Thecodiplosis japonensis (pine needle gall midge, PNGM) is a major forest pest in Korea, causing severe damage to pine trees through larval feeding, which leads to wilting and death. Although parasitoid wasps have been utilized for the biological control of PNGM, their extremely small size makes morphological identification challenging. In this study, we developed a molecular identification method for two dominant parasitoid species, *Inostemma seoulis* and *Platygaster matsutama.* Species-specific primer sets were designed based on *COI* sequences. Molecular detection revealed parasitism of *I. seoulis* in 23% and *P. matsutama* in 6.9% of PNGM larvae that exhibited no visible signs of infection, while no cases of multiparasitism were observed. These results provide a molecular framework for rapid and accurate species-level identification of parasitoid wasps associated with PNGM.

Key words: *Thecodiplosis japonensis*, *Inostemma seoulis*, *Platygaster matsutama*, molecular identification, *COI*

P96

A Short Review on the Species and Damage of Bark and Ambrosia Beetles (Coleoptera: Scolytinae) Distributed in Korea

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Since the first record of 51 species in 1929, about 171 species of Scolytine beetles have been documented in Korea. In the past, these beetles were mainly recognized as pests of stone fruit trees and received little attention in forests compared to lepidopteran pests. A review of published studies (1980–2024) shows that out of the 169 species historically recorded in Korea, 49 species have been consistently observed in the field, indicating their continuous presence. Frequently recorded species include Hylastes plumbeus, Hypothenemus eruditus, Ambrosiodmus rubricollis, Ambrosiophilus atratus, Xyleborinus saxeseni, and Xylosandrus germanus, while species with high trap abundance include X. saxeseni, Cnestus mutilatus, X. germanus, X. crassiusculus, Cyclorhipidion bodoanum, and Euwallacea validus.

Field monitoring was conducted in Jeju Island forests using ethanol- and pheromone-baited traps from April to August 2024. The dominant species observed were Scolytoplatypus mikado, Amasa amputatus, and Xylosandrus crassiusculus. Recently, concerns have grown over potential outbreaks due to climate change. In 2024, a severe outbreak occurred in the protected forest of Mt. Sanbangsan, Jeju Island, where about 380 Castanopsis sieboldii trees were killed. This highlights the urgent need for proactive monitoring and integrated management strategies to prevent large-scale forest damage.

Key words: Scolytine, monitoring, Bark and ambrosia beetles

P97

Seasonal and Habitat Dynamics of Blowfly Assemblages (Diptera: Calliphoridae) in Southern South Korea

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Blowflies (Diptera: Calliphoridae) are among the earliest insects to colonize cadavers and provide critical evidence for estimating the postmortem interval (PMI) in medicolegal investigations. This study investigated seasonal and habitat-related variations in blowfly assemblages across 14 regions of southern South Korea. Field surveys were conducted twice monthly from June 2022 to December 2024 using mouse cadavers as bait. A total of 17,087 adult blowflies, representing 15 species from six genera, were collected. The SOM analysis showed that community composition varied seasonally, with species-level relative abundance also showing seasonal shifts. In spring, *Lucilia illustris* (43.0%) dominated in urban areas, whereas *Lucilia porphyrina* (28.0%) was most abundant in forested habitats. During summer, *Chrysomya megacephala* (32.9%) predominated in urban sites, while *Chrysomya pinguis* (45.1%) dominated in forests. In autumn, *Ch. megacephala* was the leading species in both urban (44.1%) and forested (47.3%) areas. Notably, the occurrence of *Ch. megacephala* showed no significant difference between habitat types ($p = 0.632$) but exhibited pronounced seasonal variation ($p < 0.000$). In winter, *Ch. megacephala* was recorded exclusively on Jeju Island, a pattern potentially associated with ongoing climate warming and its influence on species persistence. These findings provide foundational insights into the ecological distribution of blowflies and highlight the importance of incorporating both seasonal and habitat factors into PMI estimation in forensic entomology.

Key words: Medico-legal entomology, Calliphoridae, Seasonal variation, Habitat, Self-Organizing Map

P98

The Role of Predatory Insects in Early Carcass Decomposition and Its Implications for Post-Mortem Interval Estimation

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In medico-legal entomology, post-mortem interval (PMI) estimation primarily relies on the development of early-arriving insect communities, particularly necrophagous flies. Yet, under natural conditions, predatory insects can profoundly disrupt fly colonization and reshape decomposition dynamics. This study evaluated the impact of predatory interference on early carcass decomposition in a Korean forest using frozen–thawed mice (*Mus musculus*), assigned to either predator-excluded or predator-exposed groups. The two treatments produced distinctly different decomposition outcomes. In the predator-excluded group (initial weight: 23.5 g), necrophagous flies (*Lucilia papuensis*) established typical maggot masses, with mass loss remaining below 4.3% (1.0 g) after 24 hours. By contrast, in the predator-exposed group (initial weight: 21.0 g), intensive feeding by the invasive Asian hornet (*Vespa velutina*) resulted in the removal of 42.9% (9.0 g) of carcass mass within 24 hours. The residual carcass was subsequently dominated by ant colonies, which actively preyed upon and removed first-instar fly larvae, thereby severely limiting further colonization. These findings reveal a critical ecological shift from biochemical decomposition to physical biomass removal under predator pressure, together with a pronounced suppression of primary decomposers. Consequently, PMI estimates based solely on fly larval development risk underestimating the actual time since death if early predator interference is overlooked.

Key words: Medico-legal Entomology, Predatory insects, Carcass decomposition, PMI, *Vespa velutina*

P99

Application of environmental DNA as a screening tool for soil toxicity test using Collembola

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As the number of emerging chemicals grows, alternative approaches are needed to complement traditional toxicity tests that require considerable labor and cost. The application of environmental DNA (eDNA), genetic material shed by organisms into the environment, in toxicity test holds promise for rapid and cost-effective evaluation of pollutant effects. This study established a soil toxicity test using eDNA of *Allonychiurus kimi* and assessed its feasibility. Conventional and eDNA-based toxicity tests conducted for four heavy metals (As, Pb, Cd, and Cu) exhibited dose-dependent responses. EC_{50} values were comparable between the tests for As, Pb, and Cd, whereas Cu showed a lower EC_{50} in the eDNA-based test. These results demonstrate that the eDNA-based toxicity test exhibits sensitivity similar to that of conventional approaches. This supports its applicability as a screening tool for soil toxicity testing.

Key words: eDNA, soil toxicity test, Collembola, screening tool, pollutant

P100

Survey of Insects in the Andong Area Using Light Traps

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As part of the 2025 National Ecosystem Survey, nocturnal insect surveys were conducted in the Andong region of Gyeongsangbuk-do, Korea. To collect nocturnal insects, light traps were installed at selected sites with well-preserved vegetation. As a result, Lepidoptera and Coleoptera were the predominant groups collected. The result of this study are expected to provide basic data on the nocturnal insect fauna of the Andong region and to be utilized in related applied fields.

Key words: Andong, insect, light trap, taxonomy, Korea

* This work was supported by a grant from the National Institute of Ecology (NIE), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIE-A-2025-01).

P101

Development of an occurrence prediction model and suggestion of optimal pesticide application timing for *Riptorus clavatus*

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Continuous climatic change affected outbreak of *Riptortus clavatus* in soybeans, which caused economic damages and excessive pesticide uses for soybean production. Thus, a forecasting model of *R. clavatus* was developed using machine learning techniques. A total of 67 data sets of bean bug catches by pheromone traps and daily average temperature at corresponding locations were obtained from the Rural Development Administration and the Korea Meteorological Administration, respectively. Of the 67 data sets, 57 sets from 2016-2023 were used for model training, and 10 sets from 2024 for model validation. The developed model showed high prediction accuracy resulting in average 3.6-day difference between predicted and actual occurrences of *R. clavatus* adults. The degree-days required for development of the first instar stage from the adult occurrence which was estimated from the developed model was calculated using a population dynamics model previously published in the literature. The optimal timings for insecticide applications were determined based on the predicted timings for the first instar stage development. To prevent unnecessary pesticide application, the model also considered the potential damage period. This approach would reduce unnecessary pesticide applications and increase efficiency for *R. clavatus* management, and ultimately contribute stable productions of soybeans in Korea.

Key words: Soybean, *Riptortus clavatus*, machine learning, degree-day model, optimal management timing

P102

Hatchability of *Allonychiurus kimi* (Collembola: Onychiuridae) according to the microbial food sources

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In a previous experiment, *Allonychiurus kimi* (Collembola: Onychiuridae) exhibited dispersal movement away from feeding sites after having consumed food sufficiently. This post-feeding movement is hypothesized to represent a precautionary behavior to reduce the risks associated with egg-laying in high-density microbial environments. As microbivores, collembolans are drawn to nutrient-rich areas that may also harbor opportunistic pathogens or harmful defensive compounds. Building on this, the present experiment was conducted to test hatchability under different food conditions. Egg hatchability was compared across five conditions: no food treatment (baseline), yeast, and three different cyanobacteria species. The results showed a severe reduction in hatchability on the yeast substrate (1.7% of baseline). Unlike yeast, hatching rates on the cyanobacteria substrates varied, ranging from neutral (100% of baseline) to significantly reduced (43% of baseline). These results indicate that the observed post-feeding movement is not solely a mitigation of crowding stress or predator-avoidance behavior for adult survival. Instead, it could function as a precautionary reproductive strategy that potentially enhances offspring survival by allowing females to lay eggs in a microbially safer environment, away from potential hazards.

Key words: Collembola, *Allonychiurus kimi*, Hatchability, precautionary behavior

P103

Assessment of pathogenicity of *Metarhizium phasmatodea* against *Ramulus mikado* and non-target insects

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Recent outbreaks of the stick insect, *Ramulus mikado* in the Seoul metropolitan area continue to damage forests. Conventional controls, including sticky traps and chemical insecticides, has problems in use over large areas and resulted in environmental concerns. Eco-friendly alternatives are needed and we tested the pathogenicity of entomopathogenic fungi, *Metarhizium phasmatodea* isolated from dead *R. mikado* in Mt. Cheonggyesan in 2022. Susceptibility and survival rate of *R. mikado* eggs, 3rd instars, and adults were tested at 1×10^4–10^8 conidia mL^{-1}. For non-target insects, the same treatments were applied to cockroaches, *Blattella nipponica* and crickets, *Gryllus bimaculatus*. Stick insects showed dose-dependent mortalities, while no difference was found in the non-target insects.

Key words: stick insect, entomopathogenic fungi, virulence, *Blattella nipponica, Gryllus bimaculatus*

* This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202510201).

P104

Relationship between water stress of *Prunus* × *yedoensis* and occurrence of *Aromia bungii* (Coleooptera: Cerambycidae)

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Prunus × *yedoensis* is an abundant roadside tree species in South Korea, but infestation by *Aromia bungii*, which resulted in tree death, has recently increased. This study examined the indice of tree water status, such as electric resistance on stem and water potential on tree crown, either beetle-infested and not infested trees. From late June to late July 2025 as the beetles' activity season, the monitoring of the water stress of *P. yedoensis* was conducted. Stem water stress was measured by a Jun's meter, while crown water potential was measured by a PMS 600 pressure chamber. Crown water potential was significantly lower in infested trees compared to non-infested trees ($p < 0.001$), while stem electrical resistance was significantly higher in infested trees ($p < 0.01$). These results indicate that *A. bungii* infestation appeared to be associated with tree water stress, and crown water potential may be more sensitive to beetles' infestation.

Key words: longhorn beetle, tree borers, urban tree, water stress, tree condition

P105

Occurrence of stored-product insects in Rice Processing Complex(RPC) in South Korea, 2021-2025

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Stored-product insect pests, which can degrade grain quality and negatively impact international trade, are a persistent problem in grain storages. This study aimed to investigate the occurrence of grain pests in rice processing complex(RPC). Identification of stored-product insect pests belonging to the orders Coleoptera and Lepidoptera, collected from RPC in 51 regions across South Korea between 2021 and 2025, has been performed through morphological classification and COI barcoding. The survey revealed 26 species from 10 families of Coleoptera, with *Tribolium castaneum*, *Attagenus unicolor japonicus*, and *Alphitobius diaperinus* being the most frequently observed. For Lepidoptera, 7 species from 4 families were identified, with *Cadra cautella, Plodia interpunctella,* and *Nemapogon granellus* being the most common. Continuous and systematic monitoring is required to track changes in the occurrence of stored-product insect pests in South Korea.

Key words: Rice processing complex, Stored-product insects, Coleoptera, Lepidoptera

P106

Development of system dynamics model for exploring relationships between *Bursaphelenchus xylophilus* and various factors in forest ecosystem

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Pine wilt disease is a fatal forest pest that kills pine and larch trees. It is caused by *Bursaphelenchus xylophilus*, which invades trees through its vector, *Monochamus alternatus*. This invasion disrupts the transport of water and nutrients, ultimately killing the tree. The disease poses a severe threat to pine forests on the Korean Peninsula, causing significant ecological disruption and devastating losses to the forestry and related economies. This study noted that the spread of pine wilt disease is a complex process influenced by a mix of biological, environmental, economic, and human factors, which are often accelerated by unpredictable events like wildfires and landslides. To understand the relationships among these components, a system dynamics model was used based on the dynamics of pests and diseases within the forest ecosystem. This computer-aided approach is designed to help people make better decisions when confronted with complex, dynamic systems. By selecting key factors associated with pine wilt disease, this study established a quantitative model and, through simulation, analyzed how the dynamics of the pests and diseases change over time.

Key words: system dynamics model, simulation, pine tree, *Monochamus alternatus*, *Bursaphelenchus xylophilus*

P107

Assessment of the Probiotic Suitability of Native *Lactiplantibacillus* Strains for their Honey Bee Host (*Apis mellifera*)

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Honey bees (*Apis mellifera*), vital agricultural pollinators, face population declines from numerous stressors. While their gut microbiota, especially lactic acid bacteria (LAB), is integral to bee health, novel strains remain underexplored. This study addresses this gap by isolating *Lactiplantibacillus* sp. IBT15 from honey bee guts and systematically assessing its probiotic potential. The isolate demonstrated robust growth under bee-relevant conditions (pH, temperature, and sucrose concentration) and was evaluated for a comprehensive suite of probiotic traits, including aggregation, antioxidant activity, and organic acid production. Safety was confirmed through hemolytic activity and antibiotic susceptibility assays. Overall, the strong probiotic characteristics and safety profile of IBT15 establish it as a potential candidate for the development of bee-specific probiotics.

Key words: Honeybee, Gut microbes, Lactic acid bacteria, Probiotics, *Lactiplantibacillus*

P108

Isolating Polyurethane-Degrading Bacteria from the Red-veined Darter, *Sympetrum fonscolombii*

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Insect gut microbiota are essential for host nutrient acquisition and environmental adaptation. In this study, we isolated intestinal strain from the Red-veined Darter (*Sympetrum fonscolombii*), *Pseudomonas* sp. IBT50, capable of degrading polyurethane. This strain effectively degraded various PU types, including polyester-, polyether-, and polyacrylic urethane. Biodegradation was validated through weight loss, scanning electron microscopy, Fourier transform infrared spectroscopy, and metabolite analyses. Notably, extracellular esterases were found to exhibit polyurethane-degrading activity. Furthermore, transcriptome analysis revealed that the strain employed distinct survival strategies under PU exposure. These results suggest that insect gut microbes contribute to host ecological resilience through their metabolic diversity and provide novel insights into the biodegradation of persistent environmental substrates.

Key words: Red-veined Darter, Polyurethane, Biodegradation, Insect gut symbionts, Plastic waste management

P109

Thermal Buffering Effect of Honey Storage Cells in Honeybee Comb

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The thermal role of stored honey in combs was investigated using 64 sensors embedded within colonies. From August 1–12, 2025, outdoor air temperatures in Jeonju fluctuated widely (21–36 °C), far outside the brood-rearing optimum (34–35 °C). Comparison between an empty comb cell and a honey-filled cell revealed striking differences. The honey-filled comb maintained a higher mean temperature (34.3 °C) with minimal fluctuation (±0.5 °C), consistently aligned with brood-compatible conditions. In contrast, the empty comb exhibited lower mean temperatures (31.5 °C) and larger daily oscillations (~6.5 °C), reflecting external variation. These findings demonstrate that stored honey provides a strong thermal buffering effect, stabilizing the comb microclimate against external fluctuations and supporting brood development. This insulating function of honey storage highlights an adaptive advantage in colony thermoregulation and offers a potential reference for smart hive design.

Key words: Honeybee comb thermoregulation, Thermal buffering, Honey storage cells, Smart hive design

P110

Development of the elite strain "An-Sim-Ae" of the edible insect *Tenebrio molitor* Linnaeus through selective breeding

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The yellow mealworm (*Tenebrio molitor*) must be harvested at the larval stage, but frequent pupation at shipping stage increases labor costs and reduces product quality. To address this issue, we performed individual-based selective breeding emphasizing delayed pupation and enhanced larval growth, resulting in the Go110 line (variety name: "An-Sim-Ae"). Under controlled conditions, Go110 outperformed other strains across three generations, with maximum advantages of +83 mg in larval weight, +108 mg in pupal weight, and +85 mg in adult weight compared with the control. The larval duration was extended by up to 24 days, and at the shipping stage (10–13 weeks) Go110 exhibited more than 70% lower pupation rates. These traits allow larvae to remain marketable until delivery, improving shipment uniformity while reducing pupation-related losses and labor costs. Future breeding programs will build on Go110 to develop additional lines with improved productivity and efficiency for industrial applications.

Key words: *Tenebrio molitor*, selective breeding, delayed pupation, larval body weight, productivity

P111

Experimental evaluation of pathogenicity and transmission routes of *Gryllus bimaculatus* Densovirus in South Korea

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Gryllus bimaculatus densovirus (GbDV) has recently emerged as a major pathogen in South Korean cricket farms. We conducted injection, ingestion, airborne exposure, and proportion-dependent assays to evaluate pathogenicity and transmission. Injection resulted in rapid mortality, with extremely high viral loads detected prior to death. Oral ingestion, even at 1:1000 dilution, significantly reduced survival, whereas airborne exposure had no significant effect under laboratory conditions. In proportion-dependent assays, higher proportions of infected individuals accelerated colony mortality, confirming the strong transmissibility of GbDV. These findings demonstrate the high patogenicity and transmissibility of GbDV and underscore the urgent need for effective disease management strategies in cricket farming.

Key words: disease management, *Gryllus bimaculatus* densovirus, pathogenecity, transmission

P112

Effects of an Insect-Based After-School Program on Children

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As of 2024, Neulbom School is operating in 6,185 elementary schools and 178 special education schools nationwide. Insect resources can be integrated with the "Animal Life Cycle" curriculum in third-grade science, making them highly curricularly appropriate and a preferred educational resource for both children and teachers. This study aimed to explore the impact of insect-based programs within the Neulbom School system on lower elementary school children. Pre- and post-test questionnaires analyzed through field application revealed improvements in emotional regulation, school adaptability, and agricultural sensitivity ($p<0.05$). Future efforts should include developing integrated insect programs that consider child developmental stages and curriculum alignment, training insect specialist instructors, and developing operational manuals.

Key words: neulbom school, insect experience, school adaptability

P113

Healing Effects with Insects in Elderly Care

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There is evidence that insect-based healing programs have a positive effect on the health of elderly people. Insedct are diverse, relatively inexpensive, and do not require much space. This study aims to examine the effect of insect-based healing programs for the health of the elderly. Elderly people raised crickets (*Teleogryllus emma*) by themselves for 8 weeks after pre-training and participated in various experintial activities. Rusults showed that for the group of healthy elderly people aged 65 years or older, the activity in the brain area of the Quality of Life and Geriatric Depression Scale (GDS) was increased as assessed using a questionnaire and fMRI. And the group of choronically ill people aged 70 years or older who wsed nursing facilities, the Insomnia Index (ISI) and average sleep time were significantly Improved. Pet insects are effective resources to apply to AAT. It is also showed that elderly people have a positive effect on improving the mental health and sleep function of the elderly.

Key words: insects, healing program, aged people

P114

Effect of an Insect-Based Therapeutic Program on Multiculturea Adolescents

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A visual-focused insect therapy program was developed and implemented for youth from multicultural families. The program ran for four sessions from June to July 2025. A color art therapist collaborated with the program, incorporating art activities combined with physical movement to encourage emotional engagement and expression. Pre- and post-test questionnaires showed increases in participants' life satisfaction and happiness ($p<0.05$). These results suggest the positive potential of an integrated insect therapy program for emotional support for youth from multicultural families, and we anticipate its active use in therapeutic agriculture and educational settings.

Key words: insect therapy, therapeutic agriculture, sensory stimulation

Poster Presentation
Non-Competition

P115

Taxonomic revision of the genus *Syntormon* Loew (Diptera: Dolichopodidae) from Korea

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Until now, only one species of the genus *Syntormon* Loew, 1857, *S. violovitshi* Negrobov, 1975, had been reported from Korea. This genus can be easily identified from other genera by small thumb-shaped projection which inserted inner side of the postpedicel of antenna. During the taxonomic survey of Korean fauna, authors found two first recorded species in Korea, *S. flexibilis* Becker, 1922 and *S. monochaetus* Negrobov, 1975. Descriptions and figures of external features of first recorded species and key to species of genus *Syntormon* in Korea are provided here.

Key words: Sympycninae, long-legged fly, identification key

* This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBRE202501).

P116

Three New Species of Nolidae (Lepidoptera) from Palawan Island, the Philippines, with Checklists of the Genera *Wittonola*, *Aeneanola*, and *Evonima*

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During three field trips to the northern part of Palawan Island, we found three new nolid species. In this study, three genera (*Wittonola* Laszlo, Ronkay & Ronkay, 2015; *Aeneanola* Laszlo, Ronkay & Ronkay, 2013; and *Evonima* Walker, 1865) are newly reported from Palawan Island, the Philippines; among them, the first two genera are new to the Philippines. As a result of this study, the number of *Wittonola* species increases to 2, *Aeneanola* to 5, and *Evonima* to 19 in the world. Consequently, this paper contains three newly recorded genera (*Wittonola* Laszlo, Ronkay & Ronkay, 2015; *Aeneanola* Laszlo, Ronkay & Ronkay, 2013; and *Evonima* Walker, 1865) and each new species (*W. bicyana* sp. nov., *A. crassa* sp. nov., and *E. palawanensis* sp. nov.) from Palawan, the Philippines.

Key words: Oriental region, Distribution, new record, Cleopatra's needle, Nolinae

P117

Taxonomical History and Ecological Characteristics of *Meganola major* (Hampson, 1891), A Recent Outbreak in Korea

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The Korean species of *Meganola major* (Hampson, 1891) is taxonomically reviewed. This species has been widely distributed in the Old World realm, but mainly in the Oriental region. Recently, a large outbreak of the species has been confirmed in Jeollanam-do, where it has been found to cause damage to *Lagerstroemia indica* Linnaeus (Crepe-myrtle) and *Juglans mandshurica* Maxim (Monkey nuts). The taxonomic history of this species in Korea is complex, and this paper aims to confirm it exactly. In addition, brief ecological characteristics based on observation are given.

Key words: Lepidoptera, Nolidae, Nolinae, History, Taxonomy

P118

First record of the subfamily Tethininae (Diptera: Canacidae) with genus *Tethina* from Korea

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True flies of the family Canacidae, commonly known as beach flies, surf flies, and surge flies, are generally small and inhabit coastal environments. Approximately 300 species in six subfamilies are described worldwide. The subfamily Tethininae comprises over 100 species, mostly halobionts and thalassobiont flies. Adults are commonly found in the intertidal and supralittoral zones. Previously, the subfamily Tethininae had been treated as a distinct family from Canacidae, but McAlpine (2007) downgraded the family-group name Tethinidae to a junior synonym of Canacidae *sensu lato*. The genus *Tethina* is one of the largest genera within the group, with nearly 80 species described worldwide. In this study, the subfamily Tethininae is recorded for the first time in Korea represented by one previously unrecorded species, *Tethina saigusai*. Morphological diagnosis and photographs are provided herein.

Key words: Taxonomy, Diptera, Canacidae, Tethininae, *Tethina*

P119

Discovery of bamboo shoot pest of genus *Kumasia* Sugi, 1982 (Lepidoptera: Noctuidae) from Korea

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In this study, bamboo shoot (*Phyllostachys edulis*) borers, of the genus *Kumasia* Sugi, 1963 are newly recognized. They bore into soft upper parts of bamboo shoots, causing wilting and serious damage. The *Kumasia*, an Asian genus with a range from oriental to east, comprises six species. So far, the genus has not been reported from Korea. The present study reviews the taxonomic history of *Kumasia* and its higher rank, the tribe Apameini, including a detailed description of the newly recorded species. A checklist and distribution map for the genus are also provided.

Key words: Forest pest, Noctuinae, Apameini, taxonomic review, redescription, barcoding

P120

First Record of Rhamphomyia trilineata (Diptera: Empididae) in Korea

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The genus Rhamphomyia Meigen, together with Empis Linnaeus and Hilara Meigen, is one of three megadiverse genera within Empididae. The family Empididae currently comprises nearly 5,000 described species worldwide, including about 600 species in the genus Rhamphomyia. most of which are described from the palaearctic; many additional species across the family remain undescribed. In Korea, Rhamphomyia was first documented by Barták (1997), who reported four new species and five species newly recorded for the country. Here we add Rhamphomyia trilineata Zetterstedt, 1885 to the Korean fauna, based on material collected on Gohado Island, Mokpo (Jeollanam-do). We provided diagnostic characters of the adult male, including morphological diagnosis and photographs. We also provided mitochondrial DNA(COI), enabling rapid and accurate species identification.

Key words: Dance flies, Empidoidea, Newly Record, DNA barcode, Island biodiversity

P121

Morphological comparison and COI-based genetic divergence of *Nemophora ochsenheimerella* (Lepidoptera: Adelidae) from South Korea

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The family Adelidae (fairy moths or longhorn moths) is distributed worldwide, with the genus *Nemophora* representing a major lineage in the Palearctic region. In our previous study, we recognized 15 species of *Nemophora* from South Korea, including *N. ochsenheimerella* (Seo et al., 2024, unpublished data). We reanalyzed Korean *N. ochsenheimerella* specimens through morphological comparison with previous descriptions and COI-based genetic analysis. A 658 bp fragment was obtained from one Korean specimen and analyzed with additional conspecific sequences from Canada, Germany, Denmark, and Austria. Phylogenetic analysis showed that the Korean specimen clustered with foreign individuals of *N. ochsenheimerella*, although pairwise K2P distances indicated genetic divergence of 0.015–0.026. No significant morphological differences, including genitalia, were observed. These results suggest the potential presence of a cryptic lineage closely related to *N. ochsenheimerella*. Based on current evidence, we provisionally identify the Korean specimen as *N. ochsenheimerella* while emphasizing the need for further analyses.

Key words: Adelidae, DNA barcode, Lepidoptera, *Nemophora ochsenheimerella*, genetic divergence

P122

Six new records of the genus *Coleophora* Hübner (Lepidoptera: Coleophoridae) from Korea

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We present six species of the family Coleophoridae (Lepidoptera: Gelechioidiea) newly recorded from Korea: *Coleophora sakurae* Oku, 2009; *C. texanella* Chambers, 1878; *C. tyrrhaenica* Amsel, 1952; *C. milvipennis* Zeller, 1839; *C. deviella* Zeller, 1847; and *C. burhinella* Baldizzone & Oku, 1990. These records increase the number of coleophorid species known in Korea from the previously recognized 43 to a total of 49. Diagnostic characteristics and photographs of the six species are presented.

Key words: Gelechioidea, microlepidoptera, casebearers, new record, Korean fauna, Korean Peninsula

P123

DNA barcoding and morphological analysis of a possible new *Nematopogon* species from South Korea

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The genus *Nematopogon* was established by Zeller in 1839 based on the type species *Nematopogon schwarziellus* Zeller, 1839. Currently, 16 valid species are recognized worldwide, three of which are recorded from South Korea. During recent surveys, we discovered a possible new species of *Nematopogon* in the country. To determine its taxonomic placement and assess its phylogenetic affinities, we analyzed DNA barcode data of 12 *Nematopogon* species available in the BOLD System with that of our Korean specimens. Based on both male genitalic characters and DNA barcode evidence, a possible new taxon appears to belong to the *N. adansoniella* species complex. We also provide photographs of the external morphology and genitalia of this species.

Key words: Adelidae, DNA barcode, Lepidoptera, *Nematopogon*, new species candidate

P124

Insect fauna of Korean islands

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Korea has a total of 3,348 islands, and a synthesis of previously scattered research on the insect fauna of these islands revealed that 6,117 species of insects, belonging to 29 orders and 204 families, inhabit 541 islands. Subsequently, Honam National Institute of Biological Resources conducted surveys of native insects in under-studied island regions and established a comprehensive species inventory.

From 2021 to 2024, surveys were carried out on 71 inhabited islands, resulting in the identification of 4,991 insect species. Among these, 566 species were newly recorded from islands, including five new species and 14 species newly recorded in Korea. In addition, insect occurrences were newly confirmed on 20 islands.

As a result, it was confirmed that a total of 6,683 insect species inhabit 561 islands in Korea.

Key words: island, insect fauna, National species list of Korean islands.

P125

First record of *Eutrichosiphum sinense* Raychaudhuri, 1956 (Hemiptera: Aphididae: Greenideinae) from South Korea

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The genus *Eutrichosiphum* Essig & Kuwana, 1918 includes 54 species worldwide. Only one species have been recorded in Korea: *Eutrichosiphum pasaniae* (Okajima, 1908). We collected *Eutrichosiphum sinense* Raychaudhuri, 1956 on *Castanopsis sieboldii* in Jinju. This species has been recorded in Japan, China, India and Java. In this study, we report this species for the first time in South Korea, and describe morphological features of apterous viviparous females.

Key words: Greenideini, *Eutrichosiphum*, *Castanopsis sieboldii*, South Korea

P126

Two New Records of the genus *Aleiodes* (Hymenoptera: Braconidae: Rogadinae) From South Korea

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The subfamily Rogadinae comprises several genera, among which *Aleiodes* Wesmael, 1838 is the most species-rich and diverse. The genus *Aleiodes* is extensive but its diversity remains underexplored: more than 632 species have been described worldwide, and many more are likely yet to be discovered. In this study, we report two species of *Aleiodes* newly recorded from South Korea: *Aleiodes angustipterus* van Achterberg & Shaw, 2016, and *Aleiodes malichi* Butcher et al., 2012. We provide descriptions, diagnostic characters, distributional data, and illustrations for these species.

Key words: Natural enemy, Parasitoid waps, Taxonomy, Unrecorded species

P127

Taxonomic Study of the genus *Phylloecus* Newman, 1838 (Hymenoptera, Cephoidea, Cephidae: Cephinae) from South Korea

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The genus *Phylloecus* Newman, 1838 (=*Hartigia* Schiødt, 1839) belong to the subfamily Cephinae of the family Cephidae, one of the smaller families of Symphyta. Liston & Prous (2014) synonymised *Hartigia* and *Phylloecus*. Two species, *Phylloecus coreana* Takeuchi and *Phylloecus viator* (Smith), had been recorded from South Korea. *Phylloecus* faunus has been considered for use in the biological control of Rubus in Australia (e.g. Bruzzese 1982; as *Hartigia albomaculatus*). In this study, diagnoses and photos of one unrecorded species and one new species of the genus *Phylloecus* from South Korea are provided. We also provide key to genera of Cephidae from South Korea.

Key words: Cephidae, *Hartigia*, new record, sawflies

P128

Three newly recorded species of the genus *Alexeter* Förster, 1869 (Hymenoptera, Ichneumonidae, Ctenopelmatinae) from South Korea

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The genus *Alexeter* is a small group of the subfamily Ctenopelmatinae, comprising 32 species from worldwide, 11 species from the Eastern Palaearctic, seven species from the Nearctic and three species from the Neotropical region. More than 1,500 species have been reported in 107 genera and nine tribes in the world. The Ctenopelmatinae comprises one of the two major radiations of parasitoids of sawflies. Only one endemic species, *Alexeter shakojiensis* Uchida, 1930, have been reported from South Korea until now. In this study, diagnoses and photos of three unrecorded species from South Korea are provided.

Key words: Mesoleiini, new record, parasitoids, wasps

P129

An analysis of the population genetic structure of *Cryptotympana atrata* (Hemiptera: Cicadidae) in South Korea using single-nucleotide polymorphisms from direct amplicon sequencing

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Cryptotympana atrata populations are experiencing significant range expansion in response to rising temperatures, mainly from southern temperate regions, including a southern subtropical remote island, Jeju, to northern cooler areas. Therefore, this study aimed to explore the genetic diversity and structure of *C. atrata* populations across South Korea using 118 single-nucleotide polymorphisms obtained from direct amplicon sequencing. The most significant genetic differentiation was noted at ~100 km distance of the remote Jeju island population from all the inland populations. This signifies the importance of long-standing physical isolation from biogeographic history, rather than ongoing global warming. Within the mainland, only a slight genetic distinction was detected in 2 of the 3 newly-expanded populations in the northern cooler region, with similar genetic diversity in all inland populations, suggesting that an adaptation to northern lower temperatures was not the major factor facilitating the expansion to new areas.

Key words: climate-sensitive indicator insects, global warming, single-nucleotide polymorphism, amplicon sequencing

P130

Phylogenetic insights into the genus *Uroleucon* (Hemiptera: Aphididae): Molecular evidence and the role of host plants and biogeography

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The genus *Uroleucon* Mordvilko, 1914 is one of the most species-rich groups of aphids, comprising over 190 described species. However, its internal taxonomy remains systematically controversial. In this study, we analyzed nuclear and mitochondrial genes—from 29 terminal taxa representing three major subgenera (*Uroleucon*, *Uromelan*, and *Lambersius*), including species with diverse geographical distributions and host plant associations. Phylogenetic relationships were reconstructed using the maximum likelihood method. Our results support the monophyly of *Uroleucon* as a genus, but reveal incongruence at the subgeneric level, suggesting that current subgeneric classifications do not reflect evolutionary history. Instead, phylogenetic structure appears to be more strongly influenced by geographic isolation and host plant origin.

Key words: *Uroleucon*, Aphididae, phylogeny, biogeography and host plants

P131

Assessment of the Population Genetic Structure of the Pinewood Nematode in South Korea

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The pinewood nematode (PWN), *Bursaphelenchus xylophilus*, was introduced to South Korea in the 1980s and initially caused damage primarily to *Pinus densiflora*and *P. thunbergii*in the southern regions. However, severe infestations have recently been observed in *P. koraiensis*stands in central Korea, where such outbreaks had not previously been reported. To examine whether this outbreak represents a distinct haplotype compared to those in the south, we conducted Sanger-based sequence analyses using multiple markers. PWNs from 25 regions and different host species were sampled, with strains maintained through successive culturing. Three independent loci were targetedto maximize the use of public sequences: mitochondrial *cytochrome b* (cytb), the nuclear protein-coding gene *cellulase*, and the ribosomal DNA *internal transcribed spacer* (ITS). Both cytb and ITS sequences showed complete genetic identity across South Korea. In contrast, *cellulase*sequences exhibited five haplotypes differing by up to three nucleotide substitutions, but no geographic structuring or host-associated genetic differentiation was detected. These results suggest that the recent PWN outbreak in central Korea is not attributable to the emergence of a novel haplotype but may instead be driven by other, as yet unidentified, ecological or host-related factors.

Key words: *Bursaphelenchus xylophilus*, Pine Wilt Disease (PWD), ITS, Cytochrome b, Cellulase

P132

Analysis of Varroa mite resistance genes in honeybee (*Apis mellifera*) strains

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The ectoparasitic mite *Varroa destructor*, which parasitizes honeybee fat body and transmites lethal viruses, is a major cause of overwinter colony losses. To provide a foundation for resistance breeding, we investigated the expression of candidate resistance-related genes in honeybee strains, based on previous studies. The genes *TANC2* and *baz* showd no significant expression differences between Varroa-free and infected pre-pupae but were upregulated in infected pupae. Comparative analysis across five honeybee strains (A, C, D, F, V) revealed that strains D and V exhibited significantly higher expression of *Alh* and *hormone receptor 78*, both associated with Varroa-resistance. Furthermore, analysis of nine Varroa-sensitive hygiene (VSH) genes and two olfactory genes in brain tissue revealed strain-specific variation, althoug consistent expressin patterns were not evident across all genes.

Key words: *Apis mellifera*, *Varroa destructor*, Varroa-sensitive hygiene, Resistant

P133

Skim milk: A potential extender for short-term storage of honeybee sperm at 4°C

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The preservation of honeybee sperm is crucial for selective breeding and genetic conservation. To identify optimal extenders for short-term storage of honeybee sperm, we compared Tris, skim milk (SK), and SK supplemented with 25mM fructose (SK+F). Sperm samples were diluted with each extender and stored at 4 °C for 72 hours. Motility and plasma membrane integrity were evaluated daily using motility analysis and the hypo-osmotic swelling test (HOST). By 72 hours, sperm stored in the Tris extender exhibited a complete loss of motility, whereas the SK and SK+F extenders maintained over 60% motility. Similarly, HOST results showed that intact plasma membrane (IPM) was maintained at >65% in SK groups, compared to ~46% in Tris. These findings suggest that skim milk-based extender may be effective for short-term storage of honeybee sperm.

Key words: *Apis mellifera*, drone, skim milk, sperm storage, extender

P134

Divergent nutrient preferences of two coexisting fruit flies, *Drosophila melanogaster* and *Drosophila simulans*

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Species exploiting the same food resources are expected to face strong competitive interactions, often preventing their coexistence. However, recent studies have shown that coexistence can be maintained if species occupy sufficiently different nutritional niches. We examined this possibility in two coexisting species of fruit flies, *Drosophila melanogaster* and *Drosophila simulans,* which exploit the same food resources. Using a food choice assay, we compared the preferred amount and balance of protein and carbohydrate consumed by these two species. *D. simulans* consumed less calories but selected a higher ratio of protein-to-carbohydrate (P:C=1:1.31) compared to *D. melanogaster* (1:1.84). This protein-biased intake of *D. simulans* likely reflects its higher reproductive demands compared to *D. melanogaster*. These results demonstrate clear divergence in nutrient preferences between the two *Drosophila* species, suggesting that nutrient niche partitioning may contribute to their coexistence.

Key words: carbohydrate, coexistence, *Drosophila*, nutrient balancing, niche partitioning, protein

P135

Evaluating Bioperformance Traits of *Metarhizium anisopliae* for Biocontrol: Thermotolerance and Virulence

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Entomopathogenic fungi have been studied to control insect pests as an alternative to chemical insecticides. However, all fungi haven't a high virulence against pests. In this study, we compared the biological characteristics of *Metarhizium anisopliae* strains. First, we selected four *M. anisopliae* strains and compared the thermotolerance, conidial productivity, and virulence. For the thermotolerance test, conidial suspensions were exposed to 0, 30, 60, and 90 min at 45 °C. As a result, the conidial germination rates were over 95% when exposed for 0 min but, were 64, 37.7, 6, and 3% when exposed for 30 min at 45°C, respectively. To compare conidial productivity, 200g of millet were used and inoculated with a conidial suspension of 1 ml (1×10^7 conidia/ml). Conidial productivity was investigated after 14 days. As a result of conducting a virulence test against mealworms using a spray method, differences in virulence between strains were confirmed.

Key words: conidial productivity, *Metarhizium anisopliae* strains, themotolerance, virulence

P136

The inhibition effect of insect screens on tomato leafminer adults

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토마토뿔나방(*Phthorimaea absoluta*)은 최근 유입된 외래곤충으로 토마토 재배지의 문제 해충이다. 방제방법이 부족한 친환경 재배지에서는 다양한 관리기술을 적용하고 있으며, 우선적으로 외부에서 침입하는 성충의 유입을 막기 위해 미세 방충망 설치를 권장하고 있다. 본 연구에서는 토마토 온실에 적합한 방충망을 활용하기 위한 시험을 수행하였다. 1 mm에서 3mm까지의 방충망을 이용하여 나방 성충의 이동을 조사한 결과, 15 cm 지름의 원형 케이지에서는 1mm 망에서는 성충의 이동을 차단하였으나 망크기가 클수록 차단효과가 떨어졌다. 같은 크기의 방충망이여도 시험케이지가 클 경우 통과하는 비율이 낮게 나타났다. 토마토재배 온실에서 방충망으로 씌운 100×100×150 cm 크기의 스크린케이지 안에서 토마토를 재배하였을 때 토마토뿔나방의 방제효과를 확인할 수 있었다.

검색어: 토마토, 토마토뿔나방, 방충망

P137

National Prioritization and Response Manual for Invasive Alien Plant Pests of Concern

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Even in developed countries, proactive surveillance and monitoring activities are being strengthened through prioritization to prevent enormous losses due to the introduction and spread of invasive alien species (IAS) concerned and to efficiently utilize resources through selection and concentration. The National Priority Scoring Index (NPSI) method was used to assign national priorities to 100 plant pests designated by the Animal and Plant Quarantine Agency as being at risk of introduction as follows: We categorized into Group I (7 species), Group II (12 species), Group III (26 species), Group IV (24 species), and Group V (6 species) for 75 insect pests, and categorized into Group I (6 species), Group II (5 species), Group III (2 species), Group IV (5 species), and Group V (7 species) for 25 plant pathogens including weeds and nematodes. Furthermore, "The Plant Pest Response Manual (Draft)" were developed for the 87 plant pests designated as national priorities from Group I to IV. Based on these manuals, a powerful national biosecurity network will be established by pro-actively preventing plant pests as being at risk of introduction, and by ensuring early detection and rapid response in the event of incursion.

Key words: IAS concern, proactive response, plant bioscurity, prioritization

P138

Control effect of *Scirtothrips dorsalis* Using Organic Agricultural Materials in Plastic-film house Cultivated Kiwifruit in Jeju, Korea

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Scirtothrips dorsalis Hood is a key pest of kiwifruit, causing blemishes on fruits and leaves that reduce commercial value. Populations persist during the late fruit maturation period(september-October) under plastic-film house conditions in Jeju, thereby necessitating effective and sustainable control strategies.

This study evaluated the efficacy of seven organic agricultural materials against *S. dorsalis*. In laboratory assays, all materials showed > 55% control, with derris(92.6%) and sophora(90.7%) being most effective. Pot experiments confirmed high efficacy of derris(86.5%) and sophora(85.4%), while neem extract achieved 75.3%.

In field validation trials, sequential applications of derris, neem and *S. flavescens* extracts provided 64.9% cumulative control of *S. dorsalis* compared with the standard farming practices, and reduced the incidence of damaged fruits by 3.3%. The findings highlight the practical potential of utilizing organic agricultural materials for the management of *S. dorsalis* in kiwifruit cultivation, and is expected to contribute to pesticide reduction and the establishment of a sustainable production system in Jeju.

Key words: *Scirtothrips dorsalis*, Kiwifruit, Organic agricultural materials, Control

P139

Comparison of Insecticidal and Systemic Activities of Insecticides against the Fall armyworm, *Spodoptera frugiperda* on Maize

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Insecticidal activity were conducted for 9 insecicides under laboratory conditions against *Spodoptera frugiperda*, to select effective insecticides for controling the fall armyworm, a major migratory pest causing significant damage in maize cultivation. Larvae reared for more than two years without exposure to insecticides were used to evaluate the insecticidal activity of these nine compounds. LC_{50}, LC_{90}, and Efficacy Index (E.I.) values were estimated using probit analysis against *S. frugiperda*. Management of Fall armyworm was difficult due to its feeding behavior inside maize leaf sheaths, stems, and ears. Systemic activity of 21 insecticides were evaluated under laboratory conditions to manage *S. frugiperda*,. Soil drench treatments were applied to maize plants at the 4-5 leaf stage to prevent direct insecticide contact on the leaves. One day after treatment, leaves were collected and tested to bioassays, which confirmed insecticidal activity of compounds such as Cyantraniliprole.

Key words: Fall armyworm, *Spodoptera frugiperda*, Inseciticidal acitivity, Systemic activity

P140

Monitoring the Occurrence of Soybean Insect Pests in Paddy Fields during 2025

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Soybean cultivation in paddy fields has rapidly expanded in recent years, highlighting the need to assess whether pest dynamics in these systems resemble those in upland soybean fields. To address this, a continuous monitoring was conducted in 2025 using pheromone traps across six large-scale production complexes (>100 ha as of 2024): Andong and Sangju (Gyeongsangbuk-do), Gimje and Buan (Jeollabuk-do), Jangseong (Jeollanam-do), and Nonsan (Chungcheongnam-do). Trap monitoring revealed that *Spodoptera exigua* (Lepidoptera: Noctuidae) exhibited population peaks in late July and late August, while *S. litura*(Lepidoptera: Noctuidae) showed high trap catches in late August in Gimje, Buan, Andong, and Sangju, with populations continuing to increase until September in other regions. *Riptortus pedestris*(Hemiptera: Alydidae) peaked in early July and again in late August. Compared with 2024, *S. litura* trap catches in late August declined by approximately 50%, likely reflecting climatic variation in temperature and humidity. Overall, pest occurrence patterns in large-scale paddy-grown soybean fields were similar to those in upland fields; however, in late August, *S. exigua* was 1.2-fold higher, *R. pedestris* was comparable (0.9-fold difference), and *S. litura* was more than three times higher, indicating the need for intensive monitoring of this species.

Key words: paddy soybean, pest management, monitoring

P141

First Report of *Trissolcus elasmuchae* (Hymenoptera: Scelionidae) Parasitizing *Dolycoris baccarum* in Korea

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The stink bug *Dolycoris baccarum* (Hemiptera: Pentatomidae) is an economically important pest of field crops in Korea. During laboratory rearing of D. baccarum collected from sesame fields, egg parasitoids emerged from host egg masses. The parasitoids were identified using molecular analysis, and based on partial mitochondrial cytochrome C oxidase subunit 1 (*COI*) sequences, the specimens were confirmed as *Trissolcus elasmuchae* (Watanabe, 1954) (Hymenoptera: Scelionidae). This is the first report of T. elasmuchae parasitizing *D. baccarum* in Korea, expanding knowledge on the natural enemy complex of stink bugs and indicating its potential as a biological control agent.

Key words: *Dolycoris baccarum, Trissolcus elasmuchae,* Egg parasitoid, Sasame field, Biological control

P142

Insect pest occurrence and damage assessment in cucurbit crops of Gyeongsangnam-do, South Korea

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Climate change, particularly global warming, has led to shifts in the population density and occurrence patterns of insect pests. This study was conducted to investigate the pest occurrence patterns and to develop pest management technologies for cucurbit crops. From March to May 2025, a field survey was conducted in the major cultivation regions of Changwon, Uiryeong, and Haman, located in Gyeongsangnam-do, South Korea. Western flower thrips (*Frankliniella occidentalis*) and silverleaf whitefly (*Bemisia tabaci*) were identified as prevalent pest species, with higher incidence observed in Uiryeong and Haman. Furthermore, wilting symptoms observed in melon were attributed to infestation by bulb mites (*Rhizoglyphus robini*). In the greenhouse of the Gyeongsangnam-do Agricultural Research and Extension Services, pesticide-free cultivation of watermelon resulted in fruit damage caused by aphids infestation (*Aphis gossypii*). The affected fruits showed a transverse diameter of 19.4 cm, longitudinal diameter of 21.8 cm, and a weight of 5.2 kg. While fruit size and weight were significantly reduced compared to controls, no statistically significant difference in soluble solids content (°Brix) was observed.

Key words: climate change, cucurbit crops, pest occurrence patterns, pest management technology

P143

Evaluation of Hive Spacers (or Hive Risers) for Varroa destructor Control through Drone Brood Cells in Summer

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This study examined whether hive spacers (or hive risers) can be used in July–August to control *Varroa destructor* in managed honey bee colonies (*Apis mellifera*) by inducing and removing drone cells. Varroa mites prefer drone brood over worker brood, making drone cells a potential target for ecological control. In 2025, three colonies with spacers developed drone cells at the bottom of the combs. The infestation rate in drone cells averaged 48.9%, while worker cells in the same colonies showed 7.7%. In five control colonies without spacers, worker cells had an average infestation rate of 11.6%. These results confirm that drone cells can be induced with spacers in July–August. Drone cells acted as major mite reservoirs compared to worker cells. Thus, drone cell removal using spacers may serve as a complementary strategy for Varroa management in *Apis mellifera* colonies.

Key words: *Varroa destructor*, Drone beood removal, hive spacer,*Apis mellifera.* Ecological control strategy

P144

Enhanced Fumigant Toxicity of Methyl Benzoate and Phosphine Combination on *Sitophilus oryzae* and *Rhizopertha dominica*

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The rapid evolution of phosphine resistance in stored-product beetles necessitates the development of alternative fumigation strategies. We evaluated the fumigant activity of methyl benzoate (MBe), a plant-derived ester, in combination with phosphine against two phosphine-resistant beetle species, *Rhyzopertha dominica* and *Sitophilus oryzae*. In *R. dominica*, MBe at 10.8 mg/L (LC_{30}) combined with phosphine at 1.0 mg/L (≈LC_5) resulted in 100% mortality, which was sustained to 0.5 mg/L. At 0.12 mg/L, mortality remained high at 76.0 ± 1.67%. In *S. oryzae,* complete mortality was achieved when MBe was fixed at 6 mg/L (LC_{30}) and combined with phosphine at 0.5 mg/L (≈LC_4), and this effect was maintained to 0.25 mg/L. Phosphine concentration of 0.03 mg/L, mortality still reached 81.0 ± 1.03%. Overall, the combination of phosphine and MBe demonstrated strong synergistic effects. These findings suggest that the co-application of two fumigants offers an effective and environment-friendly approach to managing resistant stored-product beetles in grain storage systems.

Key words: quarantine, phosphine resistance, synergistic, alternative fumigants

P145

Evaluation of the toxicity of six insecticides against *Myzus persicae* using the leaf dip method

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Myzus persicae, the green peach aphid, is a common agricultural pest that attacks crops such as tobacco, cabbage, and pepper. Although various insecticides are commonly used for its control, overuse has led to the widespread development of insecticide resistance in *M. persicae* populations. This study evaluated the insecticidal activity of six insecticides—benfuracarb(IRAC 1a), fenitrothion(1b), fenpropathrin(3a), dinotefuran(4a), sulfoxaflor(4c), and pyrifluquinazon(9b)—against *M. persicae* using the leaf dip method. At the recommended concentration, five insecticides, including benfuracarb, exhibited high insecticidal activity. In addition, even at half of the recommended concentration, three insecticides, including dinotefuran, demonstrated high control efficacy. These findings provide a basis for insecticide evaluation against *M. persicae* and the selection of effective control strategies.

Key words: *Myzus persicae*, insecticides, toxicity, control strategies

P146

An Analysis of the Control Effect of Environmentally Friendly Materials for the Control of *Meloidogyne hapla* after Planting Lettuce in Facilities

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In order to analyze the effect of controlling *M. hapla* using eco-friendly materials at facility lettuce plantations, a pot experiment was conducted on 7 types, including plant extracts and microbiological agents, by contrasting the untreated and chemical pesticides. As a result of treating 7 types of eco-friendly materials after inoculation with different inoculation densities of *M. hapla*, the density of untreated after 60 days was 24 in 250 inoculations, 35 in 500 inoculations, and 176 in 1,000 inoculations. The density of the chemical pesticide treatment was 0. The density was the lowest in the wasabi extract treatment and the highest in the garlic oil treatment. Therefore, the remaining 6 species except garlic oil have less density than the non-treatment, so the control effect is less than that of chemical pesticides, but it is judged to be effective in suppressing the density of *M. hapla*.

Key words: Facility lettuce, *Meloidogyne hapla*, density of occurrence, eco-friendly materials

P147

Analysis of Decrease in Pepper Yield Due to Pest Damage

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최근 노지고추의 단수 불안정성이 커지고 있어 본 연구는 통계청 농작물생산량조사 마이크로데이터(고추)를 활용하여 단수의 불안정을 야기하는 병충해 및 기상재해 등의 피해유형 중 충해를 중심으로 실태를 분석하였다.

고추 생산량 피해가 10%이상 발생한 필지는 44%이며, 피해유형별로는 병해 33.4%, 한해 3.4%, 수해 1.6%, 충해 0.6%, 기타 4.8%로 충해 피해 필지는 미미한 수준이다. 연도별 충해 피해 필지 비율은 0.2~1.6%이고, 가장 피해가 컸던 해인 2024년도 1.6%로 미미한 수준이다.

고추 충해 피해 필지(충해 피해 10% 이상)의 단수는 65~211kg/10a이며, 단수가 가장 낮았던 해는 2020년 65kg/10, 높았던 해는 2015년 211kg/10a로 차이가 크다, 고추 충해 필지 중 20.2%의 단수가 80kg/10a 미만으로 매우 심각하다.

충해에 의한 고추 단수의 감소는 평균 1.1kg/10a로 미미하며, 제주도 2018년과 2024년에는 충해로 단수가 10kg/10a이상 감소하고, 또한 2024년 충청남도와 경상남도, 2022년 경기도, 2021년 전라남도는 충해로 단수가 4kg/10a이상 감소하였다.

충해에 의한 단수 감소량과 기상요소(30개)의 상관관계를 분석결과 상관계수 0.2이상인 기상요소는 5월 평균 최저기온 1개이고, 그 외의 기상요소는 모두 0.2미만이다.

고추는 충해 발생필지(피해 10% 이상)의 단수는 매우 낮으나, 전체 단수에 미치는 영향은 미미하며, 기상요소가 해충의 발생과 관계가 있으나, 충해에 의한 단수 감소량과 기상의 상관계수가 낮다. 이는 해충방제를 위한 농업인 노력과 다양한 계층의 지원이 있었기 때문이다.

검색어: 고추, 충해, 수량감소, 실태분석

P148

Detection of Jujube Witches's Broom Phytoplasma in Major Insect Pests of Jujube Orchards in Boeun

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Jujube witches'-broom disease is a representative systemic disease of jujube trees, transmitted through insect vectors and vegetative propagation. To date, the primary confirmed vector has been identified as *Hishimonus sellatus*, but the identification of additional vectors and clarification of their transmission potential are essential for effective disease control and further research. In this study, six major insect species collected from jujube orchards in Boeun, Chungcheongbuk-do—*Ricania sp., Metcalfa pruinosa*, *Lygocoris limbatus*, *H. sellatus*, *Riptortus clavatus*, and *Euricania facialis*—were analyzed using PCR to detect the presence of the jujube witches'-broom phytoplasma. The PCR results revealed that all samples tested positive for the pathogen. These findings suggest that, in addition to the previously known vector *H. sellatus*, certain cicadellids and mirid bugs may act as potential vectors of jujube witches'-broom disease. Further studies are required to verify the transmission from infected to healthy trees and to confirm whether visible disease symptoms develop.

Key words: jujube, Phytoplasma, Witches broom, Ricania shantungensis, Euricania facialis, Hishimonus sellatus

P149

Occurrence and Chemical Control of *Pygmephorus* spp. in *Agaricus bisporus* Cultivation in South Korea

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Agaricus bisporus is one of the most widely cultivated edible mushrooms worldwide, primarily produced via artificial cultivation in indoor greenhouses or mushroom houses. In South Korea, production is concentrated in the Chungcheong and Yeongnam regions, with an annual yield of approximately 6,400 tons. Recently, substantial infestations of *Pygmephorus* spp. were observed in mushroom houses in the Gyeongbuk region. These infestations occur throughout the cultivation period, mainly on upper surfaces of fruiting bodies, damaging the mushroom surface and decreasing marketability. 5 insecticides, abamectin(EC), bifenazate(SC), cyanopyrafen(SC), spiromesifen(SC), and chlorfenapyr(SC) were evaluated for control efficacy. Abamectin(EC), bifenazate(SC), spiromesifen(SC), and chlorfenapyr(SC) showed over 90% efficacy, whereas cyanopyrafen(SC) showed less than 80%. These results will assist in pesticide management strategies of *Pygmephorus* spp. in *A. bisporus* cultivation.

Key words: *Agaricus bisporus, Pygmephorus* spp., mushroom cultivation, pest control, insecticide efficacy

P150

Monitoring of Insecticide Resistance in Western Flower Thrips (*Frankliniella occidentalis*) and Establishment of a Management System

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Western flower thrips *(Frankliniella occidentalis)*, commonly known as a sap-sucking insect pest that causes both direct and indirect damage to a variety of crops. Since being first reported in 1993, it is now widely spread in many regions in Korea. In this study, population of *F. occidentalis* were collected from 6 farms across 3 regions in Gyeonggi Province. Using these field populations, insecticide resistance levels were monitored using a leaf-dipping and residual contact bioassay. Bioassay results revealed that *F.occidentalis* possessed levels of resistance to five insecticides exhibiting different modes of action: Acetamiprid, Spinetoram. Emamectin benzoate, Chlorfenapyr, Cyantraniliprole. Resistance to Cyantraniliprole and Acetamiprid was consistently detected in both bioassay methods. In contrast, for Spinetoram, Emamectin benzoate, and Chlorfenapyr, the resistance levels varied among regions. Therefore, management strategies based on routine resistance monitoring are crucial for delaying the development of resistance and ensuring sustainable control efficacy.

Key words: Insecticide resistance, bioassay, RCVpW, *Frankiniella occidentalis*

P151

Comparison of application methods for acaricidal efficacy on eggs of *Tetranychus urticae* Koch

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The *Tetranychus urticae* Koch is a destructive pest with high fecundity and rapid resistance development. This study compared foliar spray and leaf dip methods using four acaricides registered in South Korea. Eggs on kidney bean leaves were treated by spraying 2 mL onto disc or dipping them for 20 seconds, and mortality was assessed after 120 h using probit analysis. Etoxazole, Fenazaquin, and Spiromesifen demonstrated high efficacy under the foliar spray method, while Fenazaquin showed high efficacy under the leaf dip method. These findings indicate that application method affects ovicidal efficacy and underscore the need for standardized bioassays to improve acaricide evaluation.

Key words: *Tetranychus urticae*, Acarbicide, Foliar spray, Leaf dip

P152

Biological control efficacy of *Aphidius gifuensis* against *Myzus persicae* on eggplant under greenhouse conditions with a simple quality test

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The parasitoid *Aphidius gifuensis* is an important biological control agent of the green peach aphid, *Myzus persicae*, a major pest of solanaceous crops. This study aimed to determine the optimal release density of *A. gifuensis* and to evaluate its control efficacy under greenhouse with eggplant. Optimal release density assays demonstrated that the release ratio required to suppress aphid populations increased with both the initial infestation level and the treatment volume. Specifically, greenhouse trials showed that when initial infestations were approximately 100 aphids, effective suppression of *M. persicae* was achieved by releasing *A. gifuensis* at a minimum ratio of 1:20, applied twice. These results highlight the importance of considering initial pest density and greenhouse conditions when determining release strategies for biological control. In addition, we developed a simple quality assessment method for *A. gifuensis* that predicts the number of functional parasitoids in commercial products by measuring adult emergence. This rapid assessment provides a practical tool for ensuring quality and consistency in the application of biological control agents.

Key words: *Aphidius gifuensis, Myzus persicae.* biological control, eggplant, simple quality test

P153

Patterns of pest infestation under different cultivation practices of perilla leaf in Chungnam province, Korea

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Perilla (*Perilla frutescens* var. japonica Hara) is an annual crop in the Lamiaceae family, originating from China and East Asia. Leaf perilla consumed in Korea is rarely produced abroad, making it resistant to market liberalization pressures in the era of agricultural openness.

Major production areas include Milyang and Geumsan, but its cultivation remains marginal compared to other vegetables, resulting in unclear representation in official agricultural statistics. Despite the decades-long reputation of Geumsan's Chubu perilla leaves, research on leaf perilla in the Chungnam region has been limited.

With recent advancements in protected cultivation enabling year-round supply of leafy vegetables, cultivation methods have diversified, and the expansion of production scales has heightened on-site interest in smart farm hydroponics. In alignment with these trends, this study conducted a qualitative survey to investigate differences in pest occurrence patterns between conventional cultivation and hydroponics, aiming to provide practical information for on-site application in leaf perilla farming.

Key words: pattern of pest infestation, different cultivation practices, perilla leaf

P154

Repellents effect to stink bugs in apple orchard with oils

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To minimize damage from stink bugs in apple orchards, garlic oil and neem oil were selected as repellent oils, with neem oil applied for outdoor validation. As a result, the average number of stinkbugs captured in the untreated area was 16.0, whereas in the neem oil-treated area, it decreased to 3.3. The repellent efficacy was 79.4% compared to the control, demonstrating a strong repellent effect. Indoor validation demonstrated strong repellent effects for Korean mint (64%) and lemongrass (66%). For outdoor validation, Korean mint was arranged in a barrier-style setup, and the experiment showed that the average number of stink bugs captured in the untreated area was 9.3, whereas in the repellent oil-treated area, it decreased to 2.0. The repellent efficacy was 78.5% compared to the control, indicating a high level of effectiveness.

Key words: Organic apple orchard, Stink bugs, Repellent oil, Repellent plants

P155

Efficacy of Cold Treatment and Ethyl Formate Fumigation Against *Bactrocera cucurbitae* Under Naked and Citrus-Inoculated Conditions

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Fruit flies (Tephritidae) are recognized as high-risk quarantine pests that increasingly threaten Korean agriculture due to climate warming and the expansion of subtropical fruit cultivation. The melon fly, *Bactrocera cucurbitae*, a major pest of fruit and vegetable crops, is currently spreading in neighboring countries, raising concerns about its potential invasion and establishment in Korea. The main phytosanitary treatment, methyl bromide (MB) fumigation, has been phased out because of environmental, safety, and residue concerns, creating an urgent need for effective alternatives. Ethyl formate (EF) has emerged as a promising fumigant and is already used for quarantine disinfestation in Korea. In this study, we evaluated the efficacy of two potential phytosanitary treatments, cold treatment at 1.7 °C and EF fumigation for 4 h at 23 °C, against *B. cucurbitae*. Treatments were assessed under two conditions: naked (without host fruit) and inoculated (on citrus fruits). The results provide essential baseline information for developing safe and effective phytosanitary measures against *B. cucurbitae* and reducing the risk of its establishment in Korea.

Key words: *Bactrocera cucurbitae*, Ethyl formate, Cold treatment, Phytosanitary treatment

P156

Development of Bioinsecticides Using a Entomopathogenic Fungus, *Beauveria bassiana* 331R

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Tetranychus urticae and *Bemisia tabaci* are major pests that cause significant damage to greenhouse crops. However, to date, only one organic agricultural material has been registered for their control, which is insufficient to cover diverse crop and cultivation conditions or to provide farmers with adequate options. In this study, we evaluated the safety and efficacy of "Solside-I," a microbial product developed using the entomopathogenic fungus *Beauveria bassiana* 331R, for registration as an organic agricultural material.

The test results showed no detectable toxicity in environmental toxicity studies (honeybees, freshwater fish, freshwater invertebrates, birds, and soil microorganisms) and in mammalian toxicity studies (acute oral, dermal, inhalation, and intravenous toxicity). No phytotoxicity was observed in five major crops (pepper, Chinese cabbage, lettuce, perilla, and soybean).

Efficacy trials demonstrated more than 70% control against *T. urticae* and *B. tabaci*. In addition, efficacy trials against *Frankliniella occidentalis* and *Aphis gossypii*, conducted to expand the product's target pest spectrum, also showed control levels exceeding the RDA threshold of 50%. Accelerated stability testing conducted at 30 °C for 36 weeks confirmed a product shelf life of two years.

These results indicate that "Solside-I" simultaneously ensures safety and efficacy, demonstrating its potential as a microbial-based organic agricultural material.

Key words: *Beauveria bassiana* 331R, Bioinsecticide, Pesticide registration tests

P157

Efficacy of Neem Extract via Thermal Fogging in Controlling Varroa Mites and Its Effects on Honey Bees(*Apis mellifera*)

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The Varroa mite (*Varroa destructor*) has been identified as one of the primary factors contributing to the mortality of honeybee populations in Korea. First detected in Masan, Gyeongsangnam-do in 1950, causing significant damage to bee colonies. The resistance of Varroa mites to commonly used chemical acaricides has escalated the need for alternative control measures. The study investigates the potential use of neem extract, a natural product known for its minimal toxicity to bees, as a treatment for Varroa mite infestations. The neem extract was diluted with propylene glycol and applied to adult bees and Varroa mites via thermal fogging. The results indicated that the high-temperature thermal fogging of neem extract did not lead to significant mortality in adult bees, which showed similar survival rates to the untreated control group. Additionally, a knockdown effect on the Varroa mites was observed post-treatment, suggesting a degree of efficacy in controlling mite populations.

Key words: Bee, Mite, *Azadirachta indica,* ULV, Thermal Fogging

P158

Key factors influencing *Telenomus remus* (Hymenoptera: Scelionidae) parasitism on *Spodoptera* spp. eggs : Implications for biological control

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Telenomus remus is an egg parasitoid wasp and a key biological control agent targeting noctuid pests such as *Spodoptera litura*. This study investigated the egg parasitic rates of *S. litura* by *T. remus* depending on different regions and seasons in South Korea. From May through October, egg masses of *S. litura* were deployed in soybean fields and experimental plots in Daejeon, Wanju and Miryang. *T. remus* adults were released at a rate of five pairs per 3.3 ㎡ of crop area, and the egg masses were retrieved after 48 hours to assess parasitic rates. The highest mean parasitism observed was 24.2% in August at the Daejeon site. Parasitic rated varied with released timing even within the same location, indicating that seasonal factors may influence *T. remus* efficacy. Further analysis is warranted to examine correlations between parasitic rates and seasonal environmental variables (e.g., temperature, rainfall). Additionally, the Daejeon site was surrounded by diverse neighboring crops (pepper, perilla, corn, etc.), whereas the Wanju and Miryang sites were soybean monoculture. These differences in surrounding crop diversity may also affect the wasp's biological control performance. Our findings highlight the importance of considering seasonal timing and habitat composition when implementing *T. remus*-based biocontrol programs against *S. litura*.

Key words: Soybean, *Spodoptera litura*, egg parasitoid

P159

Field application of Soybean banker plant with *Binodoxys communis* for sustainable aphid control in Fruit-vegetables greenhouses

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To enable sustainable aphid management in pepper and cucumber greenhouses, we implemented a soybean banker plants system supporting populations of the aphid parasitoid, *Binodoxys communis* in two eco-friendly farms in Wanju-gun (pepper and cucumber). Four soybean banker plants were placed evenly along the edges of each 200 pyeong (approximately 660㎡) greenhouse and replaced every 3~4 weeks. Aphid densities (number of aphids per leaf) and the number of parasitized aphid mummies per leaf were monitored at 7 day intervals. In the pepper, initial aphid density was low (≤ 1.3 aphids per leaf) and remained at 1.4 and 4.7 aphids per leaf by 30 days after transplanting, respectively, staying below the economic threshold of 10 aphids per leaf. This indicated that aphid populations were successfully suppressed by *B. communis*. In the cucumber, aphid infested seedlings were transplanted, leading to an initial density of 7.4 aphids per leaf. Despite applying an eco-friendly materials, the aphid population increased to 117.4 aphids per leaf, this level of infestation likely exceeded the economic threshold. Using healthy seedlings and maintaining low initial aphid population were essential for the banker plant system's long term successes in effectively controlling aphids.

Key words: aphid parasitoid, *Myzus persicae*, *Aphis gossypii*

P160

Evaluation of Organic Agriculture Materials for the Management of Key Pests in Cherry

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Rising temperatures driven by climate change have led to the expansion of subtropical crop cultivation in Korea. Among them, cherry (*Prunus avium* L.) has emerged as a convenient fruit, with steadily rising consumption and imports. This study examined pest incidence in Jeollanam-do cherry orchards and assessed the control efficacy of organic agricultural materials against two key pests: the spotted wing Drosophila (*Drosophila suzukii*) and the bean bug (*Riptortus pedestris*). Both pests directly reduce fruit quality by feeding on fruit tissues and facilitate secondary infections. A primary screening was conducted through laboratory assays by immersing two insect species in 15 and 18 organic agricultural materials diluted 1,000-fold, respectively. Foliar application of 15 and 10 screened organic materials showed more than 90% control efficacy against *D. suzukii* in seven cases, while three extracts, including *Sophora flavescens*, achieved up to 95% efficacy against *R. pedestris*. These results suggest organic agricultural materials can reduce pest damage during cherry harvest period and contribute sustainable pest management.

Key words: Cherry, *Drosophila suzukii*, *Riptortus pedestris*, Organic agricultural materials

P161

Insecticide Resistance of Thrips Infesting Asparagus in Export Production Areas of Gangwon Province

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Gangwon State is the leading asparagus export region in Korea, where thrips infestations pose quarantine risks. We evaluated insecticide resistance of thrips populations collected from Chuncheon and Yanggu using seven registered insecticides. Thrips from Chun cheon showed no resistance, while those from Yan ggu exhibited resistance to two insecticides.

These findings highlight that thrips populations may vary in susceptibility depending on the production area. This suggests the need for region-specific pest management strategies and rotation of insecticides to delay resistance development. The study provides baseline information that can support effective quarantine measures and ensure stable asparagus export and farm income in Korea.

Key words: Asparagus, Thrips, Insecticide resistance, Export production area, Quarantine pest

P162

Efficacy and Applicability of Entomopathogenic Fungi for Insect Pest (Heteroptera) Management in Kiwifruit

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Agricultural insect pests reduce marketability and predispose fruits to pathogen invasion. We evaluated entomopathogenic fungi (EPF) for management of Heteroptera in gold kiwifruit. In a primary screen against *Riptotus pedestris* (Bean bug), selected isolates showed strong virulence: *Metarhizium anisopliae* SIF-24 reached 100% mortality by day 10, while SIF-36 and other isolates reduced survival to ≤20% at day 10; cadavers consistently exhibited external mycosis and conidiation. To assess field-applicable production, we compared solid-state cultivation on five grains. Conidial productivity was highest on millet, particularly for SIF-24 (22.4 ± 1.1, relative units) and SIF-36 (9.4 ± 0.5), indicating millet as a promising substrate for scalable mass production; rice also supported high yields for SIF-36 (8.4 ± 1.6). Beyond insecticidal activity, EPF treatment conferred postharvest benefits: on kiwifruit inoculated with *Botryosphaeria dothidea*, SIF-36 significantly reduced lesion size versus the untreated control (≈60% reduction at 7 days post-inoculation; $p < 0.05$) and the effect persisted over time. A Y-tube olfactometer assay showed no significant preference of stink bugs between EPF-treated and untreated fruit ($p > 0.05$), suggesting neutral behavioral effects. Collectively, SIF-24 and SIF-36 combine potent virulence with feasible grain-based production and ancillary suppression of fruit rot, supporting their integration into kiwifruit IPM programs.

Key words: Biological control, *Botryosphaeria dothidea,* Kiwi, *Metarhizium anisopliae*

P163

Optimized large-scale production of beauvericin from *Beauveria bassiana* 331R and its potential for cotton aphid control

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Cotton aphid, *Aphis gossypii*, is a destructive pest with high reproductive capacity and increasing resistance to chemical insecticides, underscoring the need for sustainable alternatives. This study investigated large-scale production of the insecticidal metabolite beauvericin (BEA) from *Beauveria bassiana* 331R and its bioactivity against *A. gossypii*. Optimized media containing mealworm powder enabled a maximum yield of 516 mg/L, markedly higher than previous reports. Drying and autoclaving of mycelia improved extraction efficiency, while BEA retained insecticidal activity even after autoclaving. In both plate and pot assays, BEA significantly reduced aphid populations, and mixtures with conidia further enhanced efficacy. Collectively, these findings highlight BEA's production feasibility and strong potential as an eco-friendly agent for integrated pest management.

Key words: *Aphis gossypii*; *Beauveria bassiana*; beauvericin; bioinsecticide; mealworm powder

P164

Ensemble-based background selection to enhance species distribution modeling performance

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In species distribution modeling (SDM), the selection of background points, which serve as a counterpart to occurrence records by representing absences, is a critical regulatory factor that, along with the form and number of occurrence records, determines model performance at the initial stage. In this study, we proposed a novel background selection method to enhance the performance of machine learning-based SDMs by incorporating a mechanistic model in the selection of background points. Two example species (*Spodoptera litura, Solenopsis invicta*) were selected to develop machine learning-based models (MaxEnt and Random Forest) using background points chosen from areas where climatic suitability, as predicted by the CLIMEX model, is insufficient for their survival. Subsequently, performance metrics (TSS, Kappa, F1) were calculated under various evaluation scenarios. The results showed that the new method outperformed conventional background selection approaches (random and bias-based), improving model performance by at least 0.2 and highlighting the potential of the ensemble-based background selection method to enhance SDM performance.

Key words: ensemble modeling; background selection; species distribution model, model performance

P165

Domestic Occurrence and Damage Symptoms of *Phthorimaea absoluta* in Korea

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토마토뿔나방(*Phthorimaea absoluta*)은 유충이 잎에 터널을 만들고 줄기 및 과실 속을 가해하는 해충으로 가지과 작물 중 특히 토마토를 가장 선호하는 것으로 알려져 있다. 우리나라에는 2023년 제주에서 첫 발생 후 전국적으로 피해가 확산되고 있다. 성페로몬트랩을 이용하여 2025년 3월부터 9월까지 장수와 정읍지역에서 토마토뿔나방 발생을 조사하였다. 장수에서는 3월 20일, 정읍은 4월 7일에 토마토뿔나방의 첫 포획을 확인하였다. 5월 하순에서 6월 상순경 발생이 증가하기 시작하여 장수지역에서는 7월 4일 최성기 이후로 밀도가 증가하였으며 발생밀도도 높았다. 정읍에서는 6월 25일 이후로 발생이 증가하기 시작하였다. 토마토뿔나방은 주로 유충이 토마토의 잎이나 과실을 뚫고 들어가 넓은 터널을 만들어 농가에 피해를 주고 있다. 본 연구에서는 국내에서 발생하는 토마토뿔나방의 발생 현황과 피해증상 확인하여 조기에 적기 방제할 수 있는 자료로 활용하고자 한다.

검색어: 토마토, 토마토뿔나방, 발생, 피해증상

P166

Import risk analysis of fresh blueberry from New Zealand

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The Animal and Plant Quarantine Agency (APQA) conducts Import Risk Analysis (IRA) in accordance with international standards (ISPMs) and domestic law to reduce the risks of pests of concern that may enter with imported agricultural products. For New Zealand blueberries, New Zealand submitted a request for market access in 2017. APQA conducted an assessment of the pests occurring on New Zealand blueberries, and based on the results, imports were approved in September 2024. The pest list that needs to be managed by special risk management is fungal disease (*Colletotrichum karsti*) and three tortricid species (*Ctenopseustis obliquana, Epiphyas postvittana, Planotortrix excessana*). The pests are managed through a systems approach, although the specific methods differ. In this approach, pest free is demonstrated by monitoring, chemical control measures, and cut test, and these are applied as risk management measures.

Key words: Import risk analysis, Quarantine, Blueberry, Systems approach

P167

Import risk analysis of fresh table grape from Republic of Uzbekistan

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Animal and Plant Quarantine Agency(APQA) conducts Import Risk Analysis(IRA) in accordance with international standards (IPMSs) and domestic law and regulations to mitigate the risk of introducing pests of concern through the importation of foregin agricultural products. In 2018, Uzbekistan submitted a market access request for table grape, and thereafter an assessment of pests associated with table grape from Uzbekistan was conducted, with the risk analysis completed in March 2025. The main pests of concern for table grape from Uzbekistan are two species in the Tortricidae(*Lobesia botrana*, *Agryrotaenia ljungiana*). For *Lobesia botrana*, a methyl bormide fumigation treatment is applied as a mortality measure, and for *Argyrotataenia ljungiana*, a systems appraoch involving pheromone-trap monitoring during the growing season (from April until harvest) is applied as the risk management measure.

Key words: Import risk analysis, Plant quarantine, Table grape, MB fumigation, Systems approach

P168

Import risk analysis of fresh table grape from Republic of South Africa

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Animal and Plant Quarantine Agency(APQA) conducts Import Risk Analysis(IRA) in accordance with international standards (IPMSs) and domestic law and regulations to mitigate the risk of introducing pests of concern through the importation of foregin agricultural products. Republic of South Africa submitted a market-access request for table grape in 1994. After the assessment was put on hold in 2004 due to a change in priorities, it was resumed in 2012, and the risk analysis was completed in April 2025. There are 25 species of pests of concern associated with fresh table grape from South Africa, and three species require special risk management measures – two species of fruit flies (*Ceratitis capitata*, *C. rosa*) and the flase codling moth (*Thaumatotibia leucotreta*). A cold treatment (at or below 1.2°C for 19 days) was applied to the two species of fruit flies and the false codling moth.

Key words: Import risk analysis, Plant quarantine, Table grape, Cold treatment

P169

Monitoring of Regional Insecticide Resistance in *Frankliniella occidentalis* (Thysanoptera: Thripidae) on Greenhouse Peppers in Jeonnam Province, Korea

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Effective management of the western flower thrips, *Frankliniella occidentalis*, is challenged by the rapid development of insecticide resistance in Korea. Therefore, this study investigated the resistance status of *F. occidentalis* populations from six major greenhouse pepper production regions in Jeonnam province to nine commercial insecticides, Acrinathrin SC, Acetamiprid SL, Dinotefuran SL, Cyclaniliprole SL, Chlorfluazuron EC, Chlorfenapyr EC, Abamectin EC, Spinetoram WG, Emamectin benzoate EC. Based on mortality assays, insecticide efficacy was classified into three categories: high efficacy (>80%), moderate efficacy (30-80%), and low efficacy (<30%). Significant variation in resistance profiles was observed among the regions. The Hwasun population showed the highest resistance, with five of the nine insecticides (55.6%) showing low efficacy. In contrast, the Suncheon population was the most susceptible, where eight insecticides (88.9%) provided effective control. At the mortality, Spinetoram showed the highest efficacy, with an 88.9% efficacy rate across the surveyed farms. Emamectin benzoate (66.7%) and Chlorfenapyr (61.1%) also retained considerable efficacy. However, high frequencies of resistance were detected for Acrinathrin and Acetamiprid, with low efficacy rates of 66.7% and 77.8%, respectively. Our findings suggest that Spinetoram and Emamectin benzoate are the key ingredients for controlling *F. occidentalis* in Jeonnnam, and this information is critical for designing local insecticide resistance management (IRM) strategies to prolong the effectiveness of these vital tools.

Key words: *Frankliniella occidentalis*, Insecticide resistance management (IRM), Regional monitoring, Greenhouse pepper

P170

Environmental Factors Shaping the Distribution of *Osmia* species in South Korea

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From 2024 to 2025, four *Osmia* species were collected across 30 sites in South Korea, and their relationships with surrounding environmental factors were analyzed using a generalized linear mixed model(model fit: AIC = 377.0202, marginal R^2 = 0.695, conditional R^2 = 0.884). The highest abundance was observed at Jeongseon A (45.60%), followed by Andong A (11.65%) and Wanju B (9.85%). The distribution of *O. pedicornis* was positively associated with altitude. *O. cornifrons* increased with altitude and grassland, while *O. taurus* was positively related to temperature and grassland but negatively influenced by diurnal temperature range. *O. satoi* showed positive relationships with latitude, altitude, and relative humidity, but negative associations with longitude and wetland area. These findings indicate the habitat preferences of *Osmia* species, offering essential insights for habitat conservation and agricultural management.

Key words: Landscape ecology, Nesting habitat, Ecosystem services, Biodiversity conservation

P171

Seasonal occurrence of Tuta absoluta(Lepidoptera: Gelechiidae) in tomato greenhouse in JeonbukState

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The tomato leaf miner(*Tuta absoluta*) is a pest native to South America, found in over 100 countries. It is a major pest of solanaceous crops, including tomatoes, causing damage to leaves, stems and fruit. In Korea, it first occurred on Jeju in 2023 and has spread nationwide. In JeonbukState, it is necessary to develop control technology because it occurs in tomato cultivation area in 2023. To determine the optimal time for tomato leaf miner control, tomato plants were transplanted in greenhouses at the JeonbukState ARES in late April, and change of population of tomato leaf miner was observed using pheromone trap. As a result of the survey, adults of tomato leaf miner occurred from early May and the population reached its peak late June and mid-July. As a result of spraying the pesticide twice at four-day intervals in late May and late June, the control effect was 89.7 to 94.6% until the late growing stage.

Key words: *Tuta absoluta*, tomato, seasonal occurrence, control

P172

Evaluation of Regional Adaptability of the New RX Line of Honeybees in Chungcheongbuk-do, Korea

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Honeybees play a vital role in crop pollination and provide various beekeeping products such as honey, pollen, wax, and propolis, which contribute to farmers' income. To maintain and expand these values, the development of new honeybee strains is essential, and their adaptability to local environments must be verified. In this study, we compared colony development, productivity, overwintering ability, and disease resistance of the new RX line of *Apis cerana* with the control strain (Hanra-bee) under the conditions of Chungcheongbuk-do. The RX line exhibited similar colony growth to the control but showed higher nectar foraging ability (8%) and honey production (3%). Overwintering survival was 7.5%p higher with reduced feed consumption. Disease resistance was comparable, though the uncapping rate was higher. These results suggest that the RX line adapts well to local environments and may contribute to stable beekeeping and increased farm income.

Key words: *Apis cerana*, regional adaptability, overwintering

P173

Temperature-dependent Development Models of Fall armyworm, *Spodoptera frugiperda* (Smith) (Lepidoptera : Noctuidae) According to Different Constant Temperatures

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The temperature-dependent development of the fall armyworm, *Spodoptera frugiperda* (Smith), was investigated under seven constant temperature conditions (15.0, 18.0, 21.0, 24.0, 27.0, 30.0, and 33.0 ± 1°C; 65 ± 5% RH; 16L : 8D). The temperature-dependent development experiment was conducted from first larva to adult stage. The total developmental period was 113.5 days at 15°C, 69.8 days at 18°C, 42.9 days at 21°C, 37.0 days at 24°C, 28.5 days at 27°C, 25.2 days at 30°C, and 21.9 days at 33°C. The lower developmental threshold temperature was estimated to be 10.4°C, and the effective accumulated temperature was 476.2 degree-days (DD).

Key words: Fall armyworm, *Spodoptera frugiperda*, Lower developmental threshold, Degree days

P174

First report of Observation of Gynandromorphism in the Endangered Common Red Stag Beetle(Prosopocoilus astacoides blanchardi(Parry, 1873)) in Korea.

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The Common red Stag Beetle, a Protected spesies listed ad Class II Endangerd Wildlife in Korea, is a southern stag beetle species found exclusively on Jeju Island. Gynandromorphism, a very rare genetic condition where an individual exhibits both male and female characteristics, has occasionally been reported in other species of the Lucanidae family. However, the expression of gynandromorphism in the Common Red Stag Beetle had not been previously recorded in Korea.

On March 27, 2025, during a routine breeding study at the Insect Ecology Laboratory of Jeju National University in Jeju Special Self-Governing Province, a gynandromorphic variant of the Common Red Stag Beetle was discovered. A total of two such individuals were found, each displaying strong bilateral gynandromorphic traits.

Therefore, based on photographs and specimens, we hereby report this as the first record of gynandromorphism in the Common Red Stag Beetle in Korea.

Key words: Common red Stag Beetle, Stag Beetle, genetic disorder, gynandromorphism

P175

Occurrence Ecology and Damage Patterns of the Fig Weevil(*Aclees taiwanensis*)

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The fig weevil (*Aclees taiwanensis*) was first reported in Korea in 2020. Adults feed on fruits and stems at night, reducing yields, while larvae bore into the woody tissues of roots and stems, ultimately killing fig trees and causing severe damage to orchards. Field surveys of orchards revealed that adults and mature larvae overwintered at the root zone. Surveys of 10 fig trees conducted from May indicated that nocturnal adult density increased consistently until early September. Eggs measured an average of 1.4 mm in length and 0.9 mm in width, while head capsule widths of the first- and second-instar larvae were 0.7 mm and 1.3 mm, respectively. Significant differences between males and females were observed in body length, width, weight ($p<0.05$), and daily feeding amount ($p<0.01$). Feeding and oviposition were not observed on most major fruit trees such as apple, and statistically significant differences in adult attraction rates were observed in some species within the genus *Ficus*. These findings provide fundamental information on the ecological characteristics of *A. taiwanensis* and can serve as a basis for effective control strategies.

Key words: *Aclees taiwanensis*, *Ficus carica*, Ecology, Damage

P176

Pest occurrence during grapevine cultivation under different cultivation types

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This study investigated the occurrence patterns of major insect pests in grape orchards under different cultivation types. From April to October, pest populations were monitored at 10-day intervals in greenhouses, rain-sheltered cultivation, and heated greenhouses using inspection, pheromone, and sticky traps. The major pests identified were *Lycorma delicatula*, Thrips, Spider mites, *Apolygus spinolae*, and *Syllepte pallidinotalis*. The first occurrence of each pest was recorded as follows: *A. spinolae* in early May, *L. delicatula* in mid-May, Spider mites in late May, Thrips in early June, *Metcalfa pruinosa* in mid-June, and *S. pallidinotalis* in late July. In heated greenhouse cultivation, Spider mites were continuously detected from April to August. This continuous detection was attributed to the rapid accumulation of degree-days caused by early heating in spring. Peak occurrence periods were observed in mid-July for Spider mites, late July to early August for *L. delicatula*, late August for *S. pallidinotalis*, and early July for Thrips. These results clarify the influence of cultivation type on pest dynamics in grape orchards, providing a basis for prediction modeling and the establishment of optimal control timing.

Key words: bark beetle, monitoring, grapevine, cultivation types

P177

A report on the sporadic occurrence of *Phaeochrous emarginatus* in Jeju

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Among the two species of the genus *Phaeochrous* distributed in Korea, *P. emarginatus* is known to occur only on Jeju island. Although this beetle does not directly damage crops or humans, sudden outbreaks of the populations causes indirect problems such as unpleasant appearances and offensive odors resulting from the accumulation of numerous dead individuals, which can be considered as a nuisance pest like a love bug. In this survey, the species was first detected on July 21 and was found to occur for about one month. In particular, a massive outbreak was observed around August 10 for approximately one week, after which the population rapidly declined. Collections were carried out at seven sites using pit-fall traps, light traps, and traps baited with makgeoli. The number of *P. emarginatus* collected, reflecting site-specific abundance, varied considerably among sites, ranging from 0 to 80 individuals.

Key words: Hybosoridae, scavenger, out break, trap, forest pest

P178

Environmental factors affecting butterfly community in Jeju Island

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In this study, to identify the factors influencing butterfly community formation across 23 sites ranging from coast to high elevations of Hallasan Mountain on Jeju Island, we conducted a detailed analysis of biological traits of butterfly populations (Sedentary, male territory, Habitat type of larva, wing length, and annual generations times) as well as abiotic factors of survey sites (habitat altitude, vertical distribution range, nectar plants, and relative size of grasslands). Comparisons based on mean habitat altitude revealed statistically significant differences in vertical distribution range, number of nectar plants, number of annual generations times, wing length, and sedentary. Comparisons based on vertical distribution range showed significant differences in number of nectar plants, annual generations times, wing length, and male territory. Among the biological traits of butterflies wing length and annual generations times exhibited significant variation. Furthermore, decision tree analysis using ten variables indicated that vertical distribution range (Y7) had the greatest influence in differentiating groups.

Key words: Butterfly community, Biological factors, Nectar plants, Vertical distribution, Jeju Island

P179

Insect fauna of Dokdo Island, Korea: results of the 2025 survey

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Dokdo Island is the easternmost territory of South Korea, consisting of Dongdo, Seodo, and 89 other associated rocks. Due to its isolated location, approximately 87.4 km from the nearest island, Ulleungdo, and 216 km from the Korean Peninsula. It is considered a significant area for geological, biodiversity, and biogeographical research. The insect fauna of Dokdo has been investigated for approximately 50 years, begining in 1974. To date, 201 species representing 80 families and 10 orders have been reported. In this study, we carried out two surveys in May and August 2025 using various methods including sweeping, sifting, light traps, UV bucket traps, pitfall traps, and a Malaise traps. The species list and habitus images of the collected insects are also provided.

Key words: Dokdo, Biodiversity, new records

P180

Sex-Manipulating Endosymbiont Infections in Korean Insects: Patterns Across Orders and Ecological Traits (Terrestrial vs. Aquatic)

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Insects interact with diverse endosymbiotic bacteria. These associations may influence their ecological adaptation and evolutionary processes. The prevalence of these endosymbionts may vary depending on host ecology, including habitat, life-history traits, and diet. However, to our knowledge, only a few studies have reported the infection patterns of sex-manipulating endosymbionts (*Wolbachia*, *Spiroplasma*, *Cardinium*, and *Rickettsia*) across insect taxa in Korea. In this study, we surveyed insects collected from various regions in Korea to detect endosymbiont infections and compared prevalence across insect orders and habitat types. The analysis revealed significant variation in prevalence among orders. Notably, infection prevalence also differed significantly between terrestrial and aquatic insects, with infections rarely detected in aquatic taxa. These results suggest that infection patterns of sex-manipulating endosymbionts may be associated with host ecological traits, particularly habitat type. This study provides baseline data for understanding insect–microbe associations within an ecological framework.

Key words: Sex-manipulating endosymbionts, *Wolbachia, Spiroplasma*, Infection patterns

P181

Comparison of Insect and Plant Communities in Eco-friendly and Conventional Upland Fields of Chungcheong Provinces, Korea

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This study compared insect and plant communities between eco-friendly and conventional upland fields in the Chungcheong region, Korea. Surveys were conducted three times in pepper (Taean), soybean (Cheongyang), potato(Yesan), and maize(Goesan) fields. Insects were sampled using sticky traps, pitfall traps, and sweep nets, while plant communities were assessed using the Braun-Blanquet scale. Conventional fields were characterized by a dominance of Diptera, Thripidae, Aphididae, and Hymenoptera, with diverse weed species evenly distributed. In contrast, eco-friendly fields were overwhelmingly dominated by Formicidae, and only a few weed species, such as Equisetum arvense, Digitaria ciliaris, and Trifolium repens, prevailed. Overall, conventional farming supported greater ecological diversity, whereas eco-friendly farming exhibited skewed dominance by specific taxa.

Key words: agricultural environment change survey, ecological environment, biota, biodiversity

P182

Temperature variability as a driver of overwintering outcomes in honey bee colonies across South Korea

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Honey bee (*A. mellifera*) colonies are increasingly threatened by climatic instability and landscape changes. Winter colony losses have recently increased in South Korea, but studies on climatic and landscape influences remain limited. In this study, we examined the effects of winter temperature variability and landscape composition on overwintering success of colonies at 40 apiaries. Average overwintering success was 69.1%, and colony strength declined by 41.3%. Mean winter temperature showed no effect, but higher temperature variability was negatively associated with survival. Crops and wetlands showed weak positive effects depending on temperature stability. Our results suggest that stable winter conditions and autumn floral resources are important for colony survival, and region-specific management is needed under climate change.

Key words: managed pollinator, land cover, overwintering success, colony strength

P183

Critical issues in hyperspectral monitoring: experimental design and radiometric calibration

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Hyperspectral imaging faces a few critical methodological challenges that significantly impact classification reliability. First, over 94% of studies suffer from the "small N, large P" problem where spectral bands exceed observations, causing overfitting, and lack independent validation. Our simulations demonstrate that even random data achieves misleadingly high accuracies (Kappa 0.7-1.0) without proper validation. Second, temporal radiometric repeatability remains poorly addressed. Using 52 flight missions across three days, we compared four calibration methods and found that enhanced atmospheric radiative transfer model significantly outperforms traditional empirical line method (>95% vs 71-87% repeatability). Spectral bands beyond 900 nm show disproportionately lower repeatability. These findings establish that classification targets must differ by at least 5% for reliable performance and provide validated frameworks for improving hyperspectral monitoring methodology.

Key words: hyperspectral sensing, overfitting, repeatability

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P184

Evaluation of Biodiversity Changes According to Land Use and Farming Methods in Agricultural Lands Nationwide

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To conserve the domestic agricultural environment and ensure agricultural sustainability, it is necessary to appropriately manage agricultural input use and shift toward organic matter-based farming practices. Since 2021, this study has divided the nation into five regions (Gangwon, Gyeonggi, Chungcheong, Gyeongsang, and Jeolla) and has been conducting biodiversity surveys (flora and insect communities) in different land uses—uplands, orchards, rice paddies, and greenhouses—on a four-year rotation cycle. According to flora survey results from 2021 to 2024, survey results on flora showed that the number of plant taxa observed was 6 to 40 more in environmentally friendly farming methods compared to conventional methods each year. Similarly, in terms of insect fauna, the number of species observed was 10.0% to 35.0% higher nationwide under environmentally friendly farming practices compared to conventional practices.. This study aims to provide fundamental data for the discovery of biological resources in agricultural ecosystems and for policy initiatives to improve the agricultural environment.

Key words: *Flora, Insect fauna, Environmentally friendly farming*

P185

Mathematical analysis of critical thermal parameters in *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) using SSI model differentiation

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The green peach aphid, *Myzus persicae*, is a serious pest whose development depends on temperature. In addition to R-based estimation of the SSI model, we simultaneously applied differential and partial differential analyses to directly determine critical parameters. Stage-specific data under constant temperatures (5~32.5°C) revealed critical thresholds. Development accelerated up to 25°C but declined sharply beyond 30°C, reflecting strong heat stress. The differential approach provided more precise insights into stage-dependent thermal optima. These results underscore the utility of mathematical analysis of the SSI model for predicting aphid population dynamics.

Key words: *Myzus persicae,* SSI model, Differentiation, Temperature, Thermal thresholds

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P186

Oviposition characteristics of *Zeugodacus cucurbitae* (Coquillett) on host fruits and vegetables

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The melon fruit fly, *Zeugodacus cucurbitae*, is a polyphagous pest that attacks a broad range of fruits and vegetables. Female adults oviposit beneath the host surface, and larvae feed internally, causing rapid decay. We investigated oviposition behavior on ten fruit and eight vegetable species to assess host use. Females marked oviposition sites and deposited eggs on all tested crops, but the frequency of oviposition and adult emergence varied among hosts. We assessed adult emergence from the infested fruits and vegetables to evaluate host suitability.

Key words: *Zeugodacus cucurbitae*, adult emergence, host crop, oviposition

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P187

Comparative morphological analysis of mixed pollen in Robinia honey and nectar plants around apiaries in Korea

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This study investigated the morphological characteristics of pollen grains mixed into Robinia honey from 17 regions in South Korea and compared them with pollen from nearby nectar plants. The number of pollen types per sample ranged from 12 to 31, with some regions showing distinctive morphotypes. Rounded, triangular and elongated forms were common. While saccated and irregular types were region-specific. Although partial morphological similarity was found between honey and local plant pollen, complete matches were not observed. These findings suggest that mixed pollen reflects both local flora and the broader foraging range of honeybees, influenced by migratory beekeeping. This morphology-based comparison offers insight into regional pollen patterns in Korean Robina honey.

Key words: Robinia honey, Mixed pollen, Pollen morphology, Nectar plant comparison

Acknowledgement: This research was funded by the RDA(PJ01745701), Republic of Korea.

P188

Re-calculation of the degree-day model including developmental inhibition at high temperature on the insect: case study for phenological analysis of *Grapholita molesta*

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A relationship between insect development rate and temperature is schematically linear within the optimal temperature range, but a nonlinear curve emerges, with development rates rapidly declining at high temperatures above 28-30℃. Degree-day, calculated using the lower developmental threshold(℃) and thermal constant derived from a linear model, is widely used as a method for predicting pest occurrence because it is very simple method and derive key values with relatively little data. However, failure to account for the developmental inhibition at high temperature, coupled with the recent climate crisis, can lead to overestimation of pest occurrence. Therefore, we recalculated and verified the two parameters for the pest using three cut-off methods of high temperature effect:1) horizontal, 2) intermediate, 3) vertical cut-off. Using a lower developmental threshold of 8.1℃, the thermal constant of 330.6DD obtained from intermediate method was found to be the most appropriate value for a single generation of *G. moelsta*.

Key words: thermal constant, cut-off, Grapholita molesta, pome pest, heat inhibition

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P189

Biological note on *Coccotrypes cardamomi* Schaufuss (Coleoptera, Curculionidae) in South Korea.

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Species belonging to the genus *Coccotrypes* are known primarily as pests that attack various plant seeds. Recently, the species, *Coccotrypes cardamomi* Schaufuss, 1905, newly recorded in Korea, has been found in Jeollanam-do and Jeju-do, where it was confirmed to infest the acorns of *Quercus acuta* Thunberg (Fagaceae). These beetles mainly bore into fruits that have been cut from the branches and dropped to the ground by the acorn weevil, *Cyllorhynchites* (*Cyllorhynchites*) *ursulus quercuphillus* Legalov, 2007, after oviposition. One to three females bored into an acorn, and between six and seventeen eggs were observed. Among the larvae, the number of males corresponded to that of the female adults, and all the remaining larvae were females. The pupae usually consisted of one male and at least two females, and the male pupa was distinctly smaller than the female pupae.

Key words: *Coccotrypes cardamomi, Quercus glauca, Cyllorhynchites* (*Cyllorhynchites*) *ursulus quercuphillus,* acorn, seed pests.

Acknowledgments: This research was funded by the Korea Forest Service, Republic of Korea, "Forest Science and Technology Development" (Project No. FE0300-2023-01).

P190

Occurrence and analysis of citrus nematode(*Tylenchulus semipenetrans*) in Jeonbuk State

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In order to investigate the infection status of the citrus nematode(*Tylenchulus semipenetrans*) occurring in tangor(mandarin hybrid) orchards in the Jeonbuk State, soil and root samples were collected from 13 cultivation sites, and nematodes were isolated and identified. As a result, citrus nematodes were found in 13 points (100%) of the total 13 samples, and the differences were analyzed by cultivation year, cultivar, eco-friendly. When the average nematode density was compared by cultivation year, farms with more than eight years of cultivation exhibited higher densities(average density: 729 nematodes) than those(172 nematodes) with fewer years of cultivation. When cultivar-specific differences were evaluated based on farms with more than eight years of cultivation, shiranui exhibited a markedly higher nematode density(1094 nematodes) compared with Kanpei(456 nematodes). The comparative analysis of nematode densities between eco-friendly and conventional cultivation systems demonstrated that eco-friendly cultivation exhibited approximately 55% higher densities than conventional farms.

Key words: tangor, *Tylenchulus semipenetrans*

P191

Identification of stink bugs collected from corn fields in 2024 and 2025

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최근 초당옥수수 재배 농가에서는 노린재에 의한 이삭 피해가 지속적으로 발생하고 있다. 2024~2025년 모니터링 결과, 옥수수 재배지에서 총 5종의 노린재가 관찰되었다. 이 중 장님노린재과(Miridae) 2종은 주로 옥수수 수술에 서식하여 이삭에는 직접적인 피해를 주지 않으나, 알락수염노린재(*Dolycoris baccarum*), 풀색노린재(*Nezara antennata*), 시골가시허리노린재(*Cletus punctiger*)는 옥수수 이삭을 흡즙하여 피해를 일으키는 것으로 확인되었다. 2024년에는 남부 지역에서 6월 중순 알락수염노린재가, 북부 지역에서는 6월 하순~7월 하순 동안 시골가시허리노린재가 우점하는 양상이 나타났다. 2025년에는 7월 상순 북부 지역에서 3종의 노린재가 혼재 발생하였으며, 7월 하순 남부 지역에서는 알락수염노린재가 우점하였다. 채집된 개체군은 미토콘드리아 사이크롬 c 산화효소 I(COXI) 유전자 염기서열 분석을 통해 종 동정을 수행하였고, 지역별 유전적 변이를 비교하였다.

검색어: 노린재, 옥수수, 종동정

P192

A Survey on the current status of leading Black soldier fly(*Hermetia illucens*) farms in Korea

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Since the implementation of the Insect Industry Promotion Act in 2018, Korea's insect industry has steadily developed, reaching sales of 47.9 billion KRW in 2023, with an annual growth rate of over 7%. Among industrial insects, the Black Soldier Fly (Hermetia illucens), a representative feed insect, has shown the largest increase in sales, accounting for approximately 25% of the total market (11.5 billion KRW). In Korea, the Black Soldier Fly is already being utilized as a feed ingredient for livestock, including swine and aquaculture species. However, as it mainly serves as a protein source to replace fishmeal, farms must adopt intensive and large-scale production systems to secure price competitiveness. Despite this need, the number of farms and the overall production volume remain limited. A major constraint lies in the lack of information on rearing systems and intensive farming techniques, which poses difficulties for new entrants. To address this, we investigated the facilities and rearing systems of farms with large-scale production capacity, defined as those operating on an area of at least 660 m². Most farms used square cages of 150–160 cm stacked in 5–6 tiers, supplying 150–200 kg of wet feed per unit. The average wet feed input was more than 200 tons per month, exceeding 20 tons per day. These large-scale farms produced approximately 60 tons of larvae per month, with 20 tons processed into dried larvae for feed applications. Such practical information is expected to be valuable for attracting and supporting new participants in the industry.

Key words: Leading farms, farm status, black soldier fly

P193

Productivity improvement of human papillomavirus virus like particles in insect cells using hyper-expression baculovirus vector system

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Virus-like particle (VLP) vaccines based on human papillomavirus (HPV) L1 proteins have high efficacy for preventing cervical cancer and other HPV-associated diseases. The production yields of commercial HPV VLPs remain suboptimal, we aimed to improve HPV VLP production efficiency using a hyper-expression vector system for the expression of L1 proteins of major HPV serotypes. HPV L1 proteins were expressed in *Trichoplusia ni*(Hi5) insect cells via a hyper-expression baculovirus vector system. Immunogenicity was evaluated using a murine model. The resulting IgG and neutralizing antibody responses were compared with those elicited by the commercial vaccine. The L1 proteins from major HPV serotypes. were successfully expressed at high levels in Hi5 cells, forming uniformly sized VLPs with hydrodynamic diameters of 50–60 nm. The average production yield of the VLPs exceeded 40 mg/L, an improvement over conventional yields. The candidate VLPs elicited strong HPV-specific IgG and neutralizing antibody responses in mice. The hyper-expression baculovirus vector system enables high-yield production of HPV L1 VLPs with desirable structural and immunogenic properties.

Key words: Baculovirus, Human papillomavirus, Cervical cancer, VLP, immunogenicity, vaccine

P194

Acceptability and Effectiveness of Insect-Based Healing Programs: A Survey Analysis

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This cross-sectional survey of 164 adults was conducted to assess the acceptability of insect healing programs. Insect preference analysis showed that 86.5% of respondents reported a favorable perception. Program activities were evaluated on a 5-point Likert scale, with mean scores ranging from 3.37 to 3.46; listening to insect sounds received the highest score (3.46±1.07), and the gap across activities was minimal (0.09). No significant differences were found by insect-rearing experience (n.s.), indicating a consistent acceptance regardless of participants' background. Overall, insect healing programs were received positively. As the survey was conducted at an insect contest, participants may have been more familiar with insects than the general population, so interpretation requires caution. Future studies should use randomized sampling and integrate physiological and psychological indicators to validate program effects.

Key words: insect healing program, acceptability, preference, survey

P195

Silkworm Germplasm Preservation in Gangwon Province with Automated Rearing and Data Management

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The Gangwon State Agricultural Products Seed Center manages and preserves 90 silkworm germplasm lines, including both its own lines and those distributed by the Rural Development Administration. Since long-term preservation of silkworm eggs is difficult, the eggs are hatched and reared every year. Through rearing, mating, and oviposition, the Center records and maintains information on the morphology, rearing period, and rearing conditions of the 90 germplasm lines. The Insect Industry Center manages rearing by using rearing boxes and an automated line data collection application, in order to ensure efficient data management and to prevent errors such as crossbreeding or misidentification of strains.

Key words: *Bombyx mori*, Silk worm, Germplasm line preservation

P196

Optimization of Rearing Density for the Industrialization of the Yellow Mealworm (*Tenebrio molitor*)

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The yellow mealworm (*Tenebrio molitor*) is one of the most extensively studied models for insect industrialization, and production systems in the form of smart farms have already been established overseas. This study was conducted to determine the optimal rearing density required for establishing a large-scale production system of *T. molitor*. Previous studies have primarily focused on surface area(cm^2) without considering depth, making it difficult to determine the appropriate number of larvae to rear within large rearing boxes in a three-dimensional setting. Therefore, the objective of this study was to establish the optimal rearing density for mass production by supplying pellet-type feed and evaluating core temperature, survival rate, and growth rate.

Key words: *Tenebrio molitor*, Meal worm, Rearing Density

P197

Effect of Water depth on survival rate of *Lethocerus deyrollei*

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Lethocerus deyrollei, designated as an Endangered Wildlife Class II species in the Republic of Korea, is currently being studied for artificial propagation at the Institute for Biodiversity Research, an ex situ conservation institution accredited by the Ministry of Environment. This study aimed to investigate the survival rate of *Lethocerus deyrollei* nymphs under different water depth conditions during artificial propagation, with the goal of developing a systematic rearing method. A pair of artificially propagated adults was mated, and the hatched individuals were reared from the first instar in circular PET rearing containers (12 cm × 30 cm) at water depths of 3, 6, and 9 inches, with 20 individuals assigned to each condition. The rearing was conducted for two months, from July to August 2025, under otherwise identical experimental conditions. As a result, the survival rates were 5% at 3 inches, 15% at 6 inches, and 25% at 9 inches. These findings suggest the need for further studies under diverse conditions to establish the optimal artificial propagation parameters for *Lethocerus deyrollei*.

Key words: *Lethocerus deyrolli*, water depth, survival rate

P198

Evaluation of the parasitic ability of *Sclerodermus harmandi* according to host species

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천공성 해충인 하늘소 유충의 천적인 개미침벌 *Sclerodermus harmandi* (=S. *guani*, S. *sichuanensis*)은 25℃ 암조건에서 약 1개월의 생활사를 가지며 하늘소 유충에 외부기생하여 기주를 무력화한다. 그러나 천적 활용을 위해서는 기주 하늘소 유충의 안정적 사육이 필요하므로, 대체기주 발굴이 요구된다. 본 연구에서는 알락하늘소, 갈색거저리, 꿀벌, 동애등에, 부식성 하늘소인 버들하늘소 유충을 대상으로 기주 적합성을 조사하였다. 공시된 유충을 대상으로 기생 능력을 평가한 결과 하늘소류에서만 기주 반응을 나타냈다. 특히 버들하늘소 종령 유충에서는 약 360마리의 부화 유충이 확보되어 울도하늘소(207마리) 대비 42% 많은 유충 수를 보였으나, 표피가 두꺼워 개미침벌유충 생육은 불량하였다. 따라서 버들하늘소를 대체기주로 활용할 경우 초기 또는 중기 유충을 이용하는 것이 적합할 것으로 판단된다. 향후에는 버들하늘소의 발육단계별 개미침벌의 산란수, 부화 유충수 및 생존율을 조사하여 대체기주 활용 가능성을 종합적으로 평가할 예정이다.

검색어: 개미침벌, 대체기주, 천공성해충 , 천적, 방제

P199

Overwintering diapause and oviposition characteristics of laboratory-reared *Anoplophora malasiaca* (Coleoptera: Cerambycidae)

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천공성 해충인 알락하늘소(*Anoplophora malasiaca=A.chinensis*)는 2020년 천안 블루베리 농장에서 34.2%의 피해가 확인되는 등 확산이 지속되고 있다. 특히 유충은 나무 속에서 활동하기 때문에 작물보호제로 방제하기가 쉽지 않다. 이에 따라 효과적인 방제방법 개발을 위해 알락하늘소의 인공사육 기반 확립을 목적으로 월동휴면 및 산란 특성을 조사하였다. 본 연구의 공시충인 알락하늘소는 충남 천안시의 무가온 블루베리 시설 하우스내에서 2024년 6월 상순~중순에 채집하였다. 증식한 유충은 월동 휴면자극을 위해 일정 온도와 기간를 처리한 결과 5℃ 휴면온도에서 30일간 월동 시 유충기간이 가장 짧게 나타났으며 무월동처리구는 대부분 용화하지 못했다. 우화한 성충은 새순을 급이하며 버드나무 가지를 넣은 처리구에서 가장 많은 38개/마리의 산란량을 보였다. 실내 시험조건에서의 알락하늘소 생활사는 알 7~15일, 유충 207~243일(월동휴면 30~60일), 번데기 14~15일 성충 37~64일로 총 263~338일의 생활사를 가지는 것으로 나타났다. 따라서 알락하늘소 실내사육 시 5℃ 휴면온도에서 30일간 월동 자극을 주어 성충으로 우화시키고 성충 산란환경 조성 시에는 버드나무 가지에 새순을 함께 급이하는 것이 산란량이 많아 가장 효과적임을 확인하였다.

검색어: 알락하늘소, 블루베리 피해, 생활사, 인공사육

P200

Optimization of Timing, Temperature, and Duration for Cold Storage of *Locusta migratoria* Egg Mass

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Locusta migratoria eggs use diapause and cold tolerance mechanisms, supporting potential for mass rearing. Long-term cold storage conditions for maintaining egg hatching rates remain understudied. This study aimed to determine optimal cold storage conditions for long-term preservation of *L. migratoria* egg masses. Eggs were stored at 7.5°C for 1 month starting on Days 1, 3, 6, and 9 after oviposition. The highest hatching rate (96.3%) was observed when storage began on Day 6 after oviposition, and no hatching occurred when initiated on Day 1. Among the temperatures tested (5°C, 7.5°C, 10°C, 12.5°C, and 15°C), 10°C yielded the highest hatching rate at 1 month (74.3%), followed by 7.5°C (69.3%). The lowest hatching rate (26.4%) was recorded at 5°C. Egg masses stored at 7.5°C and 10°C maintained high hatching rates (81.1%–86.9%) over a 10-day observation period, even after 5 months of storage. Regression analysis estimated maximum storage durations for maintaining hatching rates ≥ 90% as 2.8–3.9 months at 7.5°C, 2.3–3.8 months at 10°C, and only 0.6 months at 5°C. Notably, eggs stored at 7.5°C for 4 months beginning on Day 6 after oviposition exhibited a hatching rate > 90%, confirming the condition's suitability for extended preservation. Moreover, prolonged storage was associated with shorter hatching durations, suggesting continued embryonic development during cold storage. Thus, initiating cold storage at 7.5°C–10°C 6-day postoviposition allows effective long-term preservation of *L. migratoria* egg masses, contributing to the establishment of stable, year-round rearing systems.

Key words: cold storage, egg mass, hatching rate, *Locusta migratoria*

P201

Nutritional Improvement of *Cordyceps militaris* on Insect-Derived Substrates with *Tenebrio molitor* Larvae

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Cordyceps militaris has gained considerable attention owing to its diverse pharmacological properties, and the use of insect-derived substrates has emerged as a promising strategy for improving its nutritional quality. This study examined the effects of using an edible insect, *Tenebrio molitor*, as a cultivation substrate on the nutritional composition, amino acid profile, mineral content, and heavy metal levels of the fruiting bodies and mycelia of *C. militaris*. Three media types were used: a brown rice control (CTR), brown rice supplemented with *T. molitor* powder (TMP), and whole *T. molitor* larvae as the sole substrate (WTM), with samples classified into fruiting bodies (-f) and mycelia (-m). Insect-based media, particularly WTM, significantly enhanced protein contents in fruiting bodies and mycelia compared to those by CTR. Crude protein content increased from 24.8 ± 0.4% (CTR-f) to 40.6 ± 0.2% (WTM-f) in fruiting bodies, a 1.6-fold increase, and from 5.8 ± 0.2% to 71.5 ± 1.4% in mycelia, more than a 12-fold increase. In addition, essential amino acids were also elevated in WTM; lysine content increased from 0.43 ± 0.01% to 1.76 ± 0.03%, and leucine from 1.01 ± 0.01% to 2.12 ± 0.02% in WTM-f compared to those in CTR-f. Additionally, samples from the WTM group exhibited relatively high concentrations of key minerals, indicating a substantial improvement in overall nutritional quality. Furthermore, the heavy metal levels (Pb, Cd, and As) in all groups remained well below the regulatory limits, confirming the safety of insect-based cultivation. Collectively, our data support *T. molitor*-based substrates as safe, sustainable alternatives to grain media and provide a basis for industrial-scale production of high-value *C. militaris* with enhanced nutritional quality.

Key words: *Cordyceps militaris*, insect-based substrate, nutritional composition, *Tenebrio molitor*

P202

Effects of Moisture Content and Substrate Depth of Fermented Sawdust on Oviposition of the Rhinoceros Beetle (*Allomyrina dichotoma*)

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The rhinoceros beetle (*Allomyrina dichotoma*) is one of the most commercially important insect species in Korea, with applications in education, pet breeding, and exhibition. However, efficient mass rearing is constrained by its univoltine life cycle and limited oviposition under artificial conditions. This study investigated the effects of fermented sawdust moisture content and substrate filling depth on oviposition performance. Experimental treatments included five moisture levels (40%, 50%, 60%, 70%, and 80%) and four substrate depths (5, 10, 15, and 20 cm), under controlled environmental conditions (24 ± 2 °C, 60% RH, photoperiod 14L:10D). One mating pair was placed in each oviposition container for one week, then transferred sequentially to new containers. After five weeks, the number of eggs and larvae were counted. The results indicated that oviposition was maximized at 60% moisture content, yielding nearly 100 eggs per pair, whereas both lower (50%) and higher (70%) moisture levels reduced egg production to approximately 60% of the maximum. In addition, oviposition was highest when fermented sawdust was filled to at least 70% of the container height, suggesting that substrate depth is a critical factor for female oviposition preference. These findings demonstrate that optimizing both substrate moisture and depth is essential for enhancing reproductive efficiency and ensuring stable seed stock production.

Key words: *Allomyrina dichotoma*, oviposition, fermented sawdust, moisture content, substrate depth, mass rearing

P203

Temperature and Dissolved Oxygen Dynamics in Rearing Facilities of the Firefly *Luciola lateralis*

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This study aimed to evaluate the physicochemical conditions of rearing environments for the firefly *Luciola lateralis*, focusing on water temperature and dissolved oxygen (D.O.). Measurements were conducted between April and September 2025 in both groundwater storage tanks and indoor rearing systems (rearing tanks and containers). The groundwater storage tanks maintained relatively stable temperatures ranging from 19.6 to 21.7 °C with consistently sufficient DO levels. In contrast, the indoor rearing systems exhibited gradual temperature increases during summer, rising from 22.3 °C to 24.5 °C, accompanied by fluctuations in D.O. concentration. These seasonal and facility-dependent variations indicate that high summer temperatures may reduce D.O. availability, potentially affecting larval survival and development. The findings highlight the necessity of incorporating cooling and aeration strategies into large-scale rearing facilities. This study provides fundamental data to support the stable mass-rearing of *L. lateralis* for ecological exhibitions, conservation, and educational programs.

Key words: *Luciola lateralis*, rearing environment, water temperature, dissolved oxygen, firefly culture

P204

Nutritional optima for key performance traits in the lesser mealworm, *Alphitobius diaperinus* (Coleoptera: Tenebrionidae)

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In recent years, the lesser mealworm, *Alphitobius diaperinus* (Coleoptera: Tenebrionidae), has attracted attention as a promising protein source for animal feed. Despite its growing commercial relevance, the nutritional requirements of *A. diaperinus* larvae remain poorly understood compared with related species. Here, we employed a nutritional fitness landscape approach, rearing larvae on 36 chemically defined diets varying in protein:carbohydrate (P:C) ratios and total macronutrient (P+C) concentrations. We then recorded key life-history traits, including growth rate, survivorship, body mass, and the duration of larval stage. Our results revealed distinct nutritional optima across traits, reflecting possible nutrient-mediated trade-offs among them. Survivorship was high under protein-rich diets while development was delayed on carbohydrate-biased diets. Growth rate peaked at an extremely protein-skewed P:C ratio of 7:1, whereas body mass was maximized at a less extreme but still protein-biased ratio of 3:1. Our findings have implications for diet optimization in the mass rearing of this insect of emerging economic importance.

Key words: nsect as feed, *Alphitobius diaperinus*, macronutrient balance, nutritional geometry

P205

Colony Management and Pollination Effects of *Bombus terrestris* in Container-type Strawberry Vertical Farms (plant factory with artificial lighting, PFAL)

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Stable strawberry production in PFAL systems requires well-structured pollination management. We evaluated the pollination efficacy of managed *B. terrestris* and analyzed colony management, colony environment, and pollination effects in a container-type strawberry vertical farm (PFAL). The marketable fruit set in the *B. terrestris* treatment was 78.4 ± 13.3%, about 28.6 percentage points higher than hand pollination, a significant increase. Therefore, in strawberry vertical farms, using pollinators rather than hand pollination is likely to be advantageous for stable production. Colony survival duration did not differ between storage sites (cultivation area vs. control room), but pollen supplementation extended it by about 12 days, highlighting the efficacy of this colony-management intervention. Diurnal activity peaked at 10:00 and 14:00, with longer floral residence at 14:00.

Key words: Bumblebee, *Bombus terrestris* L., pollination, Strawberry Vertical Farm

P206

Isolation of fungal strains for Batryticatus Bombyx, production and functional characterization

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Batryticatus Bombyx, the hardened body of silkworms infected with *Beauveria bassiana,* is widely used in traditional Korean medicine for treating conditions such as pruritus and stroke. However, large-scale domestic production is currently non-existent, relying entirely on imports. To address this, this study aimed to isolate and identify new strains of *B. bassiana* for domestic mass production. Metagenomic analysis of silkworms infected with muscardine disease revealed four novel strains of *B. bassiana*. These strains, designated YW1, YW2, YW3, and YW4, were evaluated for their infectivity to silkworms. *B. bassiana* YW1 exhibited the highest infectivity, exceeding 90%, while YW2, YW3, and YW4 demonstrated infectivities above 70%. To assess their potential as functional ingredients, the strains were subjected to enzymatic hydrolysis and extraction. Although there were no significant differences in extraction efficiency, YW4 showed the highest yield. Furthermore, an analysis of NK cell activation revealed that YW1 and YW3 exhibited superior immune-enhancing effects. YW1 and YW3 showed enhanced macropnage and Natural killer cell functions. In conclusion, while all isolated strains showed potential for mass production, YW1 and YW3 were identified as the most promising candidates for industrialization due to their high infectivity and functional properties.

Key words: Batryticatus Bombyx, Beauveria bassiana, infectivity, functionality

P207

Comparative Analysis of Nonlinear Growth Curve Models for BSF(*Hermetia illucens*) Larvae

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The black soldier fly (*Hermetia illucens*) is a promising insect resource for feed production and organic waste valorization. Understanding its growth dynamics is essential for optimizing mass-rearing strategies. This study aimed to evaluate the applicability of four nonlinear growth curve models; Logistic, Gompertz, Richards, and von Bertalanffy to describe larval development. The experiment began with larvae at 5 days post-hatching, and body weight was recorded at regular intervals during the larval stage. Growth data were fitted to each model, and key parameters such as asymptotic weight, growth rate, and inflection point were estimated. Model performance was assessed using R^2, AIC, BIC, and RMSE. Preliminary analysis indicated that the Gompertz, Richards and Logistic models provided the most flexible description of the growth trajectory. These findings suggest that nonlinear modeling can effectively characterize the growth of *H. illucens*, offering a quantitative framework for future applications in insect farming and industrial production systems.

Key words: *Hermetia illucens*, Nonlinear growth curve

P208

Evaluation of agro-industrial by-products as alternative feed resources for black soldier fly (*Hermetia illucens*) larvae

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The black soldier fly (BSF) is a representative feed insect widely used as an alternative protein source. Regulatory changes, however, have restricted the direct use of food waste for livestock, creating a need for alternative resources. In this study, agro-industrial by-products were evaluated as feed for BSF larvae. Larval weight was comparable to or higher than the control when soybean curd residue, cake sheet, and ginseng were supplied, with cake sheet and ginseng showing increases of 13% and 13.7%, respectively. Soybean curd residue did not significantly affect weight but allowed harvesting four days earlier. Feed conversion efficiency and larval reduction rate did not differ significantly from the control when soybean curd residue and cake sheet were mixed with food waste at a 2:8 ratio. Overall, these results suggest that agro-industrial by-products can serve as alternative feed resources for BSF. The soybean curd residue treatment resulted in ammonia emission about 3.45 times higher than the control, suggesting that odor mitigation strategies should be implemented in parallel.

Key words: Black soldier fly, BSF, Agro-industrial by-products

P209

Trait-based evaluation of silkworm genetic resources for core collection selection

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Animal genetic resources, including breeds, strains, and wild relatives of domesticated species, are essential biological assets that support agricultural productivity both directly and indirectly. *Bombyx mori*, the domesticated silkworm, is a major industrial insect, with 340 genetic resources currently preserved and managed under national programs. In this study, 50 representative genetic resources were selected based on historical breeding records and phenotypic characteristics to improve the efficiency of conservation and utilization. Morphological features and rearing traits were examined across larval, pupal, and adult stages, and antioxidant activity was also assessed, revealing marked phenotypic and functional diversity among the resources. This core collection provides a valuable foundation for future strategies in genetic resource conservation, breeding, and industrial application of silkworms.

Key words: *Bombyx mori*, silkworm, genetic resources, core collection, trait

P210

Variant discovery and trait association through whole genome re-sequencing of silkworm genetic resources

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Among the 340 silkworm (*Bombyx mori*) genetic resources conserved in Korea, 20 representative resources with diverse morphological and rearing traits were selected. Whole-genome resequencing was conducted on 200 individuals to identify useful genetic variants for future molecular breeding. Sequencing generated an average of 56× coverage per individual. Variant calling yielded 28.7 million variants, of which 14.3 million high-confidence SNVs remained after stringent filtering. Population structure analysis revealed that most genetic resources were clearly differentiated from one another, while genomic similarity among individuals within each resource was generally very high. In addition, genome-wide association studies for 21 traits using mixed linear models detected numerous significant variants, providing a valuable resource for future molecular breeding in silkworm.

Key words: silkworm, genetic resources, single nucleotide polymorphism, genome-wide association studies

P211

Comprehensive phenotypic characterization of 74 additional silkworm genetic resources

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The domesticated silkworm (*Bombyx mori*) is an economically important industrial insect, with more than 340 genetic resources preserved in Republic of Korea. Despite this diversity, many resources remain insufficiently characterized, limiting their potential applications in biotechnology. In this study, we evaluated 74 additional silkworm strains for developmental and cocoon traits, such as larval duration, weight, pupation rate, cocoon and shell weight, and cocoon color under standardized conditions. The results revealed considerable variation across all traits, underscoring the rich phenotypic diversity maintained in silkworm resources. These findings expand the phenotypic database of Korean silkworm resources and provide a foundation for targeted breeding, conservation, and the development of functional biomaterials.

Key words: *Bombyx mori*, silkworm, genetic resources, phenotypic diversity

P212

Evaluation of feeding ability of silkworm original strains on an artificial diet

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Silkworm original strains serve as fundamental genetic resources for silkworm breeding and are primarily preserved by research institutions such as the National Institute of Agricultural Sciences. This study was conducted to develop silkworm strains suitable for artificial diet-based rearing by applying artificial diets to original strains and selecting those with superior adaptability. For this purpose, artificial diet adaptability tests were performed on 17 Chinese strains and 18 Japanese strains, and traits such as pupation percentage, whole cocoon weight, and cocoon shell weight were investigated. Among the 35 original strains tested, 8 original strains exhibited low feeding ability on the artificial diet, showing setae dispersion rate of less than 10%. The larval period ranged from 24.00 to 28.23 days. The cocoon shell ratio was highest in Jam 153 at 33.22% and lowest in Jam 151 at 10.71%. In the future, silkworm original strains with superior feeding ability will be selected, aiming to develop silkworm varieties capable of complete larval rearing on artificial diets.

Key words: artificial diet, silkworm, original strain

P213

Effect of feeding by-products of king oyster mushroom cultivation on the growth and nutritional value of *Protaetia brevitarsis* larvae

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To investigate the effects of feeding king oyster mushroom cultivation by-products (Kom) on the development, nutrition, and safety of *Protaetia brevitarsis* larvae, we conducted a comparative analysis of body weight, survival rate, nutrients, and toxic substances. When Kom were mixed with fermented oak sawdust (Fos+Kom), larvae weight increased 1.2-5.3 times compared to the control group (fermented oak sawdust, Fos). Nutritional analysis revealed that the Fos+Kom group increased protein content by 1.5 times and dietary fiber by 1.6 times compared to the control group. Among minerals, only iron content increased by 1.2 times. All groups met the edible insect heavy metal management standards. Considering these results, a mixed feed of king oyster mushroom cultivation by-products and fermented oak sawdust is considered highly valuable as a feed for *Protaetia brevitarsis* larvae.

Key words: *Protaetia brevitarsis*, king oyster mushroom cultivation by-products, mixed feed

Small Group Meeting

SG1-1

Insecticide response of the western flower thrips (*Frankliniella occidentalis*) occurring in hot pepper cultivation facilities in the Yeongnam region

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The western flower thrips (WFT), a major pest occurring in domestic hot pepper cultivation areas, are a representative sap-sucking pest that damages plant tissues, causing growth retardation and the spread of viruses. WFT have been reported to be resistant to various insecticides. As part of a study to screen for insecticide resistance in WFT occurring in greenhouse pepper cultivation areas in Korea, this study examined the insecticide responses of WFT collected from 17 greenhouse pepper cultivation areas in 7 cities and counties in the Yeongnam region to nine commercially available insecticides (acrinathrin, acetamiprid, dinotefuran, cyclaniliprol, chlorfenapyr, abamectin, spinetoram, and emamectin benzoate). In addition, we investigated the pesticide use history of WFT collecting farms and information on the thrips species occurring in each farm.

Key words: greenhouse, hot peppe, insecticide, resistance, western flower thrips

SG1-2

Monitoring of regional insecticide resistance of *Frankliniella occidentalis* in pepper greenhouses in Gangwon Province, Republic of Korea.

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The western flower thrips, *Frankliniella occidentalis*, is known as a significant agricultural pest that causes substantial damage to vegetable, fruit, and ornamental crops through feeding and oviposition. They also transmit the tomato spotted wilt virus (TSWV) during feeding. Numerous insecticides have been applied to control *F. occidentalis*. Resistant populations have rapidly emerged due to their biological characteristics, such as a short life cycle and high reproductive capacity. To date, over 100 cases of insecticide resistance have been reported for various active ingredients worldwide, including Spain, Turkey, New Zealand, Japan, and China. In this study, field populations were collected from chili pepper greenhouses in eight regions in Gangwon Province, the Republic of Korea (Chuncheon, Hoengseong, Hongcheon, Hwacheon, Inje, Pyeongchang, Yanggu, and Yeongwol) to evaluate the level of insecticide resistance, which was measured using the leaf dipping assay against nine insecticides classified by different modes of action. Spinetoram, emamectin benzoate, and chlorfluazuron were highly effective against *F. occidentalis*, while acrinathrin and abamectin were less effective insecticides. Regional differences in mortality were also observed for acetamiprid, dinotefuran, chlorfenapyr, and cyclaniliprole. Taken together, these results highlight the necessity of continuous resistance monitoring and region-specific management strategies to ensure the sustainable control of *F. occidentali*s in Korea.

Key words: *Frankliniella occidentalis*, Bioassay, Insecticide resistance

SG1-3

Monitoring of Regional Insecticide Resistance in *Frankliniella occidentalis* (Thysanoptera: Thripidae) on Greenhouse Peppers in Jeonnam Province, Korea

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Effective management of the western flower thrips, *Frankliniella occidentalis*, is challenged by the rapid development of insecticide resistance in Korea. Therefore, this study investigated the resistance status of *F. occidentalis* populations from six major greenhouse pepper production regions in Jeonnam province to nine commercial insecticides, Acrinathrin SC, Acetamiprid SL, Dinotefuran SL, Cyclaniliprole SL, Chlorfluazuron EC, Chlorfenapyr EC, Abamectin EC, Spinetoram WG, Emamectin benzoate EC. Based on mortality assays, insecticide efficacy was classified into three categories: high efficacy (>80%), moderate efficacy (30-80%), and low efficacy (<30%). Significant variation in resistance profiles was observed among the regions. The Hwasun population showed the highest resistance, with five of the nine insecticides (55.6%) showing low efficacy. In contrast, the Suncheon population was the most susceptible, where eight insecticides (88.9%) provided effective control. At the mortality, Spinetoram showed the highest efficacy, with an 88.9% efficacy rate across the surveyed farms. Emamectin benzoate (66.7%) and Chlorfenapyr (61.1%) also retained considerable efficacy. However, high frequencies of resistance were detected for Acrinathrin and Acetamiprid, with low efficacy rates of 66.7% and 77.8%, respectively. Our findings suggest that Spinetoram and Emamectin benzoate are the key ingredients for controlling *F. occidentalis* in Jeonnnam, and this information is critical for designing local insecticide resistance management (IRM) strategies to prolong the effectiveness of these vital tools.

Key words: *Frankliniella occidentalis*, Insecticide resistance management (IRM), Regional monitoring, Greenhouse pepper

SG1-4

Insecticide resistance monitoring of *Frankliniella occidentalis* (Thysanoptera: Thripidae) on greenhouse peppers in Gyeonggi-do, South Korea

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The western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae), is an agricultural pest that feeds on more than 500 species of plants throughout its developmental stages. In addition, adults serve as vectors of multiple plant viruses. To establish baseline information for pest management, we monitored resistance of *F. occidentalis* to nine commonly used insecticides in South Korea. Field populations were collected from greenhouse pepper farms in six regions of Gyeonggi-do in 2025, with three farms sampled per region. Insecticide resistance was evaluated using leaf-dip bioassays with pepper leaves. Lethality at recommended application rate was evaluated against adults 72 hours after exposure for eight insecticides, while that was assessed against nymphal instars 168 hours after exposure for one insect growth regulator. Our results provide important information for designing an effective pest management strategy.

Key words: pest management, insecticide resistance, virus vector, *Capsicum annuum*

SG1-5

Monitoring of Insecticide Resistance in Western Flower Thrips (Frankliniella occidentalis) on Greenhouse Peppers in Gyeonggi-do and Jeollanam-do Provinces, Korea

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The western flower thrips (Frankliniella occidentalis) is a significant pest of greenhouse peppers, primarily due to its role as a virus vector, and developing insecticide resistance complicates its management. To address this, we assessed regional and chemical-specific resistance levels in major pepper cultivation areas of Korea. Field populations of thrips were collected from Gyeonggi-do (Ganghwa, Gimpo, Anseong, Yeoju, Paju, Hwaseong) and Jeollanam-do (Naju, Hampyeong, Muan). The resistance status was evaluated against nine insecticides from different modes of action: acrinathrin SC, acetamiprid SL, dinotefuran SL, cyclaniliprole SL, chlorfluazuron EC, chlorfenapyr EC, abamectin EC, spinetoram WG, and emamectin benzoate. Resistance was classified based on mortality rates into three categories: susceptible (>80%), intermediate (30-80%), and resistant (<30%). The results revealed that resistance to dinotefuran SL, cyclaniliprole SL, abamectin EC, acetamiprid SL, and acrinathrin SC was prevalent in many populations. Conversely, spinetoram WG, emamectin benzoate EC, and chlorfenapyr EC generally remained effective, showing lower resistance levels. Significant regional variations were observed, with populations from Paju, Anseong, Muan, and Naju exhibiting higher frequencies of resistance to multiple insecticides. The findings of this research serve as crucial baseline data for developing sustainable and localized control programs for western flower thrips, aiming to reduce the incidence of virus diseases in greenhouse peppers.

Key words: Frankliniella occidentalis, Insecticide resistance monitoring, Greenhouse pepper

SG2-1

Advances in dsRNA-Based Biopesticides: Mechanisms, Applications, and Policy Challenges

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Double-stranded RNA (dsRNA) is emerging as a next-generation biopesticide, offering high specificity and environmental safety. Yet, challenges remain in stability, delivery, and regulatory acceptance. Recent advances include novel carriers such as exosome-like vesicles and engineered microbiomes, self-amplifying RNA platforms that enhance efficacy at low doses, and insights into cross-kingdom RNAi between plants, insects, and pathogens. In parallel, global regulatory frameworks are evolving to address safety and off-target effects. These developments signal a shift from proof-of-concept studies toward integrated approaches that link molecular innovation with industrial application and policy readiness.

Key words: dsRNA, RNAi, Biopesticides, Nano-carriers, Regulation

SG2-2

Potential targets for forest pest management: Functions of cuticular chitin-degrading enzymes in insect molting

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Insect cuticle/exoskeleton, an extracellular matrix primarily formed from cuticular proteins and structural polysaccharide, chitin, protects them from environmental stresses and mechanical injury as well as from pathogenic microorganisms. However, insects must shed their old cuticle and deposit new one simultaneously during each molting cycle to accommodate continuous growth. Here we report the vital roles of epidermal group I (MaCHT5) and group II chitinase (MaCHT10) in molting of the pine sawyer beetle, *Monochamus alternatus*. In addition to these two chitinolytic enzymes, we also investigated the physiological function of group I lytic polysaccharide monooxygenase 15-1 (MaLPMO15-1), which can oxidatively breaks glycosidic bounds in crystalline chitin. RNAi of either *MaCHT5*, *MaCHT10* or *MaLPMO15-1* caused 100% lethal pupal-adult molting defects, in which a failure of degradation of the chitinous endocuticle layer of their old cuticle was evident. These results indicate that these chitin digestive enzymes could be potential targets for management of forest pest.

Key words: Cuticle/exoskeleton, Molting, Chitinase, Lytic polysaccharide monooxygenase, Forest pest

SG2-3

Exogenous dsRNA application as a novel strategy to control cucumber mosaic virus and its aphid vector

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The green peach aphid, *Myzus persicae*, is a destructive pest that inflicts damage through phloem feeding and efficiently transmits plant viruses, including cucumber mosaic virus (CMV). RNA interference (RNAi) provides a promising strategy for aphid and virus management by delivering double-stranded RNA (dsRNA). In this study, we first applied virus-induced gene silencing (VIGS) to express dsRNA targeting the vacuolar ATPase subunit B (vATPase B) and voltage-gated sodium channel gene. Although VIGS achieved gene silencing and reduced *M. persicae* survival, its application is not suitable for field-level pest control. To address this limitation, we evaluated nanoparticle-based dsRNA delivery using chitosan, star polycation (SPc), and layered double hydroxide (LDH). Bioassay and molecular analyses showed that nanoparticle-coated dsRNA enhanced stability, improved gene silencing, and significantly increased aphid mortality compared to naked dsRNA. Among the tested carriers, LDH–dsRNA was the most effective. For virus management, naked dsRNA targeting CMV genes successfully reduced viral accumulation in plants. Taken together, these findings highlight LDH–dsRNA as a promising dual-action approach, with the potential to simultaneously control *M. persicae* and CMV through stomatal penetration and stable dsRNA delivery, offering a practical alternative to VIGS for field application.

Key words: *Myzus persicae*, cucumber mosaic virus (CMV), dsRNA, nanocarrier delivery, insect–virus management

SG2-4

Molecular Determinants and Constraints of siRNA-Mediated RNA Interference

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곤충에서 RNA 간섭(RNAi)의 기본 메커니즘은 잘 알려져 있으나, siRNA의 구조적 특성이 mRNA 절단 효율에 미치는 영향은 충분히 규명되지 않았다. 본 연구는 초파리(*Drosophila melanogaster*)에서 siRNA 길이, 말단 돌출부, 그리고 표적 mRNA 구조가 RNAi 효율에 미치는 영향을 분석하였다. 21-bp siRNA가 RNAi를 일으킨다고 알려져 있으나 더 짧은 형태의 siRNA에서도 녹다운(knockdown) 효능을 보였고, 2-뉴클레오타이드 돌출부가 평활말단(blunt end)보다 높은 효율을 보였다. 또한 siRNA가 상응하는 mRNA의 구조에 따라서도 RNAi 효율의 차이가 확인되었다. 차세대 시퀀싱(NGS)을 통해 siRNA 분포와 절단 위치, 서열 선호도를 매핑하였으며, 이는 곤충 RNAi에서 siRNA 설계 최적화와 오프타겟 효과 이해에 새로운 통찰을 제공한다.

Key words: *Drosophila melanogaster*, RNAi, siRNA, off-target effects, pest control

SG2-5

StaufenC facilitates utilization of the ERAD pathway to transport dsRNA through the endoplasmic reticulum to the cytosol

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RNAi is unusually efficient in coleopterans, in part due to StaufenC (StauC), a beetle-specific dsRNA-binding protein. In Colorado potato beetle cells, confocal imaging and organelle fractionation show that dsRNA routes through the endoplasmic reticulum (ER). StauC is ER-localized; when StauC is knocked down, dsRNA accumulates in the ER and drops in the cytosol, reducing access to Dicer and Argonaute. Co-immunoprecipitation indicates StauC links dsRNA to ER-associated degradation (ERAD) factors, enabling translocation of dsRNA to the cytosol, where it is processed and loaded into RISC. Thus, StauC cooperates with ERAD to drive intracellular dsRNA transport—a mechanism that could be targeted to enhance dsRNA delivery and RNAi efficacy in pest control.

Key words: RNA interference, intracellular trafficking, C- terminal KDEL motif, protein localization

SG3-1

Ecology and management of invasive insect pests in forests: lessons from pine wood nematode and vector insects

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Since the 2000s, the introduction of invasive insects has been recognized as a significant threat to forest ecosystems in Korea. These insects primarily impact on pine forests, sometimes causing significant damage. Pine forests account for approximately 23% of Korea's forests, but climate change is expected to lead to decline of pine forests. The introduction of the pine wood nematode (PWN), native to North America, in 1988 has accelerated the decline of pine forests. The PWN cooperates with its vectors, such as *Monochamus alternatus* and *M. saltuarius* that are native to East Asia including Korea, causing pine wilt disease. As of April 2025, the PWN has killed approximately 18 million pine trees since the introduction, and an average of 72 million USD has been invested annually in control measures over the past decade. Since 2010, the introduction of invasive insects, including *Leptoglossus occidentalis* and *Anoplophora horsfiedldii*, has continued, posing a threat to forests. Lessons learned from the introduction of the PWN and their impact on forests are crucial for future forest pest management.

Key words: Non-native insect, Introduced insect, Pine wilt disease, Forest insect pests, Vector insects

SG3-2

A Future Outlook on the Impacts of Changing Environmental and Socio-Economic Conditions on Pine Wilt Disease Control

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Pine wilt disease has severely damaged Korea's pine forests, and its management strategies have shifted over time with the spread of outbreaks. Climate change can directly influence the distribution and activity of vectors and weaken the ecological stability of pine forests, thereby increasing the likelihood of pine wilt disease outbreaks. Growing awareness of environmental conservation and biodiversity has increased demand for eco-friendly and sustainable control methods rather than chemical treatments. However, with limited budgets, a strategy of selection and concentration is required to effectively manage severely affected regions. In addition, proper utilization of timber generated from damaged stands can create economic value and enhance the sustainability of control policies. This study aims to examine how climate change and shifting socio-economic conditions are expected to affect the management of pine wilt disease.

Key words: climate change, management strategy, pine wilt disease, socio-economic factors

SG3-3

Research trends and responses to the outbreak of pine wilt disease

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Pine wilt disease (PWD) has been one of the most devastating forest diseases in Korea, caused by the pinewood nematode *Bursaphelenchus xylophilus* and transmitted by vector beetles such as *Monochamus alternatus* and *M. saltuarius*. Over the past three decades, the National Institute of Forest Science (NIFoS) has led national efforts to manage PWD through staged R&D strategies: basic research (1989–2009), technology diversification (2010–2015), and precision diagnostics and integrated management (2016–present). This study highlights the recent advancements including LAMP-based molecular diagnostics, field-deployable rapid test kits, automated preventive trunk injection systems. Future strategies aim to develop peptide-based biopesticides targeting GPCR pathways, to investigate attractants and repellents for implementing a Push-Pull strategy, and to utilize disease-resistant pine clones for forest resilience.

Key words: *Bursaphelenchus xylophilus*, pine wilt disease, LAMPCR, automated trunk injection, GPCR, Push-Pull strategy

SG3-4

Forest Service Response to Invasive and Outbreak Pests

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Recent climate change and the expansion of international trade have heightened the risks posed by invasive and outbreak pests to the ecosystems of forests and urban green spaces. These pests are capable of inflicting extensive damage within a short period, resulting in severe ecological and economic consequences. This study discusses the Forest Service's comprehensive response strategies, which include the establishment of pest monitoring and surveillance systems, the implementation of rapid response procedures, and the enhancement of preparedness through information sharing and inter-agency collaboration. By examining these approaches, this presentation aim to the effectiveness of current measures and provides insights for strengthening future responses to emerging pest threats.

Key words: Forest Service, Invasive pest, Outbreak pest, Forest, urban green spaces

SG4-1

Purposes and direction of the research group of pest & disease modeling

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Due to climate change, increased trade volume, changes in cultivation techniques, and diversification of cultivated crops, the frequency, amount, and area of occurrence of pests and diseases in the domestic agricultural ecosystem are becoming unpredictable. However, the number of experts in pest outbreak prediction and surveillance in Korea is severely insufficient, making it difficult to respond immediately to these phenomena. Accordingly, the authors of this study plan to organize a pest forecasting research group and unite a group of experts who are scattered across various fields and are pursuing the same goal, and to develop new pests and their prediction and forecasting methodologies. The newly established Pest and Disease Forecasting Research Association will jointly conduct disease outbreak prediction and development of new forecasting technologies, and aim to take the lead in pest control work in Korea.

Key words: insect pests, plant deased, prediction, monitering, control

SG4-2

Forecasting Plant Diseases: Lessons from BLITECAST to AI

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The forecasting of plant disease outbreaks has been a subject of scientific inquiry for more than a century. Potato late blight (*Phytophthora infestans*), one of the earliest plant diseases studied, was found to flourish under “blight weather” - humid and rainy conditions. From the 1940s onward, research into weather-disease relationships led to the first predictive models, culminating in the early 1970s with BLITECAST at Pennsylvania State University, the first computer-based plant disease forecasting system. Since then, advances in computing and information technologies have supported the development of forecasting models for a wide range of crops. Today, interest is shifting toward AI- and machine learning-driven approaches. This presentation revisits BLITECAST to explore the evolution and practical application of disease forecasting systems.

Key words: Plant disease forecasting, BLITECAST, Potato late blight, Information delivery systems, Machine learning, AI in agriculture

SG4-3

AI-powered pest and disease modeling

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Stable crop production becomes more difficult due to vagaries of weather under climate change, low prediction accuracy of insect pest and disease models, and increased pesticide resistances. In order to increase prediction accuracy, insect pest and disease models need to accommodate site-specific characteristics of weather changes and insect pest and disease occurrence, which can be revealed by AI techniques with a large amount of historical data from corresponding locations over time. Machine learning processes were applied in this study to develop forecast models for 16 insect pests and diseases of apples, peppers, beans, and rices. A nation-wide model and 167 local models were developed for individual insect pests and diseases. Individual local models are to be updated when the Korean Meteorological Administration issues weather forecast at three-hour intervals and whenever new insect pest and disease occurrence data are additionally provided into the system. Finally, algorithms to determine optimal timings for pesticide applications based on epidemiological knowledge of insect pests and diseases were integrated into each nation-wide and local model in the system. The AI-powered models were able to reflect site-specific weather changes and sporadic outbreaks of insect pests and diseases, so that farmers would make better decision-making regarding whether or not to spray pesticides to protect their crops. It was found that the AI-powered pest and disease models would help farmers increase the management efficiency in target crops and ultimately contribute to stable crop production.

Key words: Insect pest and disease forecast, AI-model, optimal management timing, machine learning

SG4-4

Development Status of an Automated Spore Sampler for Image-Based Identification of Fungal Spores

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Early detection of spores that act as inoculum sources is crucial for preventing fungal plant diseases. Conventional spore samplers required tape replacement and microscopic observation, demanding considerable effort for inoculum monitoring. This study reports on the development status of an automated spore sampler that generates microscopic images of fungal spores. The sampler consists of a suction unit, an imaging unit, and a control system. The suction unit has a wind-tracking inlet, an anti-static hose, and a tape roller with PollenSense (USA) adhesive tape operating at 5mm per hour. The imaging unit, positioned 120mm from the intake hose, produces 18 images per hour. Field tests were conducted in a rice paddy field at National Institute of Agricultural Sciences (Wanju) from June 18 to August 15, 2025. The malfunction rate was 3.2%, and focused images accounted for 0–57%, though overall quality was higher than that of a commercial sampler. An autofocusing function is being incorporated, and a prototype will support early field detection of fungal diseases.

Key words: Early detection, Spore sampler, Image

SG4-5

Modeling Insect–Plant Phenology and Spatial Distribution for Integrated Pest and Pollinator Management (IPPM)

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Effective agricultural sustainability requires a balanced framework that accounts for both crop protection and the enhancement of pollination services. This study addresses the integration of insect–plant phenology and spatial ecology into decision-making models for Integrated Pest and Pollinator Management (IPPM). We analyze temperature-dependent phenological dynamics of pollinator insects, crop flowering patterns, and their temporal synchrony, which critically determine pollination efficiency and crop yields. The spatial distribution of both pollinator populations and pest species across agricultural landscapes is also modeled to evaluate habitat suitability, interaction hotspots, and ecosystem service provision. By incorporating not only pest suppression but also beneficial insect population management, this framework advances beyond conventional pest-oriented IPM approaches. Our modeling highlights the dual role of insects as both potential threats and essential ecosystem service providers, offering decision-support tools for policymakers and practitioners to harmonize crop protection with pollination security. The results underscore the importance of phenology-based, spatially explicit models in shaping agricultural policy, improving ecosystem resilience, and supporting sustainable food production systems.

Key words: Tmporal synchrony, Pollination efficiency, Habitat suitability, Interaction hotspots

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