2023 한국응용곤충학회
임시총회 및 추계학술발표회

2023. 10. 25(수) ~ 27(금)

휘닉스 평창호텔

주최 (사)한국응용곤충학회 Korean Society of Applied Entomology

후원 KOFST 농촌진흥청 교육부 Ministry of Education 평창군 PYEONGCHANG COUNTY 강원도관광재단 Gangwon Tourism Organization

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본 사업은 기획재정부의 복권기금 및 과학기술정보통신부의 과학기술진흥기금으로 추진되어
사회적 가치 실현과 국가 과학기술 발전에 기여합니다.
This work was supported by the Korean Federation of Science and Technology Societies(KOFST)
Grant funded by the Korean government.

인사말

존경하는 한국응용곤충학회 회원 여러분,

안녕하십니까?
한국응용곤충학회 33대 회장, 경북대학교 박종균입니다.
모두 건강히 무더위를 잘 이겨내고 계시는지요?
무더위와 장마, 그리고 집중호우까지 올해 여름은 유난히 길고 덥게만 느껴집니다.
그래서일까요. 선선한 바람과 아름다운 단풍이 그리워지는 요즘, 올해 추계 학술대회를 생각하면 조금은 마음이 시원해집니다.
이번 추계 학술대회는 수려한 자연과 메밀꽃 필 무렵의 이야기가 있는 강원도 평창군의 '휘닉스 평창호텔'에서 10월 25일부터 27일까지 2박 3일의 일정으로 개최될 예정입니다.
이번 학술대회에서는 전 세계적으로 문제가 되는 꿀벌 개체수 감소 그리고 기후 변화에 따른 침입, 돌발해충의 확대에 대한 심도 있는 발표와 토론이 있을 예정입니다. "Bugs going wild now"라는 표어로 점점 심각해지는 기후 변화 그리고 그에 따른 인간과 곤충의 피해와 대책 마련에 대해서 이제는 우리가 함께 힘을 모을 때라고 생각합니다.
이러한 노력의 일환으로 얼마 전 농촌진흥청 국립농업과학원과 우리 학회 그리고 식물병리학회가 함께 병해충 AI 영상진단기술 활성화를 위한 업무협무 협약 체결하였습니다. 이번 학술대회부터 '병해충 AI 영상진단기술 고도화를 위한 경진대회'를 개최하게 되었습니다.
그리고 또 하나, 이번 학술대회에서는 처음으로 포스터 발표 후에 학생들의 자유로운 친목 도모와 학술 교류의 장을 마련하고자 students' mixer를 준비하였습니다. 이런 자유로운 토론을 통하여 더 나은 아이디어를 얻고 또 앞으로 더 많은 학술적인 발전의 계기가 되길 빕니다.
꼭 1년 전 경주에서 있었던 60주년 기념행사에서 보여주었던 회원 여러분들의 장기자랑을 보면서 깜짝 놀랐던 기억이 납니다. 많은 회원 여러분들의 숨은 재능을 마음껏 발휘할 기회를 이번에도 준비하고자 합니다. 그 이외에 동오상 수상, 특별 강연 및 심포지엄, 소모임 등등 다양한 행사를 준비하고 있습니다. 모두 여러분이 주인공입니다. 여러분의 많은 참여와 호응 부탁드립니다.
이번 학술대회를 준비하면서 애쓰고 수고해주시는 학술위원장님을 비롯한 많은 분께 감사의 인사를 드리며 회원 여러분 모두의 가정의 행복과 건강을 소망합니다.
건강한 모습으로 평창에서 뵙겠습니다.
감사합니다.

2022년 10월 25일
사단법인 한국응용곤충학회
33대 회장 **박 종 균**

한국응용곤충학회 운영위원

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2023년 춘계학술발표회 수상자 명단

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	일반	분류	우수상	장규동	국립농업과학원
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2023년 춘계학술발표회 심사자 명단

■ 2023년 춘계학술발표회 구두발표 심사자 ■

성 명	소 속
김동순	제주대학교
김재수	전북대학교
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우수동	충북대학교
이두형	가천대학교
이영수	경기도농업기술원
이종호	농림축산검역본부
최준열	전라북도농업기술원

■ 2023년 춘계학술발표회 포스터 발표 심사자 ■

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김영호	경북대학교
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이동운	경북대학교
이흥식	농림축산검역본부
임종욱	원광대학교
정성훈	충남대학교
정종국	강원대학교
조건호	순천대학교
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Program

■ 2023 한국응용곤충학회 임시총회 및 추계학술발표회 ■

25 October (Wed)

Time	Section	Room
12:30~	Registration	Desk
	Oral Presentation Ⅰ	
14:00~16:30	Graduates, Taxonomy/Phylogeny (Competition)	Forest Hall (1F)
	Graduates, Ecology/Pest Control (Competition)	Agenda 1 (2F)
	Graduates, Physiology/Industrial Entomology/ETC (Competition)	Agenda 2 (2F)
14:00~16:10	High School Students, All Subjects (Competition)	Agenda 3 (2F)
16:30~16:40	Coffee Break	
	Plenary Lecture Ⅰ	
16:40~17:20	Honeybee winter failure in Korea: Risk factors and management Chuleui Jung (Andong Natl. Univ.)	Forest Hall (1F)
	General Meeting	
17:20~18:20	Introduction, Business report, Awards of 1st Story Picture Competition of Agricultural Pests and Dongoh Farming Foundation and High School Student Competition	Forest Hall (1F)
	Welcome Reception	
18:20 ~	Buffet Dinner and Members' Concert	Forest Hall (1F)

26 October (Thu)

Time	Section	Room
08:30~09:00	Coffee and Breads	
	Special Symposia	
09:00~11:30	Beekeeping Crisis in Korea: Management and Strategies June-Sun Yoon (Jeonbuk Natl. Univ.) Je Won Jung (Kyungsung. Univ.) Keon Mook Seong (Chungnam Natl. Univ.)	Forest Hall (1F)
11:30~11:40	Coffee Break	
	Plenary Lecture Ⅱ	
11:40~12:20	Development of prediction models for dispersal and population change of exotic forest pests (Arthropoda) Yang-Seop Bae (Incheon Natl. Univ.)	Forest Hall (1F)
12:20~14:00	Lunch (Bibimbab or Similar Provided)	Ondam Center Plaza (1F)

26 October (Thu)

Time	Section	Room
	Oral Presentation Ⅱ	
14:00~16:30	Post Graduates, All subjects (Competition)	Forest Hall (1F)
	Graduates, Ecology/Pest Control (Competition)	Agenda 1 (2F)
	All members, Taxonomy/Phylogeny/Pest Control (Non Competition)	Agenda 2 (2F)
	All members, Physiology/Industrial Entomology/ETC (Non Competition)	Agenda 3 (2F)
16:30~16:40	Coffee Break	
	Poster Session	
16:40~17:40	In-person Presentation (Competition & Non Competition)	Timber Hall (2F)
17:40~18:40	Students' Mixer (Snack and Beverage Provided)	
	Small Group Meetings Ⅱ	
20:00~21:30	Academy Committee Meeting Un Taek Lim (Andong Natl. Univ.) Donghun Kim (Kyungpook Natl. Univ.)	Agenda 3 (2F)
	Editorial Board Meeting Kijong Cho (Korea Univ.) Jung-Joon Park (Gyeongsang Natl. Univ.)	Agenda 2 (2F)
	Young Lepidopterists Bong-Kyu Byun (Hannam Univ.) Sora Kim (Jeonbuk Natl. Univ.)	Agenda 1 (2F)

27 October(Fri)

Time	Section	Room
08:30~09:00	Coffee and Breads	
	Member Symposia	
09:00~11:30	Practical Application of Natural Enemies in Korea Kyeong-YeollLee (Kyungpook Natl. Univ.)	Forest Hall (1F)
	Biosecurity on Invasive Pests Heungsik Lee (Animal and Plant Quaratine Agency)	Agenda 1 (2F)
	Establishment of Information Platform for Exotic Forest Pest Monitoring and Dispersal Prediction Yang-Seop Bae (Incheon Natl. Univ.) Bong-Kyu Byun (Hannam Univ.) Young-Seuk Park (Kyung Hee Univ.)	Agenda 2 (2F)
	Insect Pests Faced to Environmental Changes Sora Kim (Jeonbuk Natl. Univ.) Jong-Kuk Jung (Kangwon Natl. Univ.)	Agenda 3 (2F)
11:30~12:30	Closing Ceremony (Awards of Competition and Raffle Ticket, Presidential Address)	Forest Hall (1F)

Contents

Plenary Lecture

10. 25. Wed | Forest Hall (1F) | **Organizer :** Un Taek Lim (Andong Natl. Univ.)

Plenary Lecture I 16:40~17:20 — Honeybee winter failure in Korea: Risk factors and management ····· 3
Chuleui Jung

10. 26. Thu | Forest Hall (1F) | **Organizer :** Un Taek Lim (Andong Natl. Univ.)

Plenary Lecture II 11:40~12:20 — Development of prediction models for dispersal and population change of exotic forest pests (Arthropoda) ····· 3
Yang-Seop Bae, Young-Seuk Park, Tae-Soo Chon, Bong-Kyu Byun, Seunghwan Lee, Jong Kyun Park and Tak-Gi Lee

Symposium - Special Symposia

S1. Beekeeping Crisis in Korea Management and Strategies

10. 26. Thu | Forest Hall (1F) | **Organizer :** June-Sun Yoon (Jeonbuk Natl. Univ.), Je Won Jung (Kyungsung. Univ.), Keon Mook Seong (Chungnam Natl. Univ.)

S1-1 09:05~09:25 — Relationship analysis of honeybee diseases and unexpected colony loss ····· 7
Yun Sang Cho, Mi-Sun Yoo, A-Tai Truong, Thi-Thu Nguyen, So-Youn Youn, Se-Ji Lee, Su-Kyoung Seo, Chae I Oh and Soon-Seek Yoon

S1-2 09:25~09:55 — Ongoing detection of viruses in honey bees: Virome analysis to investigate honey bee virus epidemics ····· 7
Minhyeok Kwon, Chuleui Jung, and Eui-Joon Kil

S1-3 09:55~09:15 — Current status and management of fluvalinate resistance of *Varroa* mites in Korea ····· 8
Susie Cho, Joonhee Lee, Youngcheon Lim, Jonghyeok Lee and Si Hyeock Lee

S1-4 10:25~10:45 — The impact honeybee decline on agricultural pollination in Korea: Current status and future outlook ····· 9
Kyeong Yong Lee, Young Bo Lee, Sujin Lee, Kyu-Won Kwak and Sankkar Kathanan

S1-5 10:45~11:05 Varroa mite and climate change influence winter survival of honey bees (*Apis mellifera*) in Korea ····· 9
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S1-6 11:05~11:25 Control studies of honey bee infectious microorganism including bacteria, fungi and parasite ····· 10
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Symposium - Member Symposia

S2. Practical Application of Natural Enemies in Korea

10. 27. Fri Forest Hall (1F) **Organizer :** Kyeong-Yeoll Lee (Kyungpook Natl. Univ.)

S2-1 09:05~09:35 Mass production and application of natural enemy insects in China ····· 11
Yuyan Li, Zhongjian Shen, Jianjun Mao, Mengqing Wang, Lisheng Zhang

S2-2 09:35~09:55 Contributions to biological control research as a braconid taxonomist ····· 12
Ilgoo Kang

S2-3 09:55~10:15 Development of indigenous natural enemies using various non-crop plants ··· 12
Jin-Won Kim

S2-4 10:25~10:40 Practical training of self-production techniques of natural enemies for farmers, and its contribution to the successful biological control ····· 13
Duck-Oung Jung, Hwal-Su Hwang and Kyeong-Yeoll Lee

S2-5 10:40~10:55 Successful case of pesticide-free strawberry farming using self-produced natural enemies ····· 13
Jung-Ha Lee, Duck-Oung Jung and Kyeong-Yeoll Lee

S2-6 10:55~11:10 Economic effects of four natural enemy species in the strawberry farm ····· 14
Gi Won Park

S2-7 11:10~11:25 Simple mass rearing of *Neoseiulus californicus* and practical application to strawberry farms ····· 14
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S3. Biosecurity for Invasive Plant Pests

10. 27. Fri Agenda 1 (2F) **Organizer :** Heungsik Lee (Animal and Plant Quaratine Agency)

S3-1 09:05~09:30 Korea's national priorities as part of its strategy to respond to invasive alien plant ····· 15
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S3-2 09:30~09:55 Current status of exotic insect pests in Korea ····· 15
Wonhoon Lee and Seokyoung Son

S3-3 09:55~10:20 Status of research on quarantine treatment and application of sulfuryl fluoride to wood destorying pests ····· 16
Min-Goo Park

S3-4 10:30~10:55 A brief history of phytosanitary framework development ····· 16
Hyon Chong Choe

S3-5 10:55~11:20 Necessity of quarantine pest handling guidelines, facilities, and certification standards in Korea ····· 17
Jaeyong Chun, Jun-ran Kim and Ji-young Choi

S4. Establishment of Information Platform for Exotic Forest Pest Monitoring and Dispersal Prediction

10. 27. Fri Agenda 2 (2F)

Organizer : Yang-Seop Bae (Incheon Natl. Univ.)
Bong-Kyu Byun (Hannam Univ.)
Young-Seuk Park (Kyung Hee Univ.)

S4-1 09:05~09:30 Strategy of exotic forest pest monitoring and application of the digital field note ····· 17
Bong-Kyu Byun, Sang-Yoon Kim, Jae-In Oh, Ji-Young Lee and June-Hyeok Jeong

S4-2 09:30~09:55 Prognosis of population dispersal of an alien forest pest according to process based models ····· 18
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S4-3 09:55~10:20 Predicting the potential distribution of alien forest insects ····· 18
Dae-Seong Lee and Young-Seuk Park

S4-4 10:30~10:55 Development of invasive forest pest spread analysis system ····· 19
Dong Wook Kim

S4-5 10:55~11:20 Invasive forest insect pests in Korea under the influence of climate change ···· 19
Won IL Choi, Min-Jung Kim and Youngwoo Nam

S5. Insect Pests Faced to Environmental Changes

10. 27. Fri Agenda 3 (2F)

Organizer : Sora Kim (Jeonbuk Natl. Univ.)
Jong-Kuk Jung (Kangwon Natl. Univ.)

S5-1 09:05~09:25 Invasive clearwing moth borers (Lepidoptera: Cossidae: Sesiinae) to Korea ····· 20
Sora Kim

S5-2 09:25~09:45 Outbreak of walking-stick insects and their rapid decline: What is key factor? ····· 20
Jong-Kook Jung, Seul-Ki Son, Dong Gyu Min, Min Jeong Baek and Sun-Jae Park

S5-3 09:45~10:05 Recent trends in forest pest occurrence ····· 21
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S5-4 10:10~10:30 Assessment of climatic suitability and spread potential of *Anoplophora horsfieldii* (Coleoptera: Cerambycidae): A newly identified exotic insect in Jeju Island, Korea ····· 21
Min-Jung Kim, Jin-Sung Kweon, Jun-Gi Lee, Sun Keun Lee, Yonghwan Park and Youngwoo Nam

S5-5 10:30~10:50 Potential outbreakable Nolidae: Taxonomy and ecology ····· 22
Yeong-Bin Cha and Sora Kim

S5-6 10:50~11:10 Occurrence patterns of *Cephalcia koreana* (Hymenoptera: Pamphiliidae), a new species of sawfly, in Manchurian fir forests from Korea ····· 22
Cha Young Lee, Youngwoo Nam and Jong-Kook Jung

S5-7 11:10~11:30 Seasonal occurrence of the western conifer seed bug, *Leptoglossus occidentalis* heidemann from cone of Korean white pine and cone damage by period ····· 23
Gun-Hyung Kwon, Sun-Hee Kim and Youngwoo Nam

Oral Presentation - Competition

1. Post Graduates - All Subjects

10. 26. Thu | Forest Hall (1F) | **Moderator :** Kyeong-Yeoll Lee (Kyungpook National University), Iksoo Kim (Chonnam National University)

PG1 14:10~14:25 Predicting disease vector mosquito population using machine learning model ····· 27
Su Mi Na, Seo Hyeon Kim, Jong Gyu Jung, Hye Min Jeong, Sang Chul Lee and Dong Gun Kim

PG2 14:25~14:40 Trojan horse in an insect symbiosis ····· 28
Seonghan Jang, Kota Ishigami, Aoba Yoshioka, Hiroyuki Morimura, Kazutaka Takeshita, Aya Yokota, Lionel Moulin, Peter Mergaert, Daisuke Nakane and Yoshitomo Kikuchi

PG3 14:40~14:55 Revealing the biological insights of the specialist herbivore, *Helicoverpa assulta*, through comparative genomics and chromosome-level genome assembly ····· 29
Jiyeong Shin, Md-Mafizur Rahman, Seung-Joon Ahn, Changhee Han and Juil Kim

PG4 14:55~15:10 Genome-wide exploration of metabolic based pyrethroid resistance mechanism in *Helicoverpa armigera* (Lepidoptera: Noctuidae) ····· 30
Md-Mafizur Rahman, Jiyeong Shin, Jungwon Jeon, Changhee Han, Juil Kim, David G. Heckel and Celso Omoto

PG5 15:20~15:35 Environmentally-transmitted symbiotic bacteria enable a novel feeding strategy in the host bean bug, *Riptortus pedestris* (Hemiptera:Alydidae) ····· 30
Minhyung Jung, Jung-Wook Kho, Joo-Young Kim, Soowan Kim and Doo-Hyung Lee

PG6 15:35~15:50 Study on isolation mating efficiency for honey bee (*Apis mellifera*) breeding ··· 31
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PG7 15:50~16:05 Molecular phylogeny and evolutionary history of plant bugs (Hemiptera: Miridae) ····· 31
Minsuk Oh, Sora Kim and Seunghwan Lee

2. Graduate - Taxonomy, Phylogeny

10. 25. Wed | Forest Hall (1F) | **Moderator :** Heungsik Lee (Animal and Plant Quaratine Agency) Hee-A Lee (Gyeonggi-do Agricultural Research and Extension Services)

G1 14:10~14:25 Novel Approach: Stathmopodidae phylogenetic analysis using ChatGPT ····· 32
In-Won Jeong and Sora Kim

G2 14:25~14:40 A historical review of the classification of subfamily Erebinae (Lepidoptera: Erebidae) in Korea ····· 32
Hee Han and Sora Kim

G3 14:40~14:55 Taxonomic review of the genus *Epistrophe* (Walker) (Diptera: Syrphidae: Syrphini) in Korea based on morphology and DNA barcoding ····· 33
Chan Ouk Kim and Ho Yeon Han

G4 14:55~15:10 Understudied and ecologically significant: Exploring the pseudoscorpiones of Korea ····· 33
KyungHoon Jeong and Sora Kim

G5 15:20~15:35 Cryptic diversity of the gall-forming aphid *Tuberaphis* Takahashi (Hemiptera: Aphididae) on *Styrax* (Styracaceae) ····· 34
Minho Lee, Mariusz Kanturski, Hsin-Ting Yeh, Sun Keun Lee and Seunghwan Lee

G6 15:35~15:50 Taxonomic review of the genus *Bucculatrix Zeller*, 1839 (Lepidoptera: Bucculatricidae) in Korea ····· 34
Jae-In Oh, Ji-Young Lee, Sang-Yoon Kim, June-Hyeok Jeong and Bong-Kyu Byun

3. Graduate - Ecology, Pest Control

10. 25. Wed	Agenda 1 (2F)	**Moderator :** Youngjin Park (Andong National University) Kyungjae Andrew Yoon (Seoul National University)

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Junho Yoon and Jun-Hyung Tak

G8 14:25~14:40
Gustatory habituation to essential oil induces reduced feeding deterrence and neuronal desensitization in *Spodoptera litura* ····· 36
Hyoeun Jeonand Jun-Hyung Tak

G9 14:40~14:55
Effect of water stress on red-necked longhorned beetles, *Aromia bungii* infestation in *Prunus* x *yedoensis* trees in an urban landscape ····· 36
Byeong Jong Lee and Jong-Kook Jung

G10 14:55~15:10
Development of a LAMP-based molecular species diagnostic tools for four agricultural pests in the genus *Helicoverpa* (Lepidoptera: Noctuidae) ····· 37
Jungwon Jeon and Juil Kim

G11 15:20~15:35
Exaptation of I4760M mutation in ryanodine receptor of *Spodoptera exigua* (Lepidoptera: Noctuidae): Lessons from museum and field samples ····· 38
Changhee Han, Md-Mafizur Rahman, Jiyeong Shin and Juil Kim

G12 15:35~15:50
Analyzing pollination dependence in forest honey plnats based on plnat characteristics ····· 39
Kwanhui Lee, Minwoong Son and Chuleui Jung

G13 15:50~16:05
Evaluation of fungal pathogen *Beauveria bassiana* AAD16 against two species of coccinellids: *Harmonia axyridis* and *Chilocorus stigma* ····· 39
Md. Rajib Hasan, Md. Rasel Raju, Babatunde O. Kehinde, Seongsik Kim, Juhyeok Lee, Tae Guen Song and Un Taek Lim

G14 16:05~16:20
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Md Munir Mostafiz and Kyeong-Yeoll Lee

10. 26. Thu	Agenda 1 (2F)	**Moderator :** Lee Young Su (Gyeonggi Agricultural Research and Extension Services) Meeja Seo (National Institute of Agricultural Sciences)

G15 14:10~14:25
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Soo-Hyun Kim, Eunji Lim, Hwal-Su Hwang, Sehyeon Lim, Ilgoo Kang and Kyeong-Yeoll Lee

G16 14:25~14:40
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G17 14:40~14:55
Spatiotemporal variation of symbiotic bacterial community structure in *Riptortus pedestris* (Hemiptera: Alydidae) collected in South Korea ····· 42
Joo-Young Kim, Minhyung Jung, Jung-Wook Kho, Soowan Kim and Doo-Hyung Lee

G18 14:55~15:10
Monitoring of the regional insecticide resistance of *Bemisia tabaci* collected from the pepper house in the Republic of Korea ····· 43
Gyeongmo Gu, Jiseok Kim and Donghun Kim

G19 15:15~15:30
Occurrence Patterns of *Ramulus mikado* in host plants ····· 44
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G20 15:30~15:45
Development of molecular based species diagnostic tools for major planthoppers, in the Republic of Korea ····· 44
Minkyu Jeong, Jiyeong Shin, Hwayeon Nam and Juil Kim

G21 15:45~16:00
Beauveria bassiana ARP14 control *Tetranychus kanzawai* Kishida in laboratory and greenhouse strawberry plant ····· 45
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G22 16:00~16:15
A comparative study on the behavioral responses of *Riptortus pedestris* (Hemiptera: Alydidae) to corn seedling as a companion plant of soybean ····· 45
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G23 16:15~16:30
Effect of entomopathogenic fungus, Metarhizium anisopliae, on survivorship of Ramulus mikado during summer season in Korea ····· 46
Dong Gyu Min, Seul-Ki Son, Min Jeong Baek, Sun-Jae Park and Jong-Kook Jung

4. Graduate - Physiology, Industrial Entomology, ETC

10. 25. Wed | Agenda 2 (2F)

Moderator : Jung-Joon Park (Gyeongsang National University)
Seulki Kim (Jeonbuk National University)

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Biological significance of the multiple PLA2s in Frankliniella occidentalis ····· 48
Mojtaba Esmaeily and Yonggyun Kim

G26 14:40~14:55
Optimizing control efficacy of dsRNA insecticides using chitosan nanoparticle or bacterial formulation against the western flower thrips ····· 49
Falguni Khan and Yonggyun Kim

G27 14:55~15:10 Suppressive effect of an sEH inhibitor on anti-viral responses of insects against baculovirus ····· 49
Eticha Abdisa, Niayesh Shahmohammadi, MojtabaEsmaeily and Yonggyun Kim

G28 15:15~15:30 A study on the induced expression level of cytochrome P450s in *Apis cerana* (Hymenoptera: Apidae) by various insecticides ····· 50
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G29 15:30~15:45 Groups I and II chitinases, TcCHT5 and TcCHT10, function in turnover of chitinous cuticle during embryo hatch and post-embryonic molts in the red flour beetle, *Tribolium castaneum* ····· 51
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G30 15:45~16:00 Impact of dopamine-mediated salivary secretion in the early and late phase of tick blood-feeding ····· 52
Seoyul Hwang and Donghun Kim

G31 16:00~16:15 Distribution of bisexual and parthenogenetic *Haemaphysalis longicornis* by comparison of genetic characteristics in the Republic of Korea ····· 53
Jiseok Kim, Seoyul Hwang and Donghun Kim

G32 16:15~16:30 Eicosanoid-derived immune priming factor in a lepidopteran insect, *Spodoptera exigua* ····· 54
Shiva Haraji, Gahyeon Jin, Shabbir Ahmed, Md Tafim Hossain Hrithik, Yonggyun Kim

5. High School Students

10. 25. Wed | Agenda 3 (2F)

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Keon Mook Seong (Chungnam National University)
Gwang Hyun Roh (Gyeongsang National University)

H1 14:10~14:25 Designing new honey bee hive with multiple sensory system for urban beekeeping ····· 57
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H2 14:25~14:40 Research on the extraction of chitosan from cicada sloughs and the effect of green algae aggregation using chitosan ····· 58
Yong Je Choi, Ye Jin Kim, Su Ji Park, Yong Eun Cheon, Na Hyun Jun

H3 14:40~14:55 The factor analysis of honey bee colony disappearance (colony collapse phenomenon) in Jecheon, chungcheong buk-do, in march 2022 ····· 58
Dong Geon Jung

H4 15:10~15:25 A study on genetic factors of Type 2 Diabetes Mellitus cause and treatment method using *Drosphila melanogaster* ····· 59
Da Yeon Lee

H5 15:25~15:40 Exploring the applicability if Drosophila pheromones as eco-friendly target insect repellents ····· 60
Chan Woo Park, Ga Yeon Do and Ha Eun Kim

H6 15:40~15:55 Determination of organic matter decomposition and plant growth effects of soil bacteria in the root region of ant colonies ····· 60
Taehyeong Kim, Heeseok Jeong, Damin Lee, Soyul Park, Soyeon Kim

H7 15:55~16:10 Nesting and predatory behavior of *Euodynerus nipanicus nipanicus* (Hymenoptera:Vespidae:Eumeninae) ····· 61
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Oral Presentation - Non-Competition

6. Physiology, Industrial Entomology, ETC

10. 26. Thu | Agenda 3 (2F) | **Moderator :** Yonggyun Kim (Andong National University), Juil Kim (Kangwon National University)

AM1 14:10~14:25 Antixenosis of hot pepper against the western flower thrips, *Frankliniella occidentalis* ····· 65
Yonggyun Kim, Chulyoung Kim, Hyunje Park, Falguni Khan, Daehong Lee, Gahyun Jin, Hee-Jin Kim, Hyungwoo Choi and Yongho Jeon

AM2 14:25~14:40 Genome analysis of *Diadegma fenestrale* (Hymenoptera: Ichneumonidae) and its coevolutionary study with a symbiotic virus, DfIV ····· 66
Juil Kim

AM3 14:40~14:55 Analysis of an Oryctes rhinoceros nudivirus genome isolated from Korean rhinoceros beetles (*Trypoxylus dichotomus*) ····· 67
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AM4 14:55~15:10 Knockdown of the testis-specific serine/threonine protein kinase 1 gene affects the testis and sperm quantity in *Zeugodacus scutellata* (Diptera: Tephritidae) ··· 67
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AM5 15:20~15:35 Combined effects of temperature and dietary macronutrient balance on larval performance in the yellow mealworm, *Tenebrio molitor* L. (Coleoptera: Tenebrionidae) ····· 68
Myung Suk Rho and Kwang Pum Lee

AM6 15:35~15:50 Effect of fluorescent brighteners on the insecticidal activity of *B. thuringieniss* var. *kurstaki* (Btk) and LdMNPV on *Lymantria dispar asiatica* in Korea ····· 68
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AM7 15:50~16:05 Carbon-neutral hydrotreated-biofuels production technology using insect lipids ····· 69
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7. Taxonomy, Phylogeny, Ecology, Pest Control

10. 26. Thu Agenda 2 (2F) **Moderator :** June Wee (Korea University)

AM8 14:10~14:25 A simulation study on the efficiency of termite food transport in sinusoidal-shaped tunnel ····· 69
Sang-Hee Lee and Cheol-Min Park

AM9 14:25~14:40 Taxonomic review of genus *Hilara* (Diptera: Empididae) in Korea ····· 70
Hyeon Lee, Seung Jin Roh and Bong-Kyu Byun

AM10 14:40~14:55 Cascading effects of glyphosate application on plant and collembolan communities ····· 70
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AM11 15:10~15:25 Exploring nutritional composition of bee feed: Insights into honey bee nutrition ····· 71
Sampat Ghosh and Chuleui Jung,

Poster Presentation - Competition

1. Undergraduate

Moderator : Min-Goo Park (Jeonbuk National University)
Seung Jin Ro (Animal Research Division, Honam National Institute of Biological Resources)

P1 Identification, characterization and function of group I lytic polysaccharide monooxygenase in two longhorn beetle species, *Monochamus alternatus* and *Psacothea hilaris* ····· 75
Daehyeong Kim, Myeongjin Kim, Youngseo Lee, Yasuyuki Arakane and Mi Young Noh

P2 Assessment of insecticidal effects of freeze spray as a sustainable pest control agent ····· 76
Seongbin Kim and Jun-Hyung Tak

P3 Preliminary study to evaluate Sulfuryl Fluoride (SF) for quarantine treatment of *Reticulitermes speratus* ····· 77
Kim So Yeon, Choi Na Ra, Leo Kang and Min-Goo Park

P4 First record of the water strider *Rhagadotarsus Breddin* (Hemiptera: Gerridae: Rhagadotarsinae) in Korea ····· 77
Jiseung Kim

P5 Genetic diversity of *Ramulus mikado* (Phasmatodea: Phasmatidae) in Korea ·· 78
Jinwook Kim, Jinsung Park, In-Won Jeong and Sora Kim

P6 First record of genus *Pseudopostega* Kozlov, 1985 (Lepidoptera: Opostegidae) from Korea ····· 78
Dae-Kyeong Ra and Sora Kim

P7 Comparative efficacy of commercially available mosquito traps in the laboratory and semi-field conditions against the Asian tiger mosquito, *Aedes albopictus* ·· 79
Min Geun Son and Jun-Hyung Tak

P8 Injury and occurrence patterns of cherry tree borer in cherry trees planted in roadsides ····· 79
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P9 Comparative efficacies of essential oil-based repellent products in three testing methods against *Drosphila melanogaster* (Diptera: Drosphilidae) ····· 80
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P11 Spatial repellency of series compounds from natural products against the cotton ahpid, *Aphis gossypii* glover ····· 81
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P12 Insectcidal activity of an entomopathogenic fungi against *Pseudaulacaspis prunicola* (Hemiptera: Diaspididae) ····· 81
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2. Graduate - Taxonomy

Moderator : Heungsik Lee (Animal and Plant Quaratine Agency)
Sora Kim (Jeonbuk National University)

P13 A new record of *Norbanus meridionalis* (Masi, 1922) (Hymenoptera: Pteromalidae) from South Korea ····· 82
Jae Hyeon Lee and Wonhoon Lee

P14 The First Record of the Genus *Brachydeutera* Loew (Diptera: Ephydridae) from Korea ····· 82
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P15 Development of 16s rRNA-based molecular marker for *Spodoptera litura* (Lepidoptera: Noctuidae) ····· 83
Na Ra Jeong, Gwan Seok Lee and Wonhoon Lee

P16 Taxonomic review of the genus *Margarinotus* Marseul, 1854 (Coleoptera: Histeridae) from Korea ····· 83
Jinbae Seung and Seunghwan Lee

P17 Seven newly record species of *Eurytoma appendigaster* species-group (Hymenoptera: Chalcidoidea: Eurytomidae) from Korea ····· 84
Duk-Young Park and Seunghwan Lee

P18 New records of the family Pseudopomyzidae McAlpine, 1966 (Diptera: Nerioidea) in Korea ····· 84
Sangjin Han and Seunggwan Shin

P19 Four new species of the genus *Pholcus* (Araneae: Pholcidae) from South Korea ····· 85
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P20 Taxonomy of the necrophagous fly genus *Conicera* (Diptera: Phoridae) from South Korea ····· 85
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P21 Re-identification of *Donacia japana* Chûjô and Goecke (Coleoptera: Chrysomelidae: Donaciiinae) in the Korean Peninsula ····· 86
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Moderator : Ilgoo Kang (Kyungpook National University)
Dong June Lee (Animal Research Division, Honam National Institute of Biological Resources)

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P27 Two new species of phoretic mites on ground beetle (Coleoptera: Carabidae) ·· 89
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P28 Unexpected discovery of the pantropical genus *Discheramocephalus* (Coleoptera: Ptiliidae: Discheramocephalini) from Korea ····· 89
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P29 A new pselaphine genus from Southern Australia (Coleoptera: Staphylinidae: Pselaphinae: Faronitae) with seven new species ····· 90
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P30 The check list of genus *Ischyja* Hübner, 1823 (Lepidoptera: Erebidae) with two new records from Vietnam ····· 90
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3. Graduate - Phylogeny

Moderator : Ilgoo Kang (Kyungpook National University)
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Plenary Lecture






Plenary Lecture I

Honeybee winter failure in Korea: Risk factors and management

Chuleui Jung
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Honeybee winter failure and mortality are a big issue in korea, especially from 2021 to 2023. Traditionally, honeybee winter failure has been estimated as Approximately 10-20%. However, for last 2 years, we had more than 35% of winter failure which impacted not only beekeeping sectors but also agriculture and the whole society as well. Primary factor was ascribed as honeybee mite resistance development to conventional acaricudes. Coinhabitance of tropilaelaps mite in honeybee complicated the mite problem. Further threat of vespa hornets especially in fall season would exerbate the wintering condition. More important is that the more frequent abnormal weather condition in fall and winter season could affected the winter bee production and maintenance of honeybee overwintering physiology. On these situation, we also observed some diseases were associated to the death of bees.

Key words: parasite, mite, resistance, climate change, socail life

Plenary Lecture II

Development of prediction models for dispersal and population change of exotic forest pests (Arthropoda)

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[2]Kyung Hee University, Republic of Korea
[3]Pusan National University, Republic of Korea
[4]Hannam University, Republic of Korea
[5]Seoul National University, Republic of Korea
[6]Kyungpook National University, Republic of Korea

Recently, as the possibility of unexpected outbreaks of alien insects has increased due to climate change such as global warming, the importance of early control through rapid and accurate spread of exotic forest pest and change prediction diagnosis is required. This study summarizes and reports the followings: the establishment of monitoring strategy for exotic insects by the investigation of species distribution range through field surveys and others, the development of new diagnostic technique through microstructures and life-cycle, the dispersal of exotic insects, and ecological impact assessment using ecological methods and with the expansion of exotic insects and development of ecosystem impact prediction model.

Key words: biodiversity, exotic forest pests, dispersal, prediction, species distribution model

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S1-1

Relationship analysis of honeybee diseases and unexpected colony loss

Yun Sang Cho, Mi-Sun Yoo, A-Tai Truong, Thi-Thu Nguyen, So-Youn Youn, Se-Ji Lee, Su-Kyoung Seo, Chae I Oh and Soon-Seek Yoon

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최근 국내에서는 꿀벌 대량소실 현상이 2022년부터 전국적으로 발생하고 있다. 우리나라 뿐 만 아니라, 전세계적으로 양봉산업에 큰 위협이 되고 있는 봉군붕괴현상은 2016년 미국에서 세계 최초로 보고되었다. 국내에서는 2022년 민관 합동조사 결과, 이상기온, 응애, 말벌 등이 주요 원인으로 지목되었다. 대량소실 현상을 보인 양봉농가와 정상 농가의 병원체 검출 비교 결과, 유의성있게 검출이 증가되는 병원체는 발견되지 않았다. 그러나, *Tyrophagus* mite, *Trypanosome*, Lake Sinai virus, *Apis mellifera* filamentous virus 등의 신종 응애, 원충 및 바이러스 감염이 추가로 확인되었다. 국내에서 새롭게 감염이 확인된 기생충과 병원체가 대량소실, 나아가 봉군붕괴현상에 직간접적으로 영향을 주었을 것으로 사료되며, 지속적인 조사와 연구개발을 통해 기후등 환경변화에 따른 신종 질병 검색과 대책을 마련해야 할 것이다.

검색어: 꿀벌, 대량소실, 질병, 병원체, 응애, 봉군붕괴현상

S1-2

Ongoing detection of viruses in honey bees: Virome analysis to investigate honey bee virus epidemics

Minhyeok Kwon[1,2], Chuleui Jung[1,2] and Eui-Joon Kil[1,2]

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Over the course of two winters, the significant decline in honey bee populations in Korea has emerged as a major social issue. This phenomenon is expected as attributed to factors such as the failure of pest control due to the pesticide resistance of the Varroa mite. This mite can transmit some viruses that infect honey bees, and these viruses are among the primary causes of the globally occurring colony collapse disorder. Traditional diagnostic methods like (RT-)PCR and ELISA are not ideal for identifying pathogens that are newly emerging or have undergone mutations. To detect any novel or mutated viruses beyond those that have been primarily diagnosed in Korea, we introduced virome analysis technology in the field of honey bees. Employing this method with high-throughput sequencing techniques, we were able to identify all existing viruses within individual or group samples. We discovered that the Lake Sinai virus, which has been reported worldwide but not in Korea, has already significantly spread within the country. Additionally, we were able to confirm the prevalence of viruses previously reported in Korea, such as the recently dominant Black Queen Cell Virus. Through this virome analysis, we can provide foundational data for determining the direction and countermeasures for virus diagnosis.

Key words: Diagnosis, High throughput sequencing, Honey bee, Virome, Virus

S1-3

Current status and management of fluvalinate resistance of *Varroa* mites in Korea

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The *Varroa* mite, *Varroa destructor* is an ectoparasite that parasitizes honey bees. The widespread usage of acaricides, particularly fluvalinate, has resulted in the emergence of resistance in *Varroa mite* populations all over the world. The goal of this study is to track fluvalinate resistance in *Varroa mite* field populations in Korea using both bioassay and molecular markers. To accomplish this, a residual contact vial (RCV) bioassay for on-site resistance monitoring was developed. Early mortality evaluation in the RCV bioassay was effective for reliably separating mites with the knockdown resistance (*kdr*) genotype, but late mortality evaluation was useful for distinguishing mites with additional resistance factors. The RCV bioassay of 14 field mite populations collected in 2021 revealed potential resistance development in four populations. Quantitative sequencing was used as an alternate method to examine the frequency of the L925I/M mutation in the voltage-gated sodium channel (*vgsc*), which is related with the fluvalinate *kdr* phenotype. While the mutation was not present in *Varroa* mite populations in 2020, it appeared in 2021, rose in frequency in 2022, and was practically ubiquitous across the country by 2023. This recent emergence and rapid spread of fluvalinate resistance within a span of three years demonstrate the *Varroa* mite's significant potential for developing resistance. This situation emphasizes the critical necessity to replace fluvalinate with alternate acaricides, such as fenpyroximate, coumaphos, and amitraz. A few novel *vgsc* mutations potentially involved in resistance were identified. Potential factors driving the rapid expansion of resistance were further discussed.

Key words: *Varroa* mite, Fluvalinate, Resistance, Monitoring, Molecular diagnosis

S1-4

The impact honeybee decline on agricultural pollination in Korea: Current status and future outlook

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최근 2년동안 한국에서 꿀벌의 소실현상으로 식량난이 벌어질 것이라는 우려가 있다. 2020년 기준 국내 12개 과채류에서 화분매개벌의 의존도는 67.2%로 농업에서 화분매개벌은 중요한 위치를 차지한다. 이번 꿀벌 소실로 인해 딸기, 수박, 참외에서 화분매개용 꿀벌의 수요공급 불균형 문제가 발생하였다. 딸기에서는 12월 중 꿀벌 조기소실 문제, 수박과 참외에서는 벌의 임대가격이 30-50% 상승과 더불어 벌을 구하지 못해 인력수급의 어려움 등 작물재배 농가에 큰 부담이 되었다. 꿀벌의 소실은 전세계적인 문제이며 복합적인 원인에 의해 발생하므로 단기간에 해결되기 어렵다. 따라서 꿀벌에 소실에 대비하여 안정적인 작물 생산을 위한 종합적인 화분매개 관리가 반드시 필요하다. 첫째 화분매개용 꿀벌의 사양기술의 표준화를 통하여 기존 채밀위주의 사양기술보다 더 안정적으로 벌을 생산할 수 있는 기술이 개발되어야 한다. 둘째 작물에서 더욱 효과적으로 벌을 이용하고 관리할 수 있는 기술이 확립 보급되어야 한다. 셋째는 꿀벌을 대체할 수 있는 곤충자원(뒤영벌, 토종벌)을 이용한 화분매개 기술을 개발해야 한다. 아울러 기후변화에 대응하여 장기적인 기상변동 데이터 확보와 더불어 야생 화분매개 자원의 보호 보존을 위한 연구가 수행되어야 할 것이다.

검색어: 화분매개곤충, 꿀벌, 뒤영벌, 양봉, 산업곤충

S1-5

Varroa mite and climate change influence winter survival of honey bees (*Apis mellifera*) in Korea

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Honey bees are crucial pollinators for agricultural and natural ecosystems, but are experiencing heavy mortality in Korea due to a complex suite of factors. Extreme winter losses of honey bee colonies are a major threat to beekeeping but the combinations of factors underlying colony loss remain debatable. Finding solutions involves knowing the factors associated with high loss rates. To investigate whether loss rates are related to *Varroa* control and climate condition, we surveyed beekeepers in korea after wintering (2021–2022 to 2022–2023). The results show an average colony loss rate of 46%(2022) and 17%(2023), but over 40% colony loss before wintering at 2022. Beekeepers attempt to manage their honey bee colonies in ways that optimize colony health. Disentangling the impact of management from other variables affecting colony health is complicated by the diversity of practices used and difficulties handling typically complex and incomplete observational datasets. We propose a method to 1) Varroa mite population Control by several methods , and 2) Many nursing bee put in hive before wintering.

Key words: Colony loss, Wintering, Varroa mite, Climate change

S1-6

Control studies of honey bee infectious microorganism including bacteria, fungi and parasite

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Humans have lived in relationship with bees for a very long time. In addition, as essential pollinators, Bee also contribute to biodiversity by promoting the reproduction of various plant species, and play an important role in global food security. Therefore, strong and thriving bee populations are essential for maintaining healthy ecosystems and sustaining food production systems. However, the population of these bees is currently rapidly decreasing due to various causes such as climate change, abnormal temperatures, infectious diseases, and predators. In this presentation, we will learn about the microorganisms that affect bees, including bacteria and fungi, among the various causes of the decline in the bee population, and study their control.

Key words: Honey bee, Infectious disease, Bacteria, Fungi, monitoring

Acknowledgement: 본 연구는 농촌진흥청 연구과제 PJ015763의 연구비로 지원된 결과이다.

S2-1

Mass production and application of natural enemy insects in China

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Natural enemy insects, including predators and parasitoids, are beneficial organisms that feed upon other agricultural pests. Using natural enemy insects to suppress or prevent outbreak of pests is a key component of integrated pest management strategy. It is safe, effective, and environmentally friendly and can be applied easily to the greenhouses, filed crops and orchards. Rearing and application of natural enemy insects in biocontrol in China have a long history. As early as 1700 years ago, the predator *Oecophylla smaragdina* has been used for controlling many kinds of citrus pests. Up to now, more than 30 species of natural enemies that can be artificially mass produced and widely used for biological control of many kinds of pests, including caterpillars, aphids, whiteflies, thrips, leaf mites and scales in China. The annual average application area of natural enemies is over 11.34 million hectares. However, with the increasing demand of using natural enemies in biological control programs, the development of natural enemy insect industrialization still face many challenges. It is urgent to explore more effective candidate natural enemies, improve the production efficiency, increase the shelf life of products and enhance the colonization of natural enemy insects after release, and thus facilitate the commercially production and application of natural enemies. This is of great significance for comprehensively promoting the use of green prevention and control techniques for crop diseases and pests, reducing the use of chemical pesticides, ensuing the quality and safety of food and agricultural products, and ultimately promoting sustainable agricultural development.

Key words: Biological control; Natural enemy insects; Mass rearing; Storage; Augmentation release

Acknowledgements: This research was supported by the Cooperative Project between Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China and the Rural Development Administration of the Republic of Korea (PJ016496), and the International Science & Technology Innovation Program of Chinese Academy of Agricultural Sciences (CAAS-ZDRW202108).

S2-2

Contributions to biological control research as a braconid taxonomist

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Biological control in agriculture is an eco-friendly pest management method. Numerous parasitoid wasps have been utilized as natural enemies and biological control agents. However, due to a shortage of fundamental taxonomic information caused by taxonomic impediments, there are challenges in unveiling and developing hymenopteran biological control agents. Braconidae, the second-largest family in Hymenoptera, comprises approximately 25,000 species described and recorded. All known braconids attack only insect hosts, with many members exhibiting high host specificity. Leveraging their unique biology, many braconid species have been tested in biological control research, and some have been developed as commercial products. To create a synergistic effect between biological control and taxonomic research and to discover effective biological control agents, several collaborative research projects have been conducted. In this presentation, these collaborative research projects will highlight the critical role of bridging taxonomic knowledge and biological control expertise, offering potential solutions for more effective and sustainable pest management practices in agriculture.

Key words: Agriculture, Biological Control, Collaboration, Parasitoid, Taxonomy

Acknowledgements: I would like to thank Drs. Michael Sharkey, James Whitfield, Rodrigo Diaz, Christopher Carlton, Blake Wilson, Chris Malumphy, Ms. Victoria Bayless, Mr. Rob Deady, and Blake Carter, who were involved in the conducted research, for their harmonious collaboration. I am also grateful to the Department of Entomology at Kyungpook National University, Louisiana State University, and University of Kentucky for providing a stable research environment.

S2-3

Development of indigenous natural enemies using various non-crop plants

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국내 천적농업이 활성화되기 위해서 토착천적을 개발하여야 한다. 토착천적들을 개발하기 위하여 시설재배지 내에 다양한 비작물성 식물들을 확보하는 것이 필요하다. 식물의 종류가 많으면 이에 서식하는 기주곤충이 늘어나고 그 곤충들의 토착천적들이 증가한다. 이러한 시설재배지내에 식물 종다양성 확보를 위하여 재배작물 사이의 공간에 경합되지 않는 곳에는 다양한 잡초를 증식하거나 새로운 천적유지 식물을 개발하여 다양한 기주곤충을 증식시켜야 한다. 현재 가장 많이 사용하는 것으로서 보리를 이용한 콜레마니진딧벌 천적유지식물이 개발되었지만, 그 외에도 담배, 천사의나팔 김장배추, 쑥, 소리쟁이, 냉이 등 다양한 천적유지식물들을 개발할 수 있다. 즉, 토착천적을 개발하기 위하여 생태적으로 안정된 작물재배환경을 유지하는게 필요하고 이러한 안정된 생태계 속에서 효과적인 천적을 통한 해충방제가 이루어질 수 있다.

검색어: 천적 농업, 토착천적, 생태계, 천적유지식물, 종다양성

S2-4

Practical training of self-production techniques of natural enemies for farmers, and its contribution to the successful biological control

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경북대학교 친환경농업연구센터에서는 농업인들의 효과적인 천적 활용을 증진시키기 위하여 2016년부터 경상북도 농민사관학교의 지원을 받아서 친환경천적 교육과정을 개설하고 천적 자가생산 및 현장적용 기술의 실습교육을 실시하였다. 그동안 토양 포식성 천적인 총채가시응애(*Gaeolaelaps aculeifer*)와 뿌리이리응애(*Stratiolaelaps scimitus*), 그리고 점박이응애의 포식성 천적인 칠레이리응애(*Phytoseiulus persimilis*)와 사막이리응애(*Neoseiulus californicus*)의 간편하고 경제적인 대량생산기술을 개발하고 그 기술을 약 180명의 농업인에게 전수하였다. 즉, 농업인들이 스스로 천적을 자가생산하여 시설재배지에 적용함으로서 비용절감 및 청정 농산물 생산 효과를 높히는데 기여했다. 또한, 간편한 천적생산기술을 전국적으로 농업기술원, 농업기술센터, 그리고 친환경농업인단체 등 20여개 기관에 전수하였다. 최근, 경북의 농업기술센터(안동, 고령, 경주)에서 농업인을 대상으로 천적 대량생산 시스템 보급 시범 사업을 실시하면서 뿌리이리응애 및 칠레이리응애 등의 천적 자가생산시설을 구축하고 자체적으로 생산함으로서 지속적인 천적 활용이 가능하게 되고 해충 방제 효과를 증가시킬 수 있었다. 즉, 농업인들이 직접 천적을 생산하고 활용하게 함으로서 천적농업의 성공사례가 증가하였을 뿐만 아니라 국내 천적 공급 시스템이 다양화되어 천적농업의 활성화에 크게 기여한다고 판단한다.

검색어: 포식성 천적, 총채가시응애, 뿌리이리응애, 칠레이리응애, 사막이리응애, 천적 배양시스템

S2-5

Successful case of pesticide-free strawberry farming using self-produced natural enemies

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경북 안동의 진걸맘농장은 딸기와 쪽 농사를 주로 하고 있으며 10년 이상 친환경 무농약 농법을 인증받은 농가로서 천적을 활용하여 토경 1,000평 규모의 시설 하우스에 딸기 재배를 하고 있다. 2018-2020에 경북농민사관학교 친환경 천적과정을 통하여 천적의 자가생산 기술을 배우고 2021년부터 농가에서 직접 자가생산을 시작하였다. 그래서, 진걸맘농가는 칠레이리응애를 자가사육하여 지속적으로 딸기 재배지에 처리함으로서 점박이응애 방제에 성공한 농업인으로서 국내 첫 사례로 꼽힌다. 또한, 2022년 안동시농업기술센터에서 안전농산물 생산을 위한 천적 배양시스템 보급 시범 사업에 선정되어 딸기 해충의 생물적 방제를 위한 뿌리이리응애, 칠레이리응애, 보리뱅커플랜트 등의 천적 배양시설 완공, 천적의 자가생산 및 성공적인 현장적용 기술로서 농산물의 지역특화, 브랜드화를 통한 농산물 가격 차별화에 크기 기여하였으며 국내 천적농업의 발전을 위해 앞장서고 있는 선도농가로 인정받고 있다.

검색어: 천적 과정, 자가생산, 칠레이리응애, 천적 배양시스템 보급 시범 사업

S2-6

Economic effects of four natural enemy species in the strawberry farm

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한국에서 시설 딸기 해충을 방제하는 대표적인 방법은 살충제를 사용한 화학적 방법이다. 이는 농가에서 쉽게 접하고 처리 시기를 마음대로 조절할 수 있는 장점이 있지만, 방제 비용과 농업인부의 빈번한 화학살충제 노출이 큰 단점이다. 경주시 상평농원은 천적을 적극적으로 사용하는 농가로써 2020년부터 현재까지 4년간 4종의 천적을 구매, 사육, 방사를 실시하였다. 방사한 천적은 점박이응애 방제용 칠레이리응애와 사막이리응애, 작은뿌리파리 방제용 뿌리이리응애, 진딧물 방제용 콜레마니진딧벌이며, 농장의 규모는 재배동 1,250평, 육묘동 450평으로 자가육묘를 하기에 1년 내내 딸기를 재배하는 농장이다. 본격적으로 천적을 활용하는 시기는 9월부터 이듬해 5월까지 약 9개월이다. 이 기간 동안 소요된 비용은 천적을 구매하고 자가사육하여 사용한 경우(154만원), 천적과 약제를 구매하여 같이 사용한 경우(240만원), 천적만 구매하여 사용한 경우(262만원), 약제만 처리(377만원) 순으로 나타났다. 다만, 이 결과는 과학적으로 반복 및 재현 검증되지는 않았고, 각 농가의 천적과 해충의 생태에 대한 이해도와 작물 재배능력, 천적 사육능력에 따라 차이가 있을 수 있다.

검색어: 칠레이리응애, 뿌리이리응애, 사막이리응애, 콜레마니진딧벌, 딸기농가, 천적방제, 경제효과

S2-7

Simple mass rearing of *Neoseiulus californicus* and practical application to strawberry farms

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사막이리응애(*Neoseiulus californicus*)는 칠레이리응애에 비하여 고온건조한 조건에서 유리하고 점박이응애, 차응애, 차먼지응애 등 응애류 뿐만 아니라 가루이, 총채벌레 등 다양한 미소해충을 포식 포식하는 광식성 천적으로서 전세계적으로 산업화되고 있다. 사막이리응애를 농가수준에서 증식하기 위하여 간단한 대량생산 방법을 개발하였다. 천적의 먹이원인 가는다리고기진드기와 배지로서 밀기울(70%) 및 팽창질석(30%)을 멸균팩에 넣고 사막이리응애를 사육하였다. 그 결과 사막이리응애의 밀도는 3주차에 18배로 증식되었다. 증식된 사막이리응애를 딸기 농장에 2월초부터 4월초까지 8주간 매주 투여한 결과 잎당 점박이응애의 밀도는 무처리구에서 41.5마리이고 천적처리구는 7.0마리로서 점박이응애 방제효과가 83%로 나타났다. 본 연구를 통하여 자가생산한 사막이리응애를 활용하여 딸기농가의 점박이응애 방제에 효과적으로 사용할 수 있을 것으로 판단된다.

검색어: 생물적 방제, 포식성 응애, 천적 자가생산, 현장적용, 딸기농가

S3-1

Korea's national priorities as part of its strategy to respond to invasive alien plant pests

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Plant biosecurity refers to measures that aim to prevent the introduction and spread of pests that pose potential risks to plant health. This core concept underpins the approach undertaken by the National Plant Protection Organization (NPPO), where pre-border, border, and post-border biosecurity activities focus on early detection and rapid response. The approach recognizes the continuum from pre- to post-border, resource allocation is currently being reviewed to ensure an appropriate balance for effective risk mitigation. National Priority Plant Pests with contingency plans highlight the types of threats facing the Korean peninsula faces from exotic plant pests. This will lead to transparency of NPPO activities and ensure that it has the people, resources, tools and systems to address its most important priorities and effectively manage current and future biosecurity challenges.

Key words: National priority, alien plant pests, early detection, contingency plan, Korea

S3-2

Current status of exotic insect pests in Korea

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2015년부터 2022년도까지 6개목(딱정벌레목, 노린재목, 나비목, 벌목, 파리목, 총채벌레목)에 대해서 식물검역현장 검출실적과 국내 미기록종을 분석 하였다. 총 45,078건이 검역현장에서 검출되었으며, 545종이 새롭게 국내에 보고되었다. 이중 9종은 검역현장에서도 검출된 것으로 확인되었다. 검역현장에서는 딱정벌레목, 총채벌레목, 노린재목이 높은 검출률을 보였으며, 국내 미기록종 중에서는 벌목이 176종으로 가장 많이 보고되었다. 본 연구는 검출실적과 미기록종과의 관계를 살펴볼 때, 동시간대의 침입압력으로는 설명이 어렵다는 것을 보여주고 있으며, 이는 지속적인 식물검역시스템 개선이 필요성을 제시한다.

검색어: 생물안보, 식물검역, 검출, 미기록, 한국

S3-3

Status of research on quarantine treatment and application of sulfuryl fluoride to wood destorying pests

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Research on alternative fumigants to replace methyl bromide (MB), a harmful ozone-depleting substance and highly toxic pesticide, began in 2007. Initial tests focused on using ethyl formate for fruits and EDN for wood. Subsequently, alternative techniques were developed for a total of 94 plant types using ethyl formate, EDN, and phosphine, demonstrating Korea's superior performance compared to other countries, especially in practical applications. However, when it comes to wood products, the primary users of methyl bromide, EDN is scarcely used due to concerns about worker safety. An emerging alternative to MB is sulfuryl fluoride (SF), widely employed in North America to control wood-damaging pests like termites. SF's advantages include a lower boiling point and higher vapor pressure, making it effective against wood pests. Yet, certain bark beetle eggs require higher doses and longer treatment periods, resulting in established international standards (e.g., 120g/m3 for 48 hours at 20°C), posing challenges for field applications. Recently, the APQA initiated basic research to apply SF to wood. They are assessing SF's effectiveness against various wood-destroying pests, including termites, bark beetles, and long horn beetles, while also evaluating the feasibility of mixed treatments to reduce dosage. Once SF fumigation standards are established, it is expected to significantly reduce methyl bromide use in commonly used wood types, contributing to ozone layer protection and enhancing fumigation work safety.

Key words: methyl bromide alternative, SF fumigation, new research, interational standard, characteristic of SF

S3-4

A brief history of phytosanitary framework development

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106th Medical Detachment

The idea of phytosanitation has continuously received attentions since 1950s, as the volume of international trade began to rise. All aspects of phytosanitation, including regulatory framework as well as the supporting technologies and sciences, have developed intercorrelatedly to the exponential growth of the trade, for the protection of an importing country’s agriculture, landscape, and industries from potential damages by invasive non-native pests. Phytosanitary regulatory framework has chiefly been developed by the International Plant Protection Convention (IPPC), which is the foundation of the standardized phytosanitary measures across the borders, as delineating roles/responsibilities of every stakeholder on a trade continuum. Changes and modifications on the framework will be continuously required to cope with the on-going challenges by invasive non-native pests. Its role is no longer limited to plant protection but has blended into other frameworks, such as biosecurity and food safety.

Key words: phytosanitation, framework, invasive non-native pest

S3-5

Necessity of quarantine pest handling guidelines, facilities, and certification standards in Korea

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우리나라 식물방역법은 검역병해충으로부터 국내 농업 및 자연환경을 보호하고자 규제병해충(검역병해충, 잠정규제병해충, 규제비검역병해충) 관련 위험평가, 식물검역기술개발계획, 식물검역 절차 및 방법, 검역결과에 따른 처분, 규제병해충 예찰 및 방제 등에 관한 다양한 법적 절차 등을 규정하고 있다. 하지만, 식물검역병해충을 어떻게 취급하여야 할 지에 관한 내용은 없다. 따라서 식물방역법이 추구하는 목적을 달성하기 위하여서는 ① 검역병해충을 어떻게 취급하여야 할 지를 규정하여야 하며, ② 검역병해충을 취급하는 시설(검사, 연구, 운송, 보관 등) 기준을 설정하고, ③ 검역병해충 취급 시설을 인증하고, 주기적인 재인증 기준을 설정하여야 한다. 이를 위하여 먼저 식물방역법에 검역병해충 취급시설 등에 관한 규정을 신설하고, 시행령, 시행규칙에 반영한 후에 ① 검역병해충 취급요령 ② 검역병해충 취급시설 기준 ③ 검역병해충 취급시설 인증기준 등의 고시를 제정하여야 한다. 이를 위하여 식물병해충 관련 학계의 의견 반영이 가장 중요하다.

Key words: plant quarantine pest, handling quidelines, facilities standatds, certification standards

S4-1

Strategy of exotic forest pest monitoring and application of the digital field note

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최근 기후변화로 인해 외래 무척추동물(곤충)의 돌발발생 가능성이 높아지고 있는 추세를 감안할 때 이들에 대한 확산 및 변화예측 진단을 통한 조기방제의 중요성이 대두되고 있다. 그러나, 외래곤충의 종 정보 및 정확한 침입경로가 충분치 않아 문제해충이 될 가능성이 매우 높은 것이 사실이다. 또한, 신속정확한 정책결정을 위해서는 현장조사자료가 체계적으로 수집되어 종합되어야만 정확한 진단 및 방제에 활용될 것이므로 이에 대한 다양한 장치가 필요하다. 현재 국내 서식 중인 주요 산림해충 일부를 제외한 종들은 대부분 외래곤충으로 돌발적으로 대발생한 해충이 많이 포함되어 있어 국내에 유입된 외래 곤충에 대한 체계적인 데이터 확보를 통해 정착, 확산, 생태계 영향 예측모델 개발 및 활용시스템의 구축이 요구되는 실정이다. 따라서, 본 연구는 외래 곤충의 전국적인 모니터링을 통해 분포정보 및 생태정보 등의 중요 데이터 수집과 최신 정보를 활용하여 국내 유입된 외래 곤충의 정착, 확산, 생태계 영향 및 변화예측을 위한 전략수립과 모바일 등을 이용한 전자야장의 사용에 대해 논하고자 한다.

검색어: 산림해충, 전자야장, 모니터링, 외래곤충

S4-2

Prognosis of population dispersal of an alien forest pest according to process based models

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Process-based models are effective in addressing spatially explicit dispersal of invasive species based on life mechanisms including birth, death, movement and response to environmental factors. An invading alien species, the western conifer seed bug (*Leptoglossus occidentalis*), spreads rapidly in the Korean peninsula since 1988. Process-based models were developed to include the rules occurred in population dynamics of the western conifer seed bug population. Passive movements were additionally linked to the models to present local and global transportations due to sapling trades. Simulation results presented the rapid dispersal of the pest species, comparable to field data. Model parameters including the Alle effect threshold and contribution of global transportation were adjusted to reveal spatially-explicit advancement patters of the species. Utilization of process-based models is further discussed in monitoring and management of forest insect pests in field conditions.

Key words: forest pest, the western conifer seed bug, dispersal, movement, pest management

S4-3

Predicting the potential distribution of alien forest insects

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Invasive alien species pose a considerable threat to both natural ecosystems and human societies. Among these invasive species, forest pests stand out as particularly detrimental, as they can lead to a substantial decline in native biodiversity, deforestation, and the loss of forestry products. The recent effects of climate change and the expansion of international trade have further exacerbated the spread of these invasive species. In this study, we provide an overview of prediction models based on species distribution models for assessing the potential distribution of invasive forest pests in Korea. This information can prove invaluable in the development of effective management and control strategies for these alien species.

Key words: alien species, invasive species, monitoring, species distribution model

S4-4

Development of invasive forest pest spread analysis system

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최근 외래해충의 침입과 확산의 우려가 증대됨에 따라 이들에 대한 체계적인 탐색과 관리에 대한 필요성이 요구되고 있다. 이에 이들에 대한 종합적인 시스템구축으로 신속한 탐색과 방제에 대한 방안을 구축하기 위한 시스템의 확보를 위안 연구가 필요한 실정이다. 이를 위해 침입해충에 대한 종합시스템은 내·외부 이용자에게 제공되는 서비스페이지, 이용자별 권한에 따른 데이터 등록 페이지와 관리페이지를 중심으로 설계되었다. 또한 서비스제공 페이지는 K-SDM 소개, 통합검색, 외래 곤충 정보(종 별 정보),외래 곤충 분포(조사통계), 외래 곤충 예측(예상 분포 및 시나리오), 정보마당(공지사항, 보도자료), 서비스 이용 매뉴얼, 사이트 맵의 기능을 포함하고 있다. 본 시스템의 운용을 위해 회원가입 승인을 마친 내부이용자와 외부 이용자(일반 이용자 제외)가 데이터 등록 시에 사용하는 데이터관리 페이지는 조사데이터 등록, 이전 등록 데이터 수정, 데이터 등록 매뉴얼, 데이터 열람, 필요데이터 출력과 알림, 메시지, 과제등록현황의 기능을 포함한다. 이외에도 기관 관리자가 사용하는 DB 및 시스템 관리페이지는 데이터관리, 과제관리, 종 관리, 통계관리, 예측관리, WEB 서비스관리, 이용자 관리, 기관관리를 포함한다. 각 상세 기능들의 구현에 대하여 효율적이고 체계적인 시스템의 구축이 이루어졌다.

검색어: 산림해충, 전자야장, 확산, 모델링, 외래곤충

S4-5

Invasive forest insect pests in Korea under the influence of climate change

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기후변화가 국내 주요 외래 산림해충 발생에 미치는 영향을 리뷰하였다. 국내 주요 외래 산림해충으로 소나무재선충병, 주홍날개꽃매미, 미국선녀벌레, 갈색날개매미충, 소나무허리노린재 등이 보고되어 있다. 외래 산림해충에 대한 기후변화 영향 평가는 종 분포 모델에 기반을 둔 발생위험도 평가를 통해 분석되고 있었다. 여러 국내 연구 사례들은 기후변화가 진행됨에 따라 소나무재선충병의 발생위험도가 증가함을 보여주었다. 일본 등 국외 연구 사례에서도 기후변화에 의해 온대지역 소나무림의 소나무재선충병 발생위험이 증가할 것으로 예측되었다. 주홍날개꽃매미도 기후변화가 진행함에 따라 발생위험도가 증가하였다. 그러나 벼룩좀벌류 등의 천적이 주홍날개꽃매미 밀도를 감소시키므로 현실적인 기후변화 영향평가를 위해서는 천적류에 대한 기후변화 영향 평가가 필요할 것으로 판단되었다. 산림 분야 기후변화 대응을 위해서는 산림해충 및 천적류에 기후변화 영향평가를 기반으로 한 적응 대책의 필요성이 확인되었다.

검색어: 기후변화, 외래 산림해충, 소나무재선충병, 종 분포 모델, 주홍날개꽃매미

S5-1

Invasive clearwing moth borers (Lepidoptera: Cossidae: Sesiinae) to Korea

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This study presents a thorough identification of species of clearwing moths causing damage to street trees in Korea. Identification was carried out using both morphological and molecular studies, and their intra- and interspecific genetic divergence were analysed via molecular data. The outcomes of this research will facilitate detection of the insect pest species, which is frequently misidentified, as well as forecasting their migration routes in Korea for preemptive control studies.

Keywords: clearwing moths, invasive insect pest, integrated identification, genetic diversity

S5-2

Outbreak of walking-stick insects and their rapid decline: What is key factor?

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The walking-stick insects, *Ramulus mikado*, are outbreaks in several mountainous areas from 2020 to 2022. In recent, some population of the insect are showed rapidly decline in their abundance, while some of them are still maintained high population density. In worldwide, insects belonging to Phasmida are reported to outbreak in their habitats as mentioned above environments, but knowledge about outbreak pattern of the walking-stick insects is still lacking. In this study, we aimed which biological and environmental factors are related to wax and wane of the insect population. From 2022 to 2023, we studied host tree preferences in natural conditions, ecological stoichiometry in major host trees, overwintering ecology of *R. mikado* eggs, and infection rate by entomophathogenic fungi during growing season.

Key words: Phasmidae, insect pests, insect-host tree relationship, plant nutrition, entomophathogenic fungi

※ 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 (NIBR202311101).

S5-3

Recent trends in forest pest occurrence

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한국임업진흥원은 2012년 1월 설립된 산림청 산하의 공공기관으로서 산림과학기술의 보급과 임업 및 임산업의 고부가가치 창출을 위한 임업 서비스를 제공하고 있으며, 국내 산림분야 활성화 및 글로벌 경쟁력 확보에 기여하고 있다. 특히, 소나무재선충병으로부터 국가 산림자원 보호를 위해 소나무재선충병모니터링센터를 2016년 1월에 설치하였으며, 최근 산림병해충이 산림을 비롯하여 생활권, 농림지 등에 돌발·대발생하여 국민생활에 불편을 초래하고 재산피해를 야기함에 따라 2021년 1월에 산림병해충모니터링센터로 확대 개편하여 산림병해충 피해 예방과 감소를 위한 다양한 역할을 수행하고 있다. 주요 역할로는 주요·돌발·외래 산림병해충의 예찰 및 발생·피해현황 모니터링, 방제약제 등록시험 운영 및 방제품질 관리, 예찰·방제 전문가 양성 교육, 대국민 홍보 등이 있으며 본 발표를 통해 현재까지 산림병해충 관리를 위한 수행 내용과 결과를 공유하고자 한다.

검색어: 한국임업진흥원, 산림병해충, 예찰·방제, 모니터링

S5-4

Assessment of climatic suitability and spread potential of *Anoplophora horsfieldii* (Coleoptera: Cerambycidae): A newly identified exotic insect in Jeju Island, Korea

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최근 제주도 용연계곡 일대에서 새로운 알락하늘소속 외래해충(가칭)노랑알락하늘소가 발견되었다. 2023년 7월부터 제주 용연계곡 일대 팽나무에서 우화한 성충이 대량 발생하고 있으며, 제주 전역과 육지로 확산할 가능성이 있어 시급한 모니터링과 박멸이 필요한 상황이다. 본 연구에서는 노랑알락하늘소의 국내 기후적합성 분석을 통해 잠재적으로 정착이 가능한 지역을 사전에 탐지하는 것을 목표로 하였다. GBIF에 보고된 전 세계 분포자료와 WorldClim의 생물기후변수를 이용하여 앙상블 모델을 만들고 노랑알락하늘소의 정착 확률 지도를 제작하였다. 또한 제작된 정착 확률 지도를 바탕으로 향후 주변 지역으로 확산 패턴을 시뮬레이션하였다. 기후적합성 분석 결과 노랑알락하늘소는 원산지인 중국 남부, 대만 등 아열대 지역을 포함하여 일본과 국내에서도 정착이 가능할 것으로 추정되었다. 국내로 한정하였을 때는 이미 정착이 확인된 제주 지역 전체와 부산, 여수 등 국내 남부지방 해안가에서 기후적합성이 매우 높을 것으로 예상되었다. 확산 패턴 시뮬레이션 결과 노랑알락하늘소는 예찰 및 박멸이 이루어지지 않을 경우 빠르게 제주 전역으로 확산될 수 있을 것으로 나타났다. 이 결과는 노랑알락하늘소에 대한 생활사 연구와 함께 현재 확산 범위에 대한 시급한 모니터링과 박멸 프로그램이 필요하다는 것을 암시한다.

검색어: 노랑알락하늘소, 제주도, 침입곤충, 산림해충, 기후 적합성

S5-5

Potential outbreakable Nolidae: Taxonomy and ecology

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Family Nolidae has not much been treated as noticeable pest. In other countries, there are some pest species like *Garella musculana* (Erschoff, 1874), *Uraba lugens* Walker, 1866, and *Earias insulana* (Boisduval, 1833), but those are not reported in Korea. Recently, the occurrence of a nolid species, *Meganola major* (Hampson, 1894) has been increasing, especially in Jeollanam-do Prov. This species is mainly distributed in Indian subregion and Southeast Asia, but also East Asia reported, but until now, there are no outbreak information. Neverthereless, recent outbreak might be lead by global warming, and their growth stage. This seems to be evidence of the potential outbreak risk of nolid moths, but unfortunately, their ecology is not mostly well-studied. In this discussion, we are focusing on the potential outbreak of nolid moths in East Asiatic and Oriental regions.

Key words: pest, *Meganola major*, host plant, Oriental region, Palaearctic region

S5-6

Occurrence patterns of *Cephalcia koreana* (Hymenoptera: Pamphiliidae), a new species of sawfly, in Manchurian fir forests from Korea

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In 2020, severe defoliation was reported in *Abies holophylla* plantations located in Hwacheon-gun, Gangwon-do. This damage was attributed to an outbreak of an unidentified sawfly species from the genus *Cephalcia* (Hymenoptera: Pamphiliidae). The larvae of this sawfly caused significant defoliation of the leaves. This pest has been identified as *Cephalcia koreana* Park & Jung, sp. nov., described as a new species in 2023. To investigate the occurrence pattern and density of *C. koreana*, we set up emergence traps and analyzed samples from affected branches. Our results showed that the density peaks for adults, eggs, and larvae were in mid-May, late May, and early June of 2021, respectively. However, their density decreased sharply after a notably cold spring period in 2022. Here, I aim to discuss the outbreaks of insect pests and their population dynamics.

Key words: new insect pest, web-spinning sawfly, outbreake, popluation dynamics

S5-7

Seasonal occurrence of the western conifer seed bug, *Leptoglossus occidentalis* heidemann from cone of Korean white pine and cone damage by period

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소나무허리노린재는(Leptoglossus occidentalis)는 북미원산으로 2010년 경남 창원에서 국내 침입이 처음 확인되었다. 최근 까지는 소나무 구과에서 피해에서 나타났으나 이로 인한 피해는 수목생육에 직접적인 영향이 적은 편이다. 그러나 2020년 경기도 가평군의 잣나무 구과에서 피해가 확인되었는데, 잣나무 구과는 산림에서 경제적으로 매우 중요한 소득작물로, 이로 인한 피해가 문제가 되기 시작하였다. 잣나무 구과에서 소나무허리노린재 발생소장 조사를 위해 경기도 가평군 6개 지역의 잣나무 상부에 타임랩스 카메라(TLC2020,Brinno)설치하고 영상분석을 통해 잣 구과에서 소나무허리노린재 발생소장을 조사한 결과, 잣 구과에서 2021년 6월 7일에 최초 관찰되기 시작하여 11월 7일까지 관찰되었으며, 2022년에는 5월 17일부터 10월 29일까지 관찰되었다. 시기별 구과 피해율 조사를 위해 잣나무 구과에 4월 초순에 망대를 사전에 설치하고 5월 중순부터 각 시기별로 소나무허리노린재를 15일 간격으로 접종시켜 가해토록 한 후 제거하여 가해 시기에 따른 종자 피해율을 조사한 결과 잣 구과가 주로 성숙하는 6~7월 경이 잣 종자피해율이 높았으며 7월 하순부터는 종자 피해율이 낮아지는 경향을 보였다.

검색어: 소나무허리노린재, 잣 구과, 발생소장, 구과 피해율, 타임랩스카메라

Oral Presentation

Competition

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PG1

Predicting disease vector mosquito population using machine learning model

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모기는 감염병을 매개하는 종으로 전염병 확산 억제를 위해서는 개체수의 감시와 정확한 예측이 필요하다. 본 연구에서는 모기 개체수 및 기상 및 현장 자료를 활용해 모기 개체수 머신러닝 모델을 개발하였다. 모기 개체수는 디지털 모기 측정기(Digital Mosquito Monitoring System, DMS)의 2015년~2022년의 5월~10월의 자료를 활용하였다. 기상 자료는 기온, 강수량, 풍속, 습도를 사용하였으며, 현장 조사 자료는 현장을 명목척도와 서열척도로 나누어 기록하여, 명목 척도의 경우 원핫 인코딩으로 변환해 수치화하여 사용하였다. 분석에 사용된 머신러닝 모델은 Artificial Neural Network, Random Forest, Gradient Boosting Machine, Support Vector Machine이며 성능지표로 R^2, RMSE를 사용하였다. 연구 결과, Gradient Boosting 모델이 R^2 0.4, RMSE 22.45로 가장 좋은 성능을 나타냈다. 현장 조사 자료를 분석에 활용하였을 때 R^2는 증가하였고, RMSE는 감소하였다. 본 연구 결과 모기 개체수에 현장 조사 자료가 예측 정확도를 향상시킬 수 있음을 확인하였다.

검색어: 매개모기, 기상자료, 머신러닝, 발생예측

PG2

Trojan horse in an insect symbiosis

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Many insects form mutualistic relationships with microbial symbionts, crucial for their physiological processes. The bean bug, *Riptortus pedestris*, establishes a unique gut symbiosis with the genus *Caballeronia* and consistently acquires these symbionts from surrounding soil with each generation. As a result, the bean bug unavoidably consumes a variety of environmental microbes, including potential pathogens. To address this, the bean bug has developed a specialized organ in its midgut that selectively filters out non-symbiotic microbes, thereby preventing contamination of its symbiotic organ. In this study, we identified a pathogenic strain from the genus *Burkholderia* that lethally affects the bean bug post-invasion of the symbiotic organ. This pathogen employs a strategy of mimicking the motility of native symbionts to infiltrate the symbiont sorting organ and displays a pronounced resistance against antimicrobial agents produced by the host. Upon establishing itself in the symbiotic organ, the pathogen breaches the midgut cells, leading to host mortality, and subsequently disperses into the external environment. Our findings unveil a cunning pathogenic tactic that exploits the mimicry of native symbionts within an insect's symbiotic framework.

Key words: *Riptortus pedestris*, *Caballeronia*, *Burkhlderia*, Symbiosis, Trojan Horse

PG3

Revealing the biological insights of the specialist herbivore, *Helicoverpa assulta*, through comparative genomics and chromosome-level genome assembly

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Helicoverpa assulta (Lepidoptera: Noctuidae) exhibits a specialized herbivorous diet, primarily targeting select Solanaceae plants. Despite its significant economic impact as a pest, causing substantial harm to crops like hot pepper and tobacco, it has received comparatively limited attention in research compared to its generalist counterparts, *H. armigera* and *H. zea*.We introduce a chromosome level genome assembly using a Korean *H. assulta* (Pyeongchang strain, K18). This assembly was achieved through a combined approach utilizing Nanopore long-read sequencing (approximately 78X coverage) and Illumina NovaSeq short-read sequencing (approximately 54X coverage). The total assembled genome spans 424.36 Mb, designated as ASM2961881v1, comprises 62 scaffolds, with 98.7% of the genome contained within 31 scaffolds, confirming the insect's chromosome count (n = 31). The completeness of the assembly is reflected in BUSCO assessment, with values reaching 99.0%, while the repeat content accounts for 33.01%, and 18,593 CDS were annotated. Additionally, 137 genes were identified within 15 orthogroups that have rapidly expanded in *H. assulta*, while 149 genes in 95 orthogroups have rapidly contracted. This genome draft serves as a valuable resource to explore various aspects of the specialist's biology, enabling research into host-range evolution, chemical communication, insecticide resistance, and comparative investigations with other Heliothine species.

Key words: *Helicoverpa assulta,* Polyphagous, Specialist, Generalist, Evolution

PG4

Genome-wide exploration of metabolic based pyrethroid resistance mechanism in *Helicoverpa armigera* (Lepidoptera: Noctuidae)

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To elucidate the mechanism of pyrethroid resistance in *Helicoverpa armigera*, the study explored three possibilities based on deltamethrin as a model pyrethroid; 1) the existence of mutations in the target site of deltamethrin, 2) the existence of variation at the genomic level between insecticide-susceptible and resistant strains, 3) differences in gene expression patterns between the strains. Based on these hypotheses, three levels of resistant strains and a susceptible strain as well as nine Korean field populations were used. As results, 1) any point mutations were not detected in sodium channel gene. 2) based on newly set Korean reference genome (GCA_026262555.1), approximately 3,369,837 and 1,032,689 variants (SNPs and Indels) were revealed from genome and ORFs, respectively. However, any specific variants were not found to be highly correlated with the level of insecticide resistance. 3) based on DEG analysis, some of detoxification enzyme genes were differently expressed particularly cytochrome P450 genes. Therefore, *H. armigera* possibly acquires deltamethrin resistance through a combination of actions, including over-expression of various detoxification enzymes such as CYP3 subfamilies and cuticular proteins.

Key words: *Helicoverpa armigera*; genome; evolution; cytochrome P450; detoxification, xenobiotics

PG5

Environmentally-transmitted symbiotic bacteria enable a novel feeding strategy in the host bean bug, *Riptortus pedestris* (Hemiptera:Alydidae)

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Nutrient acquisition by insect herbivores affect all aspect of the the lifespan of individauls. For seed-sucking insect herbivores, they face challenges with nutrient acquisition due to requirement for extra-oral digestion of seed contents into a readily-ingestible state. In this study, we demonstrated environmentally-transmitted *Caballeronia insecticola* allow seed-sucking *R. pedestris* to overcome challenges with extra-oral digestion. Through the evaluation, first, we found symbiotic insects exhibited enhanced feeding efficiency by consuming significantly larger amount of food per feeding attempt compared to apo-symbiotic insects ($P<0.05$). Then, we observed feeding behavior modification in the symbiotic insects from the behavior tracking evaluation. Symbiotic insects displayed dichotomic behavior which can be generally divided into early focused feeding and later subdued resting periods. By contrast, apo-symbiotic insects displayed unordered behavior by frequent switches between feeding and walking behavior.

Key words: ecology, host-microbe interaction, symbiosis, insect behavior

PG6

Study on isolation mating efficiency for honey bee (*Apis mellifera*) breeding

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양봉꿀벌은 한 마리 여왕벌을 중심으로 일벌 및 수벌들이 군집을 이루고 있는 사회성 곤충이다. 꿀벌은 여왕벌이 깨어나면 처녀비행(반경 2.4~7.4km)을 하여 공중에서 여러 마리의 수벌들과 교미를 한 후, 자신의 봉군 내부로 돌아와 평생을 살아가는 생태적 특성을 가지고 있다. 이와 같은 이유로 계통 증식 또는 품종 육종에서 외부의 오염원을 차단하기 위해서는 여왕벌과 수벌이 격리된 지역에서 교미가 이루어져야 한다. 본 연구는 여왕벌과 수벌이 격리될 수 있는 국내 도서지역을 중심으로 격리교미 연구를 2020년부터 2023년 봄부터 가을까지 수행하였으며, 육종을 위한 격리교미의 효율성을 분석하고자 하였다. 도서지역은 전남 - 낙월도, 전북 - 위도, 왕등도, 식도에서 수행되었으며, 섬 크기, 경관 환경 요인, 교미 시기 등에 의해 격리교미의 성공률이 어떻게 변하는지를 확인하였다.

검색어: 양봉꿀벌, 꿀벌육종, 교미율, 환경인자

PG7

Molecular phylogeny and evolutionary history of plant bugs (Hemiptera: Miridae)

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Miridae show remarkable diversity (>11,700 spp.), accounting for a quarter of all Heteroptera. However, their phylogeny and evolutional history is still remain unclear. In this work, we provide new suggestions for the phylogeny of Miridae using a larger dataset than previous studies. In addition, we suggest an alternative evolutionary history based on newly calibrated divergence dates for Miridae and its subordinate groups, and present probable factors of the family's success in terms of species diversity. The entire dataset comprises 16 outgroups and 188 ingroup taxa including all seven known subfamilies and 37 out of 45 known tribes. Each species is aligned as 3,577 bp with six molecular loci (COI, 16S rRNA, 18S rRNA, 28S rRNA D3 region, H2A, and H3A).

Key words: Hemiptera, Heteroptera, Miridae, Phylogeny, Angiosperm radiation, MRCA

*This work was supproted by NIBR grant (NIBR202304203)

G1

Novel Approach: Stathmopodidae phylogenetic analysis using ChatGPT

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The family Stathmopodidae, which belongs to to the superfamily Gelechioidea, has 6 genera and 18 species reported in Korea to date. This family is classified as pests, causing serious damage to grains or fruits, depending on the species. Therefore, precise control is necessary, however, there is a lack of taxonomic and ecological research. We aim to analyze the clade and speciation timing for phylogenetic analysis of Stathmopodidae using ChatGPT, a tool that has recently garnered much attention. ChatGPT, a conversational AI chatbot developed by OpenAI, is accessible to anyone and being able to improve itself through conversations with users. In this study, we utilized the lengths of the generated lineage branches and the molecular clock rate to predict when certain species of the family Stathmopodidae diverged, measured in millions of years. However, further study is required to obtain more accurate figures.

Key words: Stathmopodidae, pest, phylogenetic, ChatGPT

G2

A historical review of the classification of subfamily Erebinae (Lepidoptera: Erebidae) in Korea

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Erebidae is one of the most diverse families within Lepidoptera. Erebinae is one of its subfamilies that stands out for having a remarkable diversity, which complicates its taxonomic classification. It exhibits a high degree of global diversity, with many yet-to-be-explored faunal aspects. In this study, we review the historical classification of Erebinae and incorporate the latest molecular phylogenetic analyses alongside traditional morphological groupings. Furthermore, we present a detailed list of Erebine tribes and species found in Korea, highlighting the literature and morphological characteristics employed in grouping genera within these tribes. This study aims to advance our understanding of Erebinae's complex taxonomy and biodiversity.

Key words: classification, Erebinae, history, review, taxonomy

G3

Taxonomic review of the genus *Epistrophe* (Walker) (Diptera: Syrphidae: Syrphini) in Korea based on morphology and DNA barcoding

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As a result of our taxonomic study of the genus *Epistrophe* (Walker) in Korea, we recognized a total of 16 species including seven putative new species (code names are temporarily given from A to F). We also conducted a DNA barcoding analysis of 25 nominal species and 130 samples of *Epistrophe*. In our barcoding analysis, despite insufficient bootstrap support, *Epistrophe* formed a cluster with two genera, *Epistrophella* and *Leucozona*, topologically supporting their close relationships. Our analysis also showed some interesting results worthy of attention: First, at least two distinct cryptic species were found within the *E. grossulariae* cluster. Second, the taxon identified as *E. nitidicollis* seems to represent at least three distinct species. Third, three BOLD-deposited European samples listed as *E. olgae* showed almost identical barcode sequences with the European *E. nitidicollis*.

Key words: DNA barcoding, *Epistrophe*, Syrphidae, Syrphinae, Syrphini

G4

Understudied and ecologically significant: Exploring the pseudoscorpiones of Korea

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The order Pseudoscorpiones De Geer, 1778, often referred to as pseudoscorpion, is a relatively understudied taxonomic group in Korea. Korea has documented only 26 species within 8 families and 13 genera of Pseudoscorpiones, a notably smaller number compared to Japan, which includes 100 species in 13 families and 35 genera, or China, with 168 species in 12 families and 39 genera. Additionally, Korea currently lacks comprehensive information regarding the ecology, behavior, and taxonomic characteristics of Pseudoscorpiones. These highly sensitive soil-dwelling predators dynamically respond to changes in soil conditions, making them potential significant biological indicator species. Furthermore, Pseudoscorpiones are known for their adaptation to lower soil temperatures, rendering them particularly sensitive indicators of climate change impacts. Through this presentation, our goal is to illuminate the ecology, behavior, and taxonomic attributes of Pseudoscorpiones species recorded in Korea. By doing so, we aim to contribute to the future expansion of research in this field and enhance our understanding of these remarkable arachnids.

Keywords: Pseudoscorpion, false scorpion, life behaviour, taxonomical characters

G5

Cryptic diversity of the gall-forming aphid *Tuberaphis* Takahashi (Hemiptera: Aphididae) on *Styrax* (Styracaceae)

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The aphid genus *Tuberaphis* Takahashi belongs to the tribe Cerataphdini (Hemiptera: Hormaphidinae) and comprises 17 valid species. Generally, its species are distributed in East and South East Asia, where they primarily feed on *Styrax* spp. (Styracaceae) and utilize species within the Loranthaceae family as their secondary hosts. They form various shapes of galls on *Styrax*, looking coral and broccoli etc. Currently, the only aphid species reported to exclusively produce gall forms resembling broccoli head-shaped is *Tuberaphis takeouchii* (Takahashi). For the first time in Korea, an aphid species forming gall structures with a broccoli-head-like appearance has been discovered. We confirmed that the species discovered in Korea is a new species through morphological and molecular comparisons with *T. takenouchii* (Takahashi). To comprehend the life cycle of this new species, we conducted a year-long study investigating how the gall forms change and examined aphid polymorphism across different seasons. The results of this study additionally include as followings: 1) Species identification, 2) DNA barcoding, 3) population genetic analyses, and 4) morphological comparison using SEM

Key words: Aphids, Hormaphidinae, new taxa, DNA barcoding, SEM

G6

Taxonomic review of the genus *Bucculatrix* Zeller, 1839 (Lepidoptera: Bucculatricidae) in Korea

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This study was conducted to review of the genus *Bucculatrix* Zeller, 1839, belonging the family Bucculatricidae of the superfamily Gracillarioidea from Korea. The genus *Bucculatrix* was comprising more than 300 species worldwide. In Korea, only two species have been reported to date. In this study, a total of 10 species are recognized from Korea. Among them, five species, *Bucculatrix* sp. nov.1, *Bucculatrix* sp. nov.2 and *Bucculatrix* sp. nov.3, *Bucculatrix* sp. nov.4 and *Bucculatrix* sp. nov.5 are described as new to science. Also, three species: *B. duanwuia* Liu, 2020, *B. tsurubamella* Kobayashi, Hirowatari & Kuroko, 2010 and *B. splendida* Seksjaeva, 1992 are reported for the first time from Korea. All available information, host plants and images of adults and genitalic structures for species is provided.

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

G7

Strategic optimization of miticidal activity, ecotoxicity, and phytotoxicity in the rosemary essential oils to develop biorational pesticides

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Due to the concerns over their environmental and health impacts, there have been attempts for shift towards biorational pesticides from synthetic pesticides. Among them, plant essential oils have emerged as promising active ingredients. Due to the complex interactions among their constituents, the bioactivities of essential oils can vary depending on the compositions, which often undermine their stability in efficacy. Here, we present a model-based optimization approach to develop reliable rosemary oil-based biorational pesticide, against two-spotted spider mites, *Tetranychus urticae* Koch. The ecotoxicity against *Daphnia magna* and foliar phytotoxicity against *Phaseolus vulgaris* were also evaluated. Our quadratic models accurately predicted miticidal activity, ecotoxicity, and phytotoxicity. We aimed to maximize, minimize, and minimize these parameters, respectively. We employed seven multi-objective evolutionary algorithms in Matlab. Among them, the nondominated sorting genetic algorithm II with adaptive rotation based simulated binary crossover (NSGA-II-ARSBX) performed best. We experimentally determined the thresholds for miticidal activity and phytotoxicity, based on the current approval process for agricultural pesticide products in Korea. After applying the thresholds, we validated the obtained viable solutions. Our study offers a novel framework to enhance the reliable and responsible use of essential oils as biorational pesticides.

Key words: rosemary oil, botanical miticides, optimization, genetic algorithm

G8

Gustatory habituation to essential oil induces reduced feeding deterrence and neuronal desensitization in *Spodoptera litura*

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The aim of this study is to investigate the habituation phenomenon of essential oils as potential feeding deterrents in agricultural practices and their associations with taste receptors. Non-choice tests and contact-fumigation bioassays were conducted to determine the feeding deterrency and insecticidal activity of 30 commercial oils on the third instar larvae of the tobacco cutworm. The results indicated that lemongrass, fennel sweet, and clove bud oils had the highest feeding deterrency in that order, and no direct correlation between insecticidal activity and feeding deterrency was observed. To validate the habituation phenomenon, larvae were exposed to the three abovementioned oils at a 1 mg/g for 48 h, then a choice assay was conducted. It showed a significant reduction in both feeding deterrence and repellency in all cases. Similar reductions in feeding deterrence were observed when individuals exposed to the main components of the three oils: citral&limonene, anethole, and eugenol. Additionally, the oil mixture of fennel sweet and clove bud exhibited the most significant synergistic effect on feeding deterrency, suggesting a relatively slower habituation process. This reduction in feeding deterrence is presumed to be due to desensitization of the larval taste sensory organs, including the maxillary palp, lateral styloconica, and medial styloconica. Further research will be conducted to investigate the specific mechanisms and spike activity associated with these sensory organs using electrophysiological study.

Key words: *Spodoptera litura*, feeding deterrent, habituation, desensitization

G9

Effect of water stress on red-necked longhorned beetles, *Aromia bungii* infestation in *Prunus* x *yedoensis* trees in an urban landscape

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In general, trees showing water stress planted in a harsh environment like urban landscapes are weakened and can be easily infested by insect borers, such as cerambycid and curculionid beetles. *Prunus* × *yedoensis* constitutes a significant portion of urban street trees in Korea and there has been an increasing incidence of damage caused by red-necked longhorned beetle (RLB), *Aromia bungii*. When water stress is incresed, the production of resin, a natural defense mechanism against the infestation of *Aromia bungii* larvae, can be decreased that impact on larval survival rates. This study was conducted to investigate the relationship between infestation rate of RLB and water stress of cherry trees. We counted number of larval entrance and adult emergence holes in 50 trees and monitored adult's behaviors during daytime. In addition, we measured water stress using a pressure chamber for each tree.

Key words: Cerambycidae, cherry tree, roadside tree, wood boring insects, pressure chamber

G10

Development of a LAMP-based molecular species diagnostic tools for four agricultural pests in the genus *Helicoverpa* (Lepidoptera: Noctuidae)

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Some of *Helicoverpa* species (Noctuidae: Heliothinae) are among the worst Lepidopteran agricultural pests in the world, such as *H. armigera*, *H. assulta*, *H. zea*, and *H. punctigera.* Despite different distribution areas, these species possibly migrate long distances both with and without human transportation, mixing insecticide resistance alleles along the way. As these species are morphologically similar at the larval stage, diagnostic methods have been developed and utilized for their identification. Here, we developed a loop-mediated isothermal amplification (LAMP) assay for rapid and effective species diagnosis, along with PCR, to identify Korean field-collected or overseas samples. Species-specific primers were designed by aligning and comparing the mitochondrial genomes of related species, including four species. There are differences depending on the species and the optimal temperature and reaction time of the LAMP assay, depending on the set of four essential primers. For instance, *H. armigera* sensitivity is good enough to allow visual discrimination when reacted at 61°C for 30 minutes. This simple and accurate LAMP assay can be used for intensive field monitoring and integrated management of these species.

Key words: Heliothinae, *Helicoverpa*, Invasive pest, LAMP, monitoring

G11

Exaptation of I4760M mutation in ryanodine receptor of *Spodoptera exigua* (Lepidoptera: Noctuidae): Lessons from museum and field samples

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Since 2007, diamide insecticides have been widely used in Korea to control various types of lepidopteran pests including *Spodoptera exigua.* For nearly a decade, diamide resistance in field populations of *S. exigua* across 18 localities has been monitored using bioassays. Based on the LC_{50} values, some field populations showed a high level of resistance against chlorantraniliprole, although regional and temporal variations were observed. To investigate resistance at a molecular level, mutations (Y4701C, I4790M, and G4946E) were examined in the ryanodine receptor (RyR), which is the primary mechanism underlying diamide insecticide resistance. As a result, only I4790M mutation was found in most of field populations. As resistance levels varied significantly despite the uniform presence of the I4790M mutation, we considered the presence of another resistance factor. Further, the I4790M mutation was also found in *S. exigua* specimens collected prior to the commercialization of diamide insecticides in Korea as well as in other countries, such as the USA. This finding led us to hypothesize that the I4790M mutation were predisposed in field populations owing to selection factors other than diamide use. For further clarification, we conducted whole-genome sequencing of *S. exigua* (449.83 Mb) and re-sequencing of 18 individuals. However, no additional non-synonymous mutations were detected in the RyR-coding region. Therefore, the high level of diamide insecticide resistance in Korean *S. exigua* is not caused by mutations at the target site, RyR, but is attributed to other factors that need to be investigated in future studies.

Key words: Ryanodine receptor, *Spodoptera exigua,* Diamide, I4790M mutation, pre-adaptation

G12

Analyzing pollination dependence in forest honey plnats based on plnat characteristics

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화분매개의존도는 밀원가치를 평가하는데 매우 필요한 자료임에도 불구하고, 산림 자원에 대한 화분매개의존도 자료는 매우 부족하다 본 연구는 국내 중부지방에 분포하는 밀원수를 대상으로 화분매개의존도, 화밀/화분 생산량 및 꽃의 형태학적 특징을 규명을 목적으로 하였다. 화분매개의존도는 개화 전 꽃봉오리를 망사를 씌워 화분매개자의 출입을 제한 후, 결실률을 조사하여 평가했다. 화밀은 모세관 튜브를 이용하여 조사하며, 화분은 꽃가루의 수와 무게 측정을 통해 생산량을 추정하였다. 식물의 특징으로는 각 식물의 본 당 꽃 수, 개화시기, 화관 및 화서의 형태 등 형태적 특징을 조사하였다. 65종 평균 화분매개자 의존도는 평균 56±3.12%로 나타났고, 최대 100%(산수유), 최소 0%(상수리)로 나타났다. 45종의 화밀 및 화분량을 추정한 결과, 꽃 당 평균 화밀의 분비량은 인동 3.56±0.33㎕으로 가장 높았으나, 본 당 평균 화밀 분비량은 피나무 212.7㎖로 가장 높았다. 평균 화분의 무게는 피나무가 141.75g로 가장 많았다. 꽃 당 화밀량은 밀원수의 개화하는 시기가 봄에서 여름이 가까워질수록 적어졌으나, 7, 8월에는 본 당 꽃의 수가 증가하여 여름에 개화하는 식물들이 본 당 화밀의 양을 더 많이 분비하는 경향을 확인하였다. 이는 산림 생태계의 밀원가치를 평가하는데 기초적인 자료로 활용될 수 있을 것으로 판단된다.

검색어: 화분매개가치, 밀원자원, 상관관계

사사: 본 연구는 산림청(한국임업진흥원) 산림과학기술 연구개발사업‘(2021362E10-2323-BD02)’의 지원에 의하여 이루어진 것입니다.

G13

Evaluation of fungal pathogen *Beauveria bassiana* AAD16 against two species of coccinellids: *Harmonia axyridis* and *Chilocorus stigma*

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The ladybird beetles have been used as biological control agents against several pest species. The aim of this study is to evaluate the compatibility between ladybird beetles and an entomopathogenic fungus *Beauveria bassiana* (Balsamo) Vuillemin AAD16. The virulence of AAD16 strain was compared with that of commercial GHA strain on three developmental stages of two coccinellids; *Harmonia axyridis* Pallas and *Chilocorus stigma* Say. The topical application method was used for both adult and larval stage while dipping method was used for egg stage. The LT_{50} and mycosis rate for all life stages of two ladybird beetles tested were not significant between AAD16 and GHA strain. In larval stage, the mycosis rates of *H. axyridis* and *C. stigma* were 36 and 40% and 63 and 60% in AAD16 and GHA strain. In adult stage, the mycosis rates of *H. axyridis* (male and female) and *C. stigma* (unsexed) were 20, 23, and 23% and 26, 30, and 30% in AAD16 and GHA strain, respectively. Therefore, the two predatory coccinellids could be compatible with these two fungus strains due to their relatively lower mycosis rate.

Key words: Entomopathogenic fungus, Ladybird beetle, Mortality, Mycosis

G14

Methyl benzoate as a prospective fumigant against stored product insects

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Historically, the control of stored-product insects has mostly relied on the use of fumigants such as methyl bromide (MB) and phosphine. However, methyl bromide is no longer used for structural fumigations, and phosphine insecticide resistance is rising globally. Methyl benzoate (MBe) is a new green pesticide that occurs naturally as a metabolite in plants. In this study, we evaluated the the potential use of MBe as a fumigant against a variety of stored-product insects. According to our laboratory findings, MBe showed strong fumigation toxicity against the Indian meal moth and flat grain beetle with an LC_{50} value of 0.1 μL/L and 0.76 μL/1.5 L air, respectively, compared to the other tested insects. Furthermore, no significant differences were observed in susceptibility levels between the lab strain and the phosphine-resistant lesser grain borer and rice weevil. However, the red flour beetle had the highest LC_{50} value of 8.26 μL/1.5 L air. Overall, MBe seems to be a highly promising candidate for the development of environmentally-friendly alternative fumigants.

Key words: volatile organic compound, fumigation toxicity, postharvest, biorational

G15

Survey of parasitoids of *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae) as biological control agents in Korea

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The box tree moth, *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae), is a native species in East Asia specialized in box trees (*Buxus* sp.) but has recently invaded most European countries. Due to the absence of its natural enemies in Europe, the economic impact is serious in most countries. In order to find parasitoids as biological control agents in Korea, *C. perspectalis* larvae were collected from ornamental and native box trees from various regions of the country from 2022 to 2023. While rearing them in the insectary, several parasitoids emerged from the larvae. We found at least six larval parasitoids, including five wasp species and one fly species. Molecular diagnosis using the nucleotide sequences of the mitochondrial cytochrome oxidase subunit I (COI) showed that most samples were 90–97% identical to the data in the NCBI database. Further studies are required to determine biological and parasitic characteristics, such as developmental rate, fecundity, host specificity, and parasitic rate, to clarify the suitability of parasitoids as biological control agents.

Key words: climate change, biological control, invasion, natural enemies, parasitoids

G16

Identification and characterization of cytochrome p450s putatively associated with fluvalinate resistance in *Varroa* mites

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The *Varroa* mite, *Varroa destructor*, a parasitic mite that afflicts honey bees, has become increasingly resistant to acaricides like fluvalinate due to its widespread use. The target site insensitivity mechanism, mediated by the L925V/M/I mutations in the voltage-gated sodium channel, plays a major role in resistance. Additionally, cytochrome P450 monooxygenases (Cyp450s) appear to function as a metabolic resistance factor; however, no Cyp450-mediated resistance mechanism has been reported to date. The aim of this study was to identify and characterize Cyp450s associated with fluvalinate resistance. A synergistic bioassay confirmed the involvement of Cyp450s in conferring tolerance or resistance to fluvalinate. Correlation analysis between mortality data and the expression levels of Cyp450 genes led to the identification of several candidates that may play a crucial role in fluvalinate resistance. Analysis of tissue distribution patterns revealed that these genes were most abundantly expressed in the cuticle and synganglion. This suggests that, despite their relatively low expression level, they may play a critical role in protecting the target site from fluvalinate due to its predominant expression in neuronal tissues. Functional analysis, in conjunction with baculovirus expression, demonstrated that fluvalinate has high inhibition rates against the recombinant candidate Cyp450s, suggestive of their strong interaction with fluvalinate. We discussed the potential utilization of their expression levels as a molecular marker for diagnosing metabolic resistance in field-collected *Varroa* mites.

Key words: *Varroa destructor*, Fluvalinate, cytochrome P450, resistance

G17

Spatiotemporal variation of symbiotic bacterial community structure in *Riptortus pedestris* (Hemiptera: Alydidae) collected in South Korea

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Riptortus pedestris has established symbiotic interactions with specific bacteria from soil environment in every generations. The soil environment is extremely heterogeneous with microbial diversity, suggesting that bacterial composition of the *R. pedestris* can be affected by surrounding environments. Therefore, we investigated spatiotemporal variation of bacterial communities in wild *R. pedestris* collected from five mainland areas and Jeju Island in South Korea across insect generations. Among the 390 *R. pedestris* adults collected, we detected a total of 28 bacterial genera from the symbiotic region of insects. Among the bacterial genera, genus *Caballeronia* bacteria was the most abundantly detected regardless of sampling site and generation. Nevertheless, bacterial richness varied among the insect generations with 10 genera detected in overwintered generation, 15 genera in the 1st generation and 18 genera in the 2nd generation. Moreover, we found five bacterial genera that were exclusively detected from the Jeju island compared to the mainland areas surveyed.

Key words: bean bug, horizontal acquisition, environemntally acquired symbionts

G18

Monitoring of the regional insecticide resistance of *Bemisia tabaci* collected from the pepper house in the Republic of Korea

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담배가루이(*Bemisia tabaci*)는 국내 주요 농업 해충으로서 고추, 오이, 토마토 등의 시설재배 작물에 큰 피해를 입힌다. 담배가루이는 작물을 흡즙하여 식물체의 상태를 악화시키고 TYLCV(tomato yellow leaf curl virus)등 100여 종의 바이러스를 매개하며, 배설물을 통해 그을음병을 유발한다. 가장 일반적인 담배가루이의 방제방법은 빠르고 높은 효과를 지닌 살충제 살포이다. 하지만, 지속적인 화학적 방제는 해충의 살충제 저항성을 야기한다. 살충제 저항성은 방제 효율 감소와 농가의 경제적 손실을 일으킨다. 본 연구는 국내 지역별 시설 고추 재배지에서 발생한 담배가루이의 약제별 저항성을 조사하여, 지역별로 효과적인 약제 선정 및 대체 약제 추천 등 지속 가능한 해충관리법을 제시하고자 한다. 담배가루이는 전국 13개(파주, 양평, 화성, 횡성, 당진, 천안, 공주, 예천, 구미, 사천, 남원, 나주, 고흥) 지역에서 채집되었다. 작용기작 별 사용량이 많은 8종을 선정하였으며, 엽침지법을 사용하여 살충률을 확인하였다. 곤충생장조절제(insect growth regulators, IGR)인 피리프록시펜계 약제는 알을 대상으로, 그 외 7개 약제는 2령약충을 대상으로 살충률을 확인하였다. 높은 살충력을 보인 약제는 아버멕틴, 밀베마이신계, 스피노신계, METI살충제, 디아마이드계 약제이다. 아버멕틴, 밀베마이신계는 권장사용농도로 처리 시 최소 84.5%, 최대 100% 살충률을 보였다. 스피노신계는 최소 86.3%, 최대 90.6% 살충률을 보였으나 천안, 파주, 사천에서 각각 59.7%, 66.6%, 79%로 다른 지역에 비해 상대적으로 낮은 살충률을 보였다. METI살충제는 최소 81.1%, 최대 98% 살충률을 보였으나 나주, 예천, 천안, 사천이 각각 61.6%, 68.8%, 68.9%, 69.2%의 상대적으로 낮은 살충률을 보였다. 디아마이드계는 최소 83.9%, 최대 91.9% 살충률을 보였으나 천안과 구미가 각각 56.6%, 59.8%로 상대적으로 낮은 살충률을 보였다. 낮은 살충력을 보인 약제는 네오니코티노이드계, 설폭시민계, 테트론산 및 테트람산 유도체, 피리프록시펜계 약제이다. 네오니코티노이드계는 최소 14.1%, 최대 41.9% 살충률을 보였다. 설폭시민계는 최소 17%, 최대 42.8% 살충률을 보였다. 테트론산 및 테트람산 유도체는 최소 30.5%, 최대 54.9% 살충률을 보였으나 천안이 14.4%로 특히 낮은 살충률을 보였다. 피리프록시펜계는 최소 55.3%, 최대 64.3% 살충률을 보였으나 횡성이 72.2%로 상대적으로 높은 살충률을 보였으며, 파주가 35%로 상대적으로 낮은 살충률을 보였다. 실험 결과를 통해 살충제 별 살충력의 차이와 지역별로 살충률의 차이를 확인하였다. 본 연구결과를 통해 효과적인 약제 추천과 지역에 따라 다른 방제 전략 제시에 도움이 되고자 한다.

검색어: 담배가루이, 생물검정, 살충제, 고추, 약제저항성

G19

Occurrence Patterns of *Ramulus mikado* in host plants

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대벌레(*Ramulus mikado*)는 1990년 이후부터 2000년대 초반까지 경북을 중심으로 대발생을 하였던 돌발 해충으로 2020~2023년에 수도권에서 대발생 사례가 다수 보고 되었다. 대벌레의 대발생 원인으로 기후변화가 지목되고 있지만, 대벌레 개체군과 생물적·비생물적 환경 조건과의 관계를 이해하기 위한 연구는 매우 부족한 실정이다. 본 연구에서는 주요 기주식물과 대벌레 발생 양상에 대한 관계를 이해하고자 수행하였다. 2022년부터 2023년까지 대벌레 대발생 지역 중 하나인 청계산 일대 등산로를 따라 조사구를 선정한 뒤 주요 기주식물이자 우점종인 신갈나무, 아까시나무, 잔털벚나무를 대상으로 대벌레의 발생 밀도를 조사하였다. 그 결과, 조사지점 간의 대벌레 평균 밀도는 유의한 차이가 발견되지 않았지만, 기주식물에 따른 밀도의 차이는 뚜렷하게 나타났다.

검색어: 돌발해충, 대발생, 대벌레, 발생 밀도, 발생 양상

※ 본 연구는 환경부의 재원으로 국립생물자원관의 지원을 받아 수행하였습니다(NIBR202311101)

G20

Development of molecular based species diagnostic tools for major planthoppers, in the Republic of Korea

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Rice serves as the staple food for many Asian countries. However, it faces a significant threat from various Hemiptera species, including *Nilaparvata lugens*, *Sogatella furcifera*, *Laodelphax striatellus*, and *Nephotettix cincticeps*, which can cause devastating diseases. These species are economically significant pests of rice. Traditional morphology-based methods have proven inefficient in accurately distinguishing these pests at the species level. In this study, we present a successful approach for designing species-specific primers and their application in both general and multiplex PCR as well as loop-mediated isothermal amplification (LAMP) assays, widely adopted molecular tools for species identification. Each primer set incorporates a species-specific sequence of at least 2 base pairs in both the forward and reverse primers. These primers have demonstrated exceptional diagnostic accuracy in conventional and multiplex PCR. Additionally, our study showcases the high sensitivity of LAMP, successfully achieving positive amplification with genomic DNA quantities ranging from 100pg to 10pg. In summary, these techniques provide an efficient means of diagnosing planthoppers in a large number of field-collected or individual samples.

Key words: loop-mediated isothermal amplification; multiplex PCR; planthopper; leafhopper; molecular diagnosis

G21

Beauveria bassiana ARP14 control *Tetranychus kanzawai* Kishida in laboratory and greenhouse strawberry plant

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Tetranychus kanzawai Kishida (Acari: Tetranychidae) is a major pest on strawberry, reducing both the quality and quantity of fruit production. We compared the virulence of an entomopathogenic fungus *Beauveria bassiana* (Balsamo) Vuillemin ARP14 with a commercial GHA strain against *T. kanzawai*. In the laboratory, leaf dipping method was conducted while a one-time spray was carried out on selected planting units in strawberry greenhouse with each fungus strain and Triton X-100 as control. Adult *T. kanzawai* showed lower LT50 when treated with ARP14 strain compared to GHA in the laboratory. The densities of both adult and nymph mites in the greenhouse were significantly reduced in the treatment of two fungus strains compared to the control. The mycosis rate of *T. kanzawai* in greenhouse was 97.9% at 14 days when treated with ARP14 strain while it was 85.5% when treated with GHA strain. The results suggest that *B. bassiana* ARP14 can be an effective mycoinsecticide against *T. kanzawai.*

Key words: Biological control, Entomopathogenic fungus, Mycosis rate.

G22

A comparative study on the behavioral responses of *Riptortus pedestris* (Hemiptera: Alydidae) to corn seedling as a companion plant of soybean

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The choice of suitable companion plants is crucial for enhancing pest management strategies in agricultural fields. *Riptortus pedestris*, an important agricultural pest, has drawn attention for its serious damage on soybean. To identify an ideal companion plant for soybean, we investigated the pest's behavioral patterns when exposed to corn seedlings in laboratory. Series of choice experiments were conducted for 4th instar nymphs and unmated female adults of *R. pedestris* when presented with corn and/or soybean pot against soybean or blank pot. In 4th instar nymphs, 56% preferred the treatment of corn pot plus soybean pot over soybean alone pot while 69% of unmated female adults preferred the same combination. These findings provide valuable insights into the behavior of this insect pest, which could be beneficial for establishing polycultures in agricultural fields.

Keywords: *Riptortus pedestris*, Behavior, Pest management

G23

Effect of entomopathogenic fungus, Metarhizium anisopliae, on survivorship of Ramulus mikado during summer season in Korea

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An outbreak of stick insects, *Ramulus mikado*, as forest pests in South Korea has become a topic of concern. While other countries have reported these insects being severely affected by the entomopathogenic fungus *Metarhizium* spp., comprehensive research in South Korea remains limited on this topic. In our two-year investigation, we investigated the infection rate and mortality of *R. mikado* caused by *Metarhizium anisopliae*. In 2022, specimens were collected from Cheonggyesan, and in 2023 from Geumamsan. Although no infections were confirmed in the specimens collected in June of both years. Beginning in July, mortality and infection rates were greatly increased. In conclusion, the summer monsoon appears to create hot and humid conditions in the forest, contributing to reduced survival rates for these insects due to infection by *M. anisopliae*.

Key words: outbreak, entomopathogenic fungus, mortality, forest pest

※ 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 (NIBR202311101).

G24

A transcriptional factor, Lrp, of an entomopathogenic bacterium, *Xenorhabdus hominickii*, activates non-ribosomal peptide synthetases to suppress insect immunity

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Two bacterial genera, *Xenorhabdus* and *Photorhabdus*, are mutually symbiotic to the entomopathogenic nematodes, *Steinernema* and *Heterorhabditis,* respectively. Success parasitism of the nematode-bacterial complex depends on the host immunosuppression by the bacteria via their secondary metabolites. Lrp (Leucine-responsive regulatory protein) is a global transcriptional factor of the bacteria and play a crucial role in the parasitism. However, its regulatory targets to suppress the insect immunity were not clearly determined. This study investigated the regulatory target genes and subsequent secondary metabolites by Lrp in *Xenorhabdus hominickii*. Lrp expression occurred at the early infection stage in a target insect, *Spodoptera exigua*. Among eight non-ribosomal peptide synthetase (NRPS1-NRPS8) genes, six gene (NRPS3-NRPS8) expressions were positively correlated with Lrp expression in the infected larvae of *S. exigua*. Exchange of the Lrp promoter with an inducible promoter altered the production of the secondary metabolites along with alteration of the NRPS expression levels. The immunosuppressive activities of *X. hominickii* depended on the Lrp expression level. The metabolites produced by Lrp expression possessed the eicosanoid-biosynthesis inhibitors and hemolytic factors. A cyclic dipeptide (= cPF) was produced under Lrp control and identified to inhibit phospholipase A2 activity of *S. exigua* in a competitive inhibitory manner. These results suggest that Lrp is a global transcriptional factor of *X. hominickii* and plays crucial role in insect immunosuppression by modulating NRPS expressions.

Key words: Lrp, NRPS, immunity, promoter, mutant, *Xenorhabdus hominickii*, *Spodoptera exigua*

G25

Biological significance of the multiple PLA2s in Frankliniella occidentalis

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Eicosanoids represent a category of oxygenated C20 polyunsaturated fatty acids that play a crucial role in regulating various physiological functions in insects. These compounds are synthesized from phospholipids through the enzymatic activity of phospholipaseA2 (PLA_2). In this study, we investigated four PLA_2 genes encoded in the western flower thrips, *Frankliniella occidentalis*, with a focus on understanding their specific functions through a variety of experimental approaches. Among the four PLA_2s identified, Fo-PLA_2A and Fo-PLA_2B fall under the category of Ca^{2+}-independent cellular PLA_2 (iPLA_2), while Fo-PLA_2C and Fo-PLA_2D are classified a secretory PLA_2 (sPLA_2). Enzyme activity assays showed that all developmental stages of the thrips exhibited significant activity against both types of PLA_2 substrates (arachidonic acid (AA) and non-AA), albeit with variations in enzyme kinetics across different developmental stages. Further examination revealed that all four PLA_2 genes were expressed in every developmental stage. Fo-PLA_2B and Fo-PLA_2C displayed higher expression levels in larvae, while Fo-PLA_2A and Fo-PLA_2D were predominantly expressed in female and male adults, respectively. These findings support the hypothesis that PLA_2s likely serve specific functions during distinct developmental stages. Our results indicated that PLA_2s play pivotal roles in mediating various physiological processes such as immunity, development, and reproduction. So, the differential expression of certain PLA_2s in various stages suggests that each PLA_2 may have a specific role during different stages. Additionally we conducted flouorescens in situ hybridization (FISH) analysis to localize PLA_2 transcripts in different tissues, shedding light on their specific functions within these tissues. In summary, the four identified PLA_2s are associated with distinct catalytic activities and exhibit differential expressions across developmental stages and tissues, collectively contributing to various physiological processes.

Key words: PLA_{2s}, immunity, reproduction, development, *Frankliniella occidentalis*

G26

Optimizing control efficacy of dsRNA insecticides using chitosan nanoparticle or bacterial formulation against the western flower thrips

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The western flower thrips, *Frankliniella occidentalis*, is a significant economic pest among thysanopterans because of its massive feeding damage and ability to spread tospovirus to hundreds of plant species worldwide. To control this pest, chemical insecticides have been used but become unsatisfactory in the control efficacy due to the rapid resistance development of *F. occidentalis*. The cost-effective chitosan-based nanoparticle (NP) formulations as dsRNA insecticide gave > 80% mortalities in 7 days in the field condition. Nevertheless, the usage of NP-based dsRNA is hindered by the conflict between the excessive expense of producing dsRNA and the massive quantity of materials required for field application. Many research reports have demonstrated microbial-based dsRNA production using the L4440 vector and HT115 (DE3) *Escherichia coli* for application to vertebrate and invertebrate systems. In this study, we aimed to compare chitosan NP and bacterial formulation-based dsRNA control tactics against *F. occidentalis* using RNAi against the vacuolar-type ATPase (vATPase) gene.

Key words: *Chitosan, L4440 vector and HT115, dsRNA, vATPase, Frankliniella occidentalis*

G27

Suppressive effect of an sEH inhibitor on anti-viral responses of insects against baculovirus

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The soluble epoxide hydrolase (sEH) plays a crucial role in insect immunity and development by metabolizing oxylipins such as EpOMEs and EETs. This study investigates sEH's involvement in insect antiviral response against Autographacalifornicanuclear polyhedrosis virus (AcNPV) infection. Viral infection assays were performed on Plutellaxylostellaand Marucavitrata, utilizing occlusion bodies (OB, via feeding) and budded virus (BV, through injection). Insect mortality was monitored every 12 h for up to 7 days. Our findings demonstrated a dose-dependent impact of both virus forms (OB and BV) on insects. Additionally, the sEH inhibitor, AUDA (12-(3-adamantan-1-yl-ureido) dodecanoic acid), was employed alongside the virus. The results indicated that combining AUDA with the virus increased insect mortality. Furthermore, fluorescence assays revealed the gradual movement of the virus from the gut to hemolymph and fat body. AUDA was observed to expedite virus infection. Moreover, sEH expression rapidly increased along with the viral infection in Spodoptera exigua. RNA interference of sEH expression enhanced the viral virulence against S.exigua. These suggest that EpOMEs play crucial roles in immune resolution against viral infection in insects.

Key words: *AcNPV, sEH, immune response, antiviral defense mechanisms*

G28

A study on the induced expression level of cytochrome P450s in *Apis cerana* (Hymenoptera: Apidae) by various insecticides

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In Korea, the Asian honey bee (*Apis cerana*) and the European honey bee (*Apis mellifera*) (Hymenoptera: Apidae) are the two most common honey bee species. These two closely related species are known to have different sensitivity levels to various insecticides due to millennia of exposure to different pests and pesticides. It is reported that *A. cerana* is known to be more sensitive to several insecticides, such as amitraz, fenitrothion, and fipronil, than *A. melllifera*. Multiple studies investigated toxicological responses and related CYPome in *A. mellifera*, but little is known in *A. cerana*. The goal of this study is to elucidate the underlying mechanism of different toxicological responses between two bee species, with an emphasis on cytochrome P450 (P450), a significant enzyme involved in metabolic activities. The differences in basal P450 expression patterns were investigated by comparing the relative expression levels of P450 orthologs in several dissected organisms of each species. To compare the sensitivity against major insecticides, lethal doses of major insecticides relevant to both honey bee species were assessed by topical and oral ingestion bioassays. The determined sublethal doses of insecticides were applied to honey bees, and the inducibility of P450s was investigated by comparing the expression patterns of multiple P450s. From these results, this study eventually attempts to compare the toxicological differences between two *Apis* species with differences in induced cytochrome P450 expression levels.

Key words: *Apis cerana,* honey bee, cytochrome P450, toxicological response, detoxification

G29

Groups I and II chitinases, TcCHT5 and TcCHT10, function in turnover of chitinous cuticle during embryo hatch and post-embryonic molts in the red flour beetle, *Tribolium castaneum*

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Insect eggshell and cuticle/exoskeleton play vital roles in protecting them from natural environmental stresses. However, these chitinous cuticular extracellular matrices must be degraded at least in part during embryo hatching and molting/ecdysis periods to accommodate continuous growth all the way to the adult stage. In this study, we investigated the functional importance of groups I and II chitinases, TcCHT5 and TcCHT10, in the turnover of chitinous cuticle during both embryonic and post-embryonic development in *Tribolium castaneum*. RNAi and TEM analyses revealed that TcCHT10 is required for digestion of chitin in the serosal cuticle for embryo hatching as well as in the old cuticle during post-embryonic molts including larval-pupal and pupal-adult metamorphosis. TcCHT10 appears to be able to substitute for TcCHT5 in all these vital physiological events except for the pupal-adult molting in which TcCHT5 is indispensable for complete digestion of chitin in the old pupal cuticle.

G30

Impact of dopamine-mediated salivary secretion in the early and late phase of tick blood-feeding

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The salivary glands of hard ticks consist of three types (type I, II, and III) of acini according to their functions and location. The type II and III acini play critical roles in tick salivation, which is likely controlled by a variety of neuropeptides or neurotransmitter via interaction with their receptor, G protein-coupled receptors (GPCRs). Orchestration of dopamine receptor (D1) and invertebrate specific D1-like dopamine receptor (InvD1L) located in type II and III acini precisely control tick salivary secretion via collection of primary saliva in the lumen and expulsion of collected saliva, respectively. The two dopamine receptors (D1 and InvD1L) in *Haemaphysalis longicornis* were identified as 1278 bp (426 aa) and 1362 bp (454 aa) in length, respectively. Both dopamine receptors were functionally analyzed through Ca^{2+} and cAMP assay using the heterologous expression system. The transcripts of D1 and InvD1L were profiled from synganglion and salivary glands of female ticks (unfed, 3/18/60/96 post blood meal and replete). D1 and InvD1L were significantly upregulated in the early phase of blood feeding from female *H. longicornis*. Salivary secretion induced by dopamine was significantly reduced by RNAi of D1 and InvD1L. Interestingly, RNAi of two dopamine receptors induced a significantly longer period of blood feeding in female ticks, which were significantly lighter after feeding than control. Taken together, it was suggested that D1 and InvD1L play critical roles in early and late phase of tick blood feeding for feeding capability.

Key words: *Haemaphysalis longicornis*, Salivary glands, G protein coupled receptor, Dopamine receptor

G31

Distribution of bisexual and parthenogenetic *Haemaphysalis longicornis* by comparison of genetic characteristics in the Republic of Korea

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The Asian longhorned tick, *Haemaphysalis longicornis*, is an ectoparasite of domestic and wild animals, which transmit various pathogens including Severe Fever with Thrombocytopenia Syndrome Virus (SFTSV). They are the predominant hard tick species in Republic of Korea (ROK) and widely distributed throughout ROK. It is known that *H. longicornis* produce their offspring via two reproductive strategies, bisexual and parthenogenesis. It might affect their population maintenance and vectorial capacity. Parthenogenesis *H. longicornis* had the insertion of two thymine 'T' in mitochondrial 16s rDNA. In this study, we analyzed the proportion of bisexual and parthenogenesis *H. longicornis* in ROK including thirteen cities: Goseong[GS], Sokcho[SC], Chuncheon[CC], Ganghwa[GH], Samcheok[SCH], Sangju[SJ], Boryeong[BR], Ulsan[US], Gochang[GC], Jinju[JNJ], Jindo[JD], Jeju[JJ], and Seogwipo[SG]. Parthenogenesis individuals predominated from the northeastern are of ROK including Goseong, Sokcho, Chuncheon, Ganghwa, Samcheok, Sangju, Ulsan, and Jinju. Whereas bisexual individuals predominated from the southwestern area in ROK including Boryeong, Gochang, Jindo, Jeju, and Seogwipo. The analysis of haplotype diversity using concatenated sequences of mitochondrial Cytochrome c oxidase subunit I (COI) and Cytochrome B (CytB) revealed that *H. longicornis* were grouped into two major haplotypes. Two major haplotypes were correlated with bisexual and parthenogenesis, respectively. Likewise, *H. longicornis* individuals were divided into two clades and each clade were indicated by bisexual and parthenogenesis. The current study provides us an understanding of the genetic characteristics of two reproductive strategies for *H. longicornis*, which will be led to expand knowledge of the life cycle and population maintaining for *H. longicornis*.

Key word: *Haemaphysalis longicornis*, reproductive system, population genetics

G32

Eicosanoid-derived immune priming factor in a lepidopteran insect, *Spodoptera exigua*

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Immune priming is an increased immunity after prior exposure to a specific pathogen as a kind of adaptive immunity and occurs in insects. However, its underlying mechanism is elusive in insects. Immune priming was detected in a lepidopteran insect, *Spodoptera exigua*. Prior infection with a heat-killed pathogenic bacterium, *Xenorhabdus hominickii*, increased survival upon the second infection of the live bacteria compared to larvae without pre-exposure. Plasma collected from larvae with the prior infection significantly up-regulated cellular and humoral immune responses compared to the similar treatment without prior exposure. However, when the active plasma exhibiting immune priming was heat-treated, it lost the priming activity, suggesting a presence of protein factor(s) in the immune priming. Lipocalin is a lipid carrier protein and is well known in vertebrates for diverse physiological functions including immunity. An apolipoprotein D3 (ApoD3) is known to be a lipocalin functioning in immune priming in a mosquito, Anopheles gambiae. A homologous ApoD3 (Se-ApoD3) was identified in *S. exigua*. Se-ApoD3 was expressed in all developmental stages and larvae, it was highly expressed in hemocytes. RNA interference (RNAi) of Se-ApoD3 expression was performed by injecting its specific dsRNA. The larvae treated with the RNAi were impaired in cellular and humoral immune responses. Furthermore, the plasma collected from RNAi-treated larvae lost the immune priming even at the prior exposure. These suggest that Se-ApoD3 mediates the immune priming in *S. exigua*.

Key words: immune priming, lipocalin, eicosanoid, RNA interference, *Spodoptera exigua*

Oral Presentation

Competition

5. High School Students ····· 57





H1

Designing new honey bee hive with multiple sensory system for urban beekeeping

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꿀벌에 대한 중요성이 인식되고 도시양봉의 수요가 증가하는 가운데 도시양봉에 최적화된 벌통을 제작하였다. 꿀벌과 도시양봉에 대한 설문를 진행한 결과, 분봉으로 인한 민원이 도시양봉을 하는 데 가장 큰 저해요소로 꼽혔다. 이에 분봉을 방지하여 시민과 어우러질 수 있으며 친환경적인 벌통을 제작하는 데 초점을 맞췄다. 분봉을 방지하기 위해서는 여왕벌의 이탈을 감지하는 자성 센서와 벌들이 분봉을 하고자 하는 욕구인 분봉열을 감지하는 온도 센서를 설치하여 효율을 파악하였다. 더불어 최근 이상기후로 인한 잦은 폭우와 고열을 견디기 위하여 밀랍을 이용한 벌통 코팅을 진행하였다. 벌통의 바닥에는 트레이를 서랍처럼 분리 설치할 수 있도록 함으로써 무더운 기온에서는 손쉽게 트레이를 빼서 환기에 중점을 두고, 그 외의 조건에서는 트레이를 끼워둠으로써 바닥에 떨어진 꿀벌의 사체를 주기적으로 수거하여 유전자 분석을 함으로써 꿀벌의 건강 상태를 점검할 수 있도록 하였다. 꿀벌이 해당 벌통으로 인하여 스트레스를 받는지 꿀벌의 주요 스트레스 마커 유전자의 상대적 발현량을 조사한 결과, 일반적인 벌통에서의 발현량 수준과 큰 차이가 없는 것을 확인할 수 있었다. 이처럼 새로이 디자인된 벌통을 이용한다면 이상기후에서도 도시양봉을 하는 데 기여할 수 있을 것으로 기대된다.

검색어: 꿀벌, 도시농업, 양봉, 기후변화

H2

Research on the extraction of chitosan from cicada sloughs and the effect of green algae aggregation using chitosan

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기존에는 생산되는 키틴과 키토산의 대부분이 게, 새우등 갑각류 껍질에서 유래하였다. 하지만 어업에 의존하는 기존 갑각류 비해 친환경적이며 품질 유지에 이점을 가지는 곤충으로부터 유래한 키틴이 최근 주목 받기 시작하며 연구가 활발해지고 있다. 이에 키토산이 남조류의 응집을 통해 녹조 제거 효과를 가지며 기존에 녹조를 억제하기 위해 널리 사용되던 살조제들이 독성을 띠어 환경에 악영향을 미치는 문제를 해결할 수 있다는 연구를 참고하여 매미 탈피각으로부터 추출한 키토산을 녹조 방제에 활용해 보고자 하였다. 매미 탈피각으로부터 키토산을 추출하고 대표적인 녹조 원인종인 Microcystis aeruginosa 배양 후 추출한 키토산을 처리하여 녹조의 응집 효과를 관찰하였다. 본 연구에서 새로운 키토산 추출 원으로서 매미 탈피각의 가능성을 제시하였으며 이를 녹조 방제에 활용함으로써 버려지는 자원인 매미 탈피각의 활용 방안을 제시하였다.

검색어: 키토산, 키틴, 매미 탈피각, 녹조 억제

H3

The factor analysis of honey bee colony disappearance (colony collapse phenomenon) in Jecheon, chungcheong buk-do, in march 2022

Dong Geon Jung
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2022년 3월12일 제천시의 발표(구체화)에 따르면 제천지역 내 양봉 농가를 대상으로 꿀벌생육실태를 확인한 결과 전체 벌통에서 절반 수준의 꿀벌이 사라진 것을 확인하였다. 이는 이전부터 국내 남부에서 진행되어 오던 꿀벌집단실종 현상의 한계선이 지구온난화로 인해 북쪽으로 이동하고 있다고 언론에서 집중 조명된 적이 있다. 이러한 현상이 과연 한반도 온난화에 의한 것인지의 여부를 파악하고자 원인분석 및 실험을 진행하였다. 먼저 꿀벌실종이 일어난 연도와 달을 중심으로 제천지역내의 기온, 일교차, 강수, 일조량 등 다양한 환경조건 중 예전과 비교하여 급격한 변화가 일어난 요인을 조사하였으며 이러한 급격한 변화가 일어나는 요인이 꿀벌의 집단실종에 미칠 수 있는 가능성을 분석하였다. 다른 요인분석으로 미국, 유럽 등에서 꿀벌실종의 주요 원인으로 주목받고 있는 네오니코티노이드계(Neonicotinoids) 살충제를 이용해 꿀벌에 미치는 영향을 실험하였으며, 생존한계농도를 측정하였다. 또한 국내 살충제의 연도별 사용량을 간접 비교함으로써 꿀벌실종의 주요요인을 찾고자 하였다. 분석결과 충북제천 꿀벌의 실종은 기온의 상승보다는 일조량이 큰 영향을 미친 것으로 보이며, 향후 일조량에 따른 벌집내부의 온도변화 및 꿀벌의 활동성 변화에 초점을 맞추어 꿀벌실종에 대한 장기적인 상관관계를 살펴보아야 할 것으로 생각된다.

검색어: 꿀벌집단실종, 군집붕괴현상, 충북제천, 온난화, 일교차, 기온상승, 일조량, 일조율, 살충제, 네오니코티노이드(Neonicotinoids)

H4

A study on genetic factors of Type 2 Diabetes Mellitus cause and treatment method using *Drosphila melanogaster*

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초파리를 당뇨병을 연구하는데 사용하는 경우가 많으나 당뇨병이 유전적 요인에 작용하여 다음 세대에 미치는 영향을 다루고 있는 연구는 적다. 따라서 본 연구에서는 초파리에 고당도의 먹이를 통해 당뇨병을 유발하고, 류신(leucine)의 당뇨병에 대한 치료효과를 확인하고 다음 세대에 미치는 영향을 알아보고자 했다. 본 연구에서는 *Drosophila melanogaster*를 초파리 모델에 사용했다. 먹이에 고농도의 설탕, 고농도의 설탕과 류신을 첨가하여 당뇨의 발병과 당뇨병의 치료효과를 확인했다. 당뇨병의 발병을 확인하기 위해 초파리의 체내의 포도당을 측정하여 대조군에 비해서 고농도의 설탕을 섭취한 경우에 포도당의 농도는 증가했고, 류신을 섭취한 경우에는 포도당이 대조군에 비해서도 급격히 떨어지는 것을 확인했다. 고농도의 설탕이 포함된 먹이 조건을 유지하고 교배를 통해 자손을 얻고자 하였다. 그 결과, 고농도의 설탕을 섭취한 경우 자손의 몸의 크기가 0.1mm 정도 감소하고 무게 또한 감소했다. 그러나 고농도의 설탕과 류신을 섭취한 경우 자손을 얻지 못했다. 당뇨병을 유발시킨 초파리를 이용해 류신과 운동의 효과를 동시에 확인했다. 당뇨병이 유발된 경우 운동만으로는 포도당의 감소에 영향을 주지 못하였으나, 류신 운동을 병행한 경우에는 포도당이 감소했고 수컷 초파리에서 잘 관찰되었다. 운동과 류신 섭취를 병행하는 실험에서는 당뇨병을 유발한 초파리의 자손을 사용했기 때문에 크기는 당뇨병을 유발하지 않은 것보다 작았다. 따라서 초파리의 당뇨병 모델을 통해서 당뇨병이 유전적으로 전달되며 Leucine에 의한 치료는 성충에 수행되는 것이 효과적임을 알 수 있었다.

검색어: drosphila melanogaster, 제 2형 당뇨병, 류신

H5

Exploring the applicability if Drosophila pheromones as eco-friendly target insect repellents

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해충에 이용되는 화학적 기피제는 생태계를 파괴할 수 있으며 내성을 가진 생물체로의 진화를 촉진한다. 같은 종의 생물끼리의 의사소통 수단인 페로몬을 이용하면 다른 종에게 영향을 미치지 않으면서 특정 곤충에 특이적으로 작용하는 방충제를 제작할 수 있을 것이라 생각된다. 본 연구는 초파리(*Drosophila*)의 페로몬 2종류를 추출하여 초파리의 기피도 및 유인도와 번식률을 확인하고자 한다. 25℃, 광주기 12h/12h의 동일한 조건에서 사육하며 10마리당 헥세인 10μL를 사용하여 암컷의 표피에서 CHC 페로몬과 수컷의 페로몬샘에서 cVA 페로몬을 추출한다. 연령, 성별, 교배 여부에 따라 관찰통에 각각의 페로몬을 처리하여 지정구간에 분포하는 초파리의 수를 계수하여 기피도 및 유인도를 확인한다. 관병에 암수 1쌍을 투입하고 하루에 1번 선정한 페로몬을 투여하며 산란수을 측정한다. 이 연구를 통해 CHC가 수컷 초파리에 대한 기피 효과가 있음을 확인하였으며 추출되는 수컷의 연령이 높을수록 cVA에 의한 번식률 감소가 크게 나타났다. 본 연구를 통해 페로몬을 통한 초파리의 방제 가능성을 확인하였으므로 다른 곤충의 방제에도 적용할 수 있을 거라 기대한다. 페로몬은 생물 농축과 같은 환경적 영향이 없으며 소량으로 유의미한 결과를 도출했다는 점에서 의의가 있으며 상용화를 통해 해충에 의해 피해를 해결할 수 있을 것이라 기대한다.

검색어: 초파리, 페로몬, CHC, cVA, 해충 방제, 번식률

H6

Determination of organic matter decomposition and plant growth effects of soil bacteria in the root region of ant colonies

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본 연구에서는 영종도에 위치한 인천과학고등학교 주변에 서식하는 개미와 개미집 근권토양을 두 차례에 걸쳐 채취한 것을 활용하여 토양미생물 순수분리 및 동정을 진행하였다. 채취된 개미의 더듬이의 모양, 털의 위치 및 분포 등의 형태학적 동정 및 DNA extraction을 통한 분자생물학적 동정을 통하여 채취한 개미를 *Camponotus japonicus*으로 결론하였다. 토양미생물을 연속희석법을 이용하여 확인한 결과 채취한 개미집 세 곳에서 각각 12, 18, 10개의 종이 동정되었다. 개미집 근권토양의 비옥도가 상대적으로 높다는 선행연구를 바탕으로 '분리한 토양미생물이 다양한 유기물 분해 효소활성을 보일 것'이라는 가설을 세웠고, 이를 확인하기 위해 분별배지를 제작하여 디스크 확산법을 진행하였다. 실험 결과 개미집 근권 토양에서 분리된 균주가 일반 토양에서 분리된 균주에 비해 높은 효소활성을 보임을 확인하였으며 개미집 근권 토양 미생물의 불용성인산 가용화능이 우수함을 확인하였다. 이후 위 실험들을 바탕으로 개미집 근권 토양 미생물이 식물 생장을 촉진시켜 미생물을 접종한 토양에서의 식물의 건조 질량이 증가하였음을 확인하였다.

H7

Nesting and predatory behavior of *Euodynerus nipanicus nipanicus* (Hymenoptera:Vespidae:Eumeninae)

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Subfamily Eumeninae, also known as the potter wasp, constructs mud cells and lays a single egg in each cell. The adult female potter wasp hunts lepidopteran larvae and paralyzes them then brings them back to the nest for its offspring. This research is focused on the behavioral study of Euodynerus nipanicus nipanicus. The environmental characteristics, nesting behavior, predatory behavior, and parasitoids are represented. The rate of occupancy of the nest holes was 70.83%, with 5.4 cells per nest hole. The average length of cells was 12.11mm long, and they were filled with 4.23 larvae respectively. Also, the time period from egg to adult of the wasp was 36.27 days, on average. By analyzing the prey hunted and stored inside the nest cell, 4 different species in minimum were found to be hunted. Additionally, hymenopteran parasitoid and lepidopteran kleptoparasite are newly discovered. The research suggests that providing nest traps to potter wasps can increase the natural biological control held by the potter wasp species and could support the conservation of the potter wasps.

Key words: *Genus Euodynerus*, hanok, nesting, predation, parasitoid, kleptoparasite

Oral Presentation

Non-Competition

6. Physiology, Industrial Entomology, ETC ····· 65

7. Taxonomy, Phylogeny, Ecology, Pest Control ····· 69

AM1

Antixenosis of hot pepper against the western flower thrips, *Frankliniella occidentalis*

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꽃노랑총채벌레(*Frankliniella occidentalis*)는 고추를 가해하는 주요 병해충 가운데 하나이다. 유충과 성충이 긁어빠는 구기로 잎과 열매에 가해하는 직접피해는 물론이고 일명 칼라병이라 일컬어지는 토마토반점위조바이러스를 전파하는 간접피해를 주고 있다. 다양한 바이러스 내병성 품종이 농가에서 재배되고 있으나, 칼라병의 발병은 해를 거듭하며 증가하고 있다. 놀라운 사실은 일부 내병성 품종에 대해서 총채벌레의 유인력이 감수성 품종에 비해 높다는 사실이다. 본 연구는 꽃노랑총채벌레에 대한 고추의 항객성 기작을 분석하였다. 총채벌레에 이미 피해를 받은 고추는 다른 총채벌레의 접근을 억제하는 것은 물론이고 천적인 미끌애꽃노린재를 유인하였다. 이 고추 내부에는 자스모닉산 생합성 관여 유전자의 발현이 증가하였다. 고추가 생산하는 향기성분을 SPME 방식으로 모아 분석한 결과 Green leaf volatile과 terpene류의 증가를 보였다. 시판되는 10개의 고추 품종을 대상으로 항객성 생물 검정과 향기성분 분석을 실시한 결과 이상의 항객성 기작을 뒷받침하였다. 또한 근권세균 가운데 일부는 고추로 하여금 이러한 항객성을 유도하였다.

검색어: 고추, 꽃노랑총채벌레, 내충성, 시노몬, 근권세균, 자스모닉산

AM2

Genome analysis of *Diadegma fenestrale* (Hymenoptera: Ichneumonidae) and its coevolutionary study with a symbiotic virus, DfIV

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Chromosomal level genome draft was assembled using a Korean *Diadegma fenestrale* (Jeju strain, KJ09). This assembly was achieved through a combined approach utilizing Nanopore long-read sequencing (approximately 134X coverage) and Illumina NovaSeq short-read sequencing (approximately 83X coverage). The assembled genome spans 243 Mb, comprises 160 scaffolds, with most of the genome contained within 11 chromosomal level scaffolds. The completeness of the assembly is reflected in BUSCO assessment, with values reaching 99.6%. Gene annotation is not completed. A symbiotic virus, Diadegma fenestrale Ichnovirus (DfIV) genome revealed 62 non-overlapping circular DNA segments the aggregate genome size was approximately 240 kb. Although the frequency of DfIV genome integration into the host's 11 chromosomes varies from 0 to 32%, it was confirmed that all 62 DfIV genome fragments were inserted into the host genome. A total of 123 ORFs were predicted from the DfIV genome and most of those were expressed in the host's ovary. This result may be contradictory to existing theories, but we propose a new hypothesis that some genes possessed by viruses may play different roles depending on the type and state of the host. Additionally, this phenomenon can be considered in relation to coevolution with the hosts.

Key words: polydnavirus, koinobiont, Campopleginae, coevolution, host adaptation

AM3

Analysis of an Oryctes rhinoceros nudivirus genome isolated from Korean rhinoceros beetles (*Trypoxylus dichotomus*)

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장수풍뎅이(*Trypoxylus dichotomus*)는 오래 전부터 애완·학습용으로 활용되는 정서곤충으로 곤충산업의 씨앗이 되는 중요한 곤충이다. 2012년 청원군에서 처음 장수풍뎅이 유충이 일제히 사망한 사례가 있고 2014년부터 비슷한 증상의 사례가 전국적으로 발생했다. 2015년에는 이러한 원인이 장수풍뎅이 누디바이러스(Oryctes rhinoceros nudivirus, OrNV)로 인한 것임이 밝혀졌고 2017년에 raw sequencing data가 NCBI에 공개되었지만 추가 분석은 이루어지지 않았다. 따라서, 우리는 국내 장수풍뎅이에서 분리한 누디바이러스(Trypoxylus dichotomus nudivirus, TdNV-KR)로 명명하고, NCBI로부터 수집한 Malaysia, Solomon Islands, Indonesia, Philippines, Palau strain의 OrNV sequence와 비교 분석하였다. 그 결과, TdNV-KR의 genome size는 126,408bp임을 확인하였고 다른 OrNV strain이 비해 가장 적은 open reading frames(ORF)를 가지고 있었으며, 3개의 ORF가 TdNV genome에서만 부재함을 확인했다. 또한, Nudivirus core genes의 아미노산 염기서열 비교에서는 Single-nucleotide polymorphism과 indels(insertion/deletion)로 인해 highly conserved 한 OrNV strain의 sequence들에 비해 TdNV의 시퀀스는 많은 변이/차이를 보였다. 우리의 연구는 누디바이러스의 종간 전파에 대한 이해도를 높이고, 바이러스 간의 유연관계를 확인함으로써 유입 경로를 추정하여 산업곤충의 질병을 효과적으로 예방하는 데 기여할 것이다.

검색어: 산업곤충, 장수풍뎅이, 누디바이러스, OrNV, TdNV

AM4

Knockdown of the testis-specific serine/threonine protein kinase 1 gene affects the testis and sperm quantity in *Zeugodacus scutellata* (Diptera: Tephritidae)

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The striped fruit fly (SFF), *Zeugodacus scutellata*, is an agricultural pest species with a strong and rapid reproductive ability that can cause significant harm. To control the population of these kind of pests, the sterile insect technique (SIT) is being used as one of the effective methods. SIT involves the introduction of sexually transmitted factors that reduce the reproductive capacity of males. This study shows that knocking down the testis-specific serine/threonine protein kinase 1 (Zs-Tssk1) gene alters male fertility and male-initiated types of communication. Since *Zs-Tssk1* influences the physiology of the testes, spermatogenesis is also affected, which in turn alters the lifespan of *Zs-Tssk1* knock down group in comparison with the control. Based on these results, *Zs-Tssk1* may be crucial in reproductive function, and its down-regulation may be helpful in controlling SFF through SIT.

Key words: Male sterility, RNAi, *Zeugodacus scutellata*

AM5

Combined effects of temperature and dietary macronutrient balance on larval performance in the yellow mealworm, *Tenebrio molitor* L. (Coleoptera: Tenebrionidae)

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The yellow mealworm, *Tenebrio molitor* L. (Coleoptera: Tenebrionidae), is an important industrial insect commercially produced around the world as food and feed. Temperature and nutrition are the two most influential environmental factors determining the rearing conditions in insects, but little is known about how these two factors interact to affect the performance of *T. molitor* larvae. In this study, we investigated the combined effects of temperature and dietary protein:carbohydrate (P:C) ratio on key performance traits in *T. moltior* larvae. Throughout their larval stage, the insects were reared on one of 36 treatment combinations of six temperatures (19, 22, 25, 28, 31, 34 °C) and six protein:carbohydrate ratios (P:C = 1:5, 1:2, 1:1, 2:1, 5:1, 1:0) and their survivorship, development, growth rate, and pupal mass were monitored. Survivorship was high at low temperatures (< 25°C) and high P:C ratios (>1:1), but decreased with increasing temperature and decreasing P:C ratio. Increase in rearing temperature accelerated larval development but resulted in a reduced pupal mass. Thermal optimum for pupal mass (19.3°C) was thus lower than that for development time (28.1°C). The growth rate was maximized at 27.9°C and P:C 1.65:1 and decreased as both the temperature and the P:C ratio deviated from their optimum. All four key performance traits (survivorship, development time, pupal mass, growth rate) were optimized at temperatures between 25.7 and 27.4°C and P:C ratios between 1.17:1 and 2.94:1. Our data provide insights into how the production and nutritional value of *T. molitor* larvae can be improved through adjusting their rearing conditions.

AM6

Effect of fluorescent brighteners on the insecticidal activity of *B. thuringieniss* var. *kurstaki* (Btk) and LdMNPV on *Lymantria dispar asiatica* in Korea

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Stilbene-based fluorescent brighteners (FB) have been shown to enhance insecticidal activities of entomopathogenic viruses but little is known its effect on entomopathogenic bacteria. We investigated the effect of two FBs (FB 28 and FB 71) on the insecticidal activity of *B. thuringiensis* var. *kurstaki* (Btk) as well as the *Lymantria dispar* multiple nuclear polyhedrosis virus (LdMNPV) in *Lymantria dispar asiatica*. FB 28 increased the mortality at the combination with low concentration (1.6×10^2 IU/ml) of Btk, but FB 71 slightly reduced the mortality with middle and high concentrations (1.6×10^3 and 1.6×10^4 IU/ml) of Btk in comparison to Btk alone. Both FB 28 and FB 71 increased mortality in combination with LdMNPV at all concentrations (3×10^2, 3×10^4, and 3×10^6 POBs/ml) compared to LdMNPV alone. Our findings suggest that FBs enhanced pathogenic activities but depend on chemical nature of FBs.

Key words: fluorescent brighteners, insecticide, entomopathogens, spongy moth

AM7

Carbon-neutral hydrotreated-biofuels production technology using insect lipids

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기후변화 위기에 대응하기 위하여 대한민국은 2030년까지 신재생연료 혼합비율(Renewable Fuel Standard, RFS)을 3.5%에서 8%까지 상향하기로 결정하였다. 국내에서 제조되는 신재생연료의 원료가 되는 바이오매스의 60%이상이 해외에서 수입하는 실정이며, 2030 탄소중립 및 RE100과 같은 바이오연료 사용증가 정책의 확대로 인하여 국내에서 제조되어 활용가능한 바이오매스의 확보가 절실하게 필요하다. 곤충은 높은 비율의 단백질과 지질을 체내에 저장하는 특징을 가지고 있으며, 곤충의 대량사육을 통하여 지질의 대량생산이 가능할 것으로 판단된다. 본 연구에서는 곤충의 대량사육환경에서 제조되는 지질을 원료로 하여 기후변화에 대응할 수 있는 바이오연료로의 전환 제조가능성을 확인하고자 하였으며, 이를 위하여 촉매공정을 통하여 디젤과 혼합하여 사용할 수 있는 수첨바이오디젤을 제조하여 그 특성을 분석하였다. 그 결과 곤충지질을 활용하여 수첨바이오디젤로 전환가능함을 확인하였다.

검색어: 곤충지질, 바이오디젤, 수첨바이오디젤, 기후변화

AM8

A simulation study on the efficiency of termite food transport in sinusoidal-shaped tunnel

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From an evolutionary perspective, it is speculated that termites have evolved to construct tunnels in a manner that optimizes search and transport efficiency. While numerous studies have focused on search efficiency, there has been limited research on transport efficiency due to the challenges associated with direct field observations. To address this challenge, we developed an individual-based model to simulate the transport process. Using the model, we examine the effects of several key variables on transport efficiency, Based on our results, we discuss potential strategies that termites might employ to optimize transport efficiency. In addition, we briefly discuss ways to improve the realism of the model.

Key words: termite, food transport efficiency, individual-based model

AM9

Taxonomic review of genus *Hilara* (Diptera: Empididae) in Korea

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The genus *Hilara* is one of the largest group in the family Empididae. It is usually found on the water surface, banks of rivers, streams, lakes or ponds and damp forests. The genus *Hilara* was established by Meigen in 1822, based on the type species *Hilara maura* (Fabricius, 1776). In this study, the genus *Hilara* is reported for the first time in Korea. A total of 6 species was recognozed in korea. Amog them, 3 new species of the genus *Hilara* Meigen: *Hilara* sp. nov. 1, *Hilara* sp. nov. 2 and *Hilara* sp. nov. 3 *Hilara* sp. nov. 4 and *Hilara* sp. nov. 5 are described as new to science. Also, one species, *Hilara echinata* Frey, is reported for the first time from korea. Adults and genitalia were examined and illustrated with a key to the genus *Hilara* in Korea and DNA barcodes, when available.

Key words: Taxonomy, *Hilara*, Empididae, Diptera, Korea

AM10

Cascading effects of glyphosate application on plant and collembolan communities

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Glyphosate, a worldwide most used herbicides, can have complex implications for terrestrial ecosystems, extending beyond its intended target, weed control. This study investigated the cascading effects of glyphosate application on both plant and collembolan communities. Our findings reveal that glyphosate application can reduce the richness of plant communities, and these effects can be pronounced in areas with low initial plant diversity. Furthermore, our results confirm that the fluctuations in plant community composition induced by glyphosate application can also impact the richness of collembolan communities. This research highlights the importance of considering both plant and invertebrate communities when assessing the impacts of herbicide use in agroecosystems.

Key words: Agroecosystem, Herbicide, Interaction, Anthropogenic, Ecological filter

AM11

Exploring nutritional composition of bee feed: Insights into honey bee nutrition

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The foraging behavior of honey bees can be attributed to the nutritional incentives they gain from their activities. Nevertheless, a persistent question has revolved around how the nutritional composition undergoes alterations during the process of converting pollen into bee bread. We embarked on a comprehensive investigation of nutritional shifts, spanning from fresh pollen to bee-pollen, pollen patties, and bee bread. Our research findings unveiled that pollen exhibited notably higher levels of individual amino acids, resulting in significantly elevated overall amino acid content compared to bee-collected pollen. While we provided pollen patty to the honey bee colony, initially, during the first 3 to 7 days, there were no substantial discrepancies in the total amino acid content between bee bread and the pollen patty. Intriguingly, unlike most amino acids, we detected a distinct pattern of higher proline content in bee bread compared to bee-pollen or the pollen patty. This shift in amino acid composition likely stems from the incorporation of nectar and other secretions during the bee bread-making process. Moreover, over a span of approximately 14 days within hive conditions, the amino acid content in bee bread increased. Conversely, in terms of fatty acid contents, they were found to be lower in bee bread than those in the pollen patty, with no significant temporal differences observed. Regarding mineral content, bee bread, in general, contained fewer minerals than bee pollen and pollen patties. In conclusion, the transformation of pollen into bee bread involves dynamic alterations in nutrient contents, influenced by both intrinsic bee-related factors and external factors within the hive environment.

Key words: Pollen, bee pollen, bee bread, apiculture, pollen patty, feed supplement, protein

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P1

Identification, characterization and function of group I lytic polysaccharide monooxygenase in two longhorn beetle species, *Monochamus alternatus* and *Psacothea hilaris*

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Lytic polysaccharide monooxygenases (LPMOs) catalyze the oxidative cleavage of glycosidic bonds in crystalline polysaccharides including chitin and cellulose. The recent discovery of LPMO family proteins in many insect species suggests that they presumably play a role in chitin degradation in the cuticle/exoskeleton, tracheae and peritrophic matrix during insect development. Insect LPMOs belong to auxiliary activity family 15 (AA15/LPMO15) and have been classified into at least four groups based on phylogenetic analysis. In this study, we identified, characterized and investigated the physiological functions of group I LPMO15 (MaLPMO15-1 and PhLPMO15-1) in two longhorn beetle species, *Monochamus alternatus* and *Psacothea hilaris*. In both species, depletion of *LPMO15-1* transcripts in last instar larvae by RNAi had no effect on subsequent larval-pupal molting and the resulting pupae developed normally. However, adverse effects on their development were observed during the pupal-adult molting period. The pharate adults were unable to shed their old pupal cuticle and died entrapped in their exuviae probably due to a failure of degradation of the chitin in their old cuticle, which is critical for completion of the insect molting and continuous growth.

P2

Assessment of insecticidal effects of freeze spray as a sustainable pest control agent

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Due to the growing concern on the adverse effects on human and environment, more attention in the non-chemical pest control methods is gaining. One of the so-called 'sustainable' control practice is to physically freeze the insect and arthropod pests. Aerosol formulation uses propellant gas which is liquefied by pressure, and it lowers the temperature when sprayed by the volume expansion. Using this phenomenon, several 'freeze spray' products in South Korea and Japan are commercialized. Nonetheless, unlike other traditional aerosol insecticides, the lack of insecticidal substances in these freeze products allowed them to circumvent legal inspection and registration, no efficacy test result is required in commercialization. In the present study, we examined the insecticidal activity of the freeze spray products against German cockroaches and the housefly in the laboratory condition as well as semi-field tests. The temperature of discharged center mass was –40-45°C, but it had relatively small active range (about 3 cm) which required pinpoint application of the product. Moreover, at least 30 sec and 12 sec of direct contact at 30 cm was required to exhibit >90% of mortality in the cockroaches and houseflies in the lab-based tests, respectively. Semi-field tests indicated an average of 15.8 g and 22.0 g were required to spray to knock down the freely-moving cockroaches and houseflies, respectively. Further utility of the freezing products is discussed.

Key words: freeze spray, sustainable pest control, german cockroach, housefly

P3

Preliminary study to evaluate Sulfuryl Fluoride (SF) for quarantine treatment of *Reticulitermes speratus*

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[2]K-Global Corp.

The utilization of methyl bromide (MB) for quarantine purposes has been hampered by its designation as an ozone-depleting substance under the Montreal Protocol. The International Plant Protection Convention's (IPPC) call for alternatives to MB and a reduction in its usage. There is an urgent need to explore and implement substitutes. Despite some substitute agents like EDN being developed for wood, EDN has been limited due to various factors such as occupational risks. This study focuses on evaluating the efficacy of Sulfuryl Fluoride (SF) as a viable alternative fumigant against *Reticulitermes speratus*, one of major wood destroying pests. Experimental trials conducted at ambient temperature (23°C) revealed promising results, with SF demonstrating LCT50 and LCT99 values of 30.87 mg·h/L and 42.53 mg·h/L, respectively. Under low-temperature conditions (5°C), SF remained effective but with slightly higher LCT50 and LCT99 values of 151.62 mg·h/L and 401.90 mg·h/L, respectively. The penetration test, conducted using R. speratus-infested pine wood cubes, further highlighted SF's efficacy, with LCT50 and LCT99 values of 31.59 mg·h/L and 53.34mg·h/L at 23°C, indicating powerful penetration capabilities. When tested at a loading ratio of 90% (v/v) at 5.0mg/L for 24 hours in a 500L chamber as a middle-scale trial, SF achieved a 100% mortality, showing its potential as a suitable replacement for MB. These findings suggest that SF could open new markets as an MB substitute and enhance safety at quarantine sites when applied to imported and exported timber.

Key words: methyl bromide alternative, SF fumigation, *Reticulitermes speratus,* wood pests, termites

P4

First record of the water strider *Rhagadotarsus* Breddin (Hemiptera: Gerridae: Rhagadotarsinae) in Korea

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The small-sized water strider genus *Rhagadotarsus* Breddin is known to be widely distributed in Southeast Asia. In a recent survey, we found *Rhagadotarsus kraepelini* Breddin from Gyeongsangbuk province. This species is known to non-native species in Japan. We provide descriptions and photographs of the external morphology of *R. kraepelini.* And a key to genera of Korean Gerridae is also provided to facilitate identification.

Key words: Gerridae, *Rhagadotarsus, Rhagadotarsus kraepelini,* new record

P5

Genetic diversity of *Ramulus mikado* (Phasmatodea: Phasmatidae) in Korea

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Ramulus mikado (Rehn, 1904) is an environmentally problematic species that has recently caused a severe outbreak on the mountainsides of the Seoul metropolitan area, resulting in significant damage to forests and causing inconvenience to people in the city centre vicinity. In this investigation, we analysed the genetic diversity through sampling in the outbreak region. The outcomes confirmed the efficiency of COI for species identification and the usefulness of haplotype analysis in examining regional variation.

Key words: stick insect, outbreak, molecular marker, genetic divergence

P6

First record of genus *Pseudopostega* Kozlov, 1985 (Lepidoptera: Opostegidae) from Korea

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Opostegidae is a microlepidopteran family (Lepidoptera: Nepticuloidea) that includes almost 190 species belonging to eight genera worldwide. Since Shin recorded *Opostegoides Kozlov* in Korea, only two species of the genus have been recorded in Korea among the family. We found the genus *Pseudopostega* Kozlov, 1988 from Gangwon-do Jeongseon. This study reports the genus *Pseudopostega* Kozlov, 1985, for the first time. Illustrations of adult and genitalisa are also provided.

Key words: *Pseudopostega*, New record, Opostegidae, Taxonomy

P7

Comparative efficacy of commercially available mosquito traps in the laboratory and semi-field conditions against the Asian tiger mosquito, *Aedes albopictus*

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The repeated use of biocidal products, including household insecticides and disinfectants, has led people to seek safer alternatives, such as light traps, ultrasound generators, or repellent lamps. By appearances, these physical/non-chemical alternatives seem appealing to many consumers and are gaining more attention. However, unlike biocidal products, these alternatives are not subject to mandatory approval and registration processes, and no standards for efficacy and safety are in place. Given the increasing numbers of insect traps on the market, there is an urgent need to investigate their efficacy. In the present study, we examined the attraction activity of ten commercially available insect trap products. They varied in size, structure, trapping methods (fan or sticky pad), and attractants. Their efficacies were assessed under both laboratory condition (1.8m x 1.8m x 1.8m) and semi-field room condition (4m x 6m x 2m). UI*****AP^{TM} demonstrated the highest capture rate (%), leading us to further study the role of its attractant. Notably, the capture rate increased by 28.9% when the CO_2 attractant was used, displaying statistical differences ($P = 0.032$). For practical application in the field, consumer acceptance and satisfaction were monitored using 20 participants. The potential of insect traps as viable alternatives to biocidal products is discussed.

Key words: Asian tiger mosquito, attractant, insect trap

P8

Injury and occurrence patterns of cherry tree borer in cherry trees planted in roadsides

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The cherry tree borer, *Synanthedon bicingulata* (Staudinger, 1887), is considered as a tree boring pest boring into cambium layer and weakens the tree. Cherry trees, the host species of *S. bicingulata*, are the most abundant ornamental trees in South Korea. However, there has been insufficient study conducted on ornamental trees compared to orchards. The study aimed to investigate the injury patterns caused by their larvae based on height and direction they faced. Since life cycle of *S. bicingulata* in Gangwon province had not been surveyed, occurrence pattern was also investigated using sex attractant. Injury patterns of 253 cherry trees in Chuncheon, were surveyed in April 2023. As a result, the injury occuring under 1 m in height was 2.61 times more extensive than injury between 1m and 2m in height of trunk. Also, the injury on the south-faced trunks was 2.68 times larger than on the north-faced trunks.

Key words: *Synanthedon bicingulata*, sex attractant, sex pheromone, frost crack

P9

Comparative efficacies of essential oil-based repellent products in three testing methods against *Drosphila melanogaster* (Diptera: Drosphilidae)

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To mitigate the intrusion of insect pests, behavioral modifications using repellents are commonly employed. Among their active ingredients, plant essential oils have gained prominence as safer alternatives to synthetic repellents. However, the absence of rigorous scientific efficacy testing have been undermined the reliability of these essential oil based repellent products. Previous studies have highlighted that the observed repellency in bioassays are strongly influenced by the testing environment. Our research introduces three distinct laboratory-scaled repellency test methods – spatial repellency, choice repellency in a closed and opened environment – to evaluate prevalent insect repellent products. Notably, we observed significant variations in repellency percentages among products. The most effective product from each method was identified, and its active ingredients were analyzed both quantitatively and qualitatively, by GC-MS analyses. To determine the applicability of these methods in selecting active ingredient concentrations, individual active ingredient components underwent dose-response testing. Our findings suggest that, when selected appropriately, these three methods can be applied for the development and evaluation of potent essential oil based repellent products.

Key word: spatial repellent, flying insect, fruit fly, biocide.

P10

Canceled by Author

P11

Spatial repellency of series compounds from natural products against the cotton ahpid, *Aphis gossypii* glover

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The cotton aphid, *Aphis gossypii* glover (Hemiptera: Aphididae), is the world-wide agriculture pest and has the ability to become resistant to many pesticides. Hence, we conducted behavioral tests on apterous and alate aphids for series compounds from natural products by using a two-choice test, a no-choice test, a host choice test and electroantennography (EAG). As a result, we found 3 out of 30 compounds for apterous aphids and 2 out of 15 compounds for alate aphids, both of which showed powerful repellent effects on these aphids. In this study, we suggest that our findings could be useful and eco-friendly spatial repellents for controlling cotton aphid.

Key words: alate aphid, apterous aphid, behavioral tests, electroantennography

P12

Insectcidal activity of an entomopathogenic fungi against *Pseudaulacaspis prunicola* (Hemiptera: Diaspididae)

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최근 벚나무에 벚나무깍지벌레에 의한 피해가 증가하여 친환경적인 방제제로서 곤충병원성 곰팡이인 *Beauveria bassiana* ARP14를 검증하였다. 경북 안동시 안동대학교 캠퍼스 내 벚나무에서 벚나무깍지벌레의 감염율을 조사하고, 벚나무의 연령을 추정하여 상관관계를 분석하였다. 곤충병원성 곰팡이의 살충력을 확인하기 위해 약충의 이동성이 가장 활발한 4월 말부터 5월 중순까지 벚나무깍지벌레에 감염된 가지를 채집하여 23℃의 항온기에 보관하면서 두 가지 곤충병원성 곰팡이(ARP14, AAD16)를 살포하여 살충제(스피로테트라맛 액상수화제) 처리구와 살충률을 비교하였다. 그 결과 대조구(물처리)보다 곤충병원성 곰팡이를 살포한 가지에서 약충의 개체 수가 더 감소하였으나, 살충제를 처리한 가지에서 보다는 약충의 수가 많았다. 따라서 가로수로 많이 식재된 벚나무 해충 방제시 일어날 수 있는 사람에 대한 피해를 최소화할 수 있는 친환경 방제제로서 곤충병원성 곰팡이를 사용할 수 있을 것이다.

검색어: 벚나무, 벚나무깍지벌레, 곤충병원성 곰팡이, 생물학적 방제

P13

A new record of *Norbanus meridionalis* (Masi, 1922) (Hymenoptera: Pteromalidae) from South Korea

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The genus *Norbanus* Walker 1843 (Pteromalidae: Pteromalinae) consists of 38 species distributed worldwide. Among them, 13 species have been described from the West and Central Palaearctic (Noyes 2003). *Norbanus* is one of several pteromalid genera that shares the character of a narrow spicula on the clava. In Korea, only one species in the genus *Norbanus* is recorded. In this study, we report *Norbanus meridionalis* for the first time in South Koera. We provided description and diagonostic illustration of *Norbanus meridionalis*.

Key words: Pteromalidae, new record, *Norbanus meridionalis,* South Korea

P14

The First Record of the Genus *Brachydeutera* Loew (Diptera: Ephydridae) from Korea

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The genus *Brachydeutera* Loew, 1862 is a small group of acalyptratae flies belonging to the subfamily Ephydrinae in the family Ephydridae. Up to now, 16 described species have been recorded worldwide, and although it occurs in all fauna regions, it is most diverse in the subtropics and tropics, particularly in Africa and Asia. This genus is recorded for the first time in the Korean fauna based on the discovery of a nominated species, *Brachydeutera meridionalis* (Rondani, 1856). Diagnoses, figures of morphological features, and an ecological photograph of the firstly recorded species are provided herein.

Key words: *Brachydeutera meridionalis*, Ephydridae, New record, 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 (NIBR202333201).

P15

Development of 16s rRNA-based molecular marker for *Spodoptera litura* (Lepidoptera: Noctuidae)

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Spodoptera litura Fabricius, 1775 (Lepidoptera: Noctuidae) is a serious crop pest with a long-distance migratory flight. To date, the DNA barcode region has been widely used in genetic diversity analysis studies of *Spodoptera litura*. However, the DNA barcode region showed maximum variation rate of *S. litura*, which from 18 regions in South Korea, was 0.608% (nine haplotypes) in previous study. In this study, four mitochondrial genes (ND4, ND4L, ND1, 16s rRNA) have higher intra-specific variation rates than the DNA barcode region. Among the four genes, The variation rate of the 16s rRNA region was confirmed to be a minimum of 0.203% (2bp) and a maximum of 1.824% (18bp). Finally, the 16s rRNA region with the highest PCR amplification efficiency and highest variation rate was selected as a high-efficiency molecular marker.

Key words: *Spodoptera litura*, 16s rRNA, Mitochondrial DNA, Molecular marker

P16

Taxonomic review of the genus *Margarinotus* Marseul, 1854 (Coleoptera: Histeridae) from Korea

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The genus *Margarinotus* Marseul, 1854 is one of the highly diverse groups of Histeridae (Histerinae), consisting more than 100 described species in the world. About 80 species are known to distributed in Palaearctic region, among them, 11 species have been reported from Korea. In this study, we report a new species, *Margarinotus pseudoboleti* sp. nov. and a new record, *Margarinotus yezoensis* Ôhara from Korea. Also, we provide a revised taxonomic key for Korean *Margarinotus*, including above two species and images of adults.

Key words: Taxonomy, Histeridae, *Margarinotus*, New species, Korea

P17

Seven newly record species of *Eurytoma appendigaster* species-group (Hymenoptera: Chalcidoidea: Eurytomidae) from Korea

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The *Eurytoma appendigaster* species-group is a second large group within the genus *Eurytoma* Illiger found in the Palearctic region. This group comprises 44 species by Zerova, but in Korea, only one species, *E. appendigaster* (Swederus), has been previously reported. They are well-known for their predation on phytophagous insects, mainly the genus *Tetramesa* which is belonged to the family Eurytomidae and associated with grasses (Poaceae). In this study, we report seven species of the *appendigaster* species-group from Korea for the first time. Also, key to Korean species of *appendigaster* species-group and photos of diagnostic characteristics are provided.

Key words: parasitoid, phytophagous, *Tetramesa*, Poaceae

P18

New records of the family Pseudopomyzidae McAlpine, 1966 (Diptera: Nerioidea) in Korea

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Pseudopomyzidae (Diptera: Nerioidea) is rare and a small family of dark-colored acalyptrate flies, comprising 24 extant species in eight genera and two fossil species in a single genus. To date, only one species *Pseudopomyza atrimana* (Meigen, 1830) has been recorded in the Korean Peninsula. This study reports the first Korean records of the family Pseudopomyzidae, with two genera and two species, *Polypathomyia stackelbergi* Krivosheina, 1979 and *Tenuia smirnovi* Shatalkin, 1995. A key to Korean Pseudopomyzidae is provided with morphological diagnosis and illustrations of habitus and genital structures of males.

Key words: Diptera, Korea, *Polypathomyia*, Pseudopomyzidae, *Tenuia*

*This research was supported by the National Research Foundation of Korea (NRF) grants funded by the Korean government (MEST, No. 2019R1A6A1A10073437; MSIT, No. 2021R1C1C1003452; Comparative medicine Disease Research Center, SRC, No. 2021R1A5A1033157). This work is also supported by Honam National Institute of Biological Resources (HNIBR, No. HNIBR202201201) and Seoul National University (Creative-Pioneering Researchers Program; the New Faculty Startup Fund; Laying the Groundwork for Peace and Unification, the Institute for Peace and Unification Studies).

P19

Four new species of the genus *Pholcus* (Araneae: Pholcidae) from South Korea

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Currently 41 valid species of the *Pholcus phungiformes*-group (Araneae: Pholcidae) have been known from Korea. In this study, four new species of this species-group were discovered from Gangwon-do and eastern Chungcheongbuk-do. These new species have common characteristics with *Pholcus socheunensis*, such as broad and membranous prolateral process and strongly curved pseudoappendix in male palp. The female of *Pholcus montanus* in the original description is the misidentification of a new species. Brief diagnosis, photographs and a distribution map of the new species and *P. socheunensis* with discussion on their sympatric distribution are provided.

Key words: cellar spiders, mismatch, *Pholcus phungiformes*-group, South Korea, sympatry, taxonomy

*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 (NIBR202102111, NIBR202203104).

P20

Taxonomy of the necrophagous fly genus *Conicera* (Diptera: Phoridae) from South Korea

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The genus *Conicera* Meigen is a group of necrophagous phorid flies mostly associated with carrion, including *C. tibialis*, commonly known as the “coffin fly” that breeds in buried corpses. In this study, specimens of the *Conicera* species collected from South Korea are examined morphologically on the basis of characteristics on male antennae, sensory organ on midfemora, and left and right surstyli on hypopygium. As a result, five species, *viz*. *C. dauci*, *C. gracilis*, *C. orientalis*, *C. pacifica*, *C. quadrata* are newly recorded from South Korea. Photographs of diagnostic characters, a distribution map and a key to males of South Korean species are provided.

Key words: coffin fly, *Conicera*, Korea, scuttle fly, taxonomy

*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 (NIBR202304203).

P21

Re-identification of *Donacia japana* Chûjô and Goecke (Coleoptera: Chrysomelidae: Donaciiinae) in the Korean Peninsula

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The members of genus *Donacia* are aquatic leaf beetles in the subfamily Donaciinae. Their larvae feed on submerged portions of aquatic plants and adults live on surface parts of the same plants. This genus includes 6 species belonging to 2 subgenera in the Korean Peninsula, of which there have been questions about the record of *D.* (*Donacomima*) *japana*. Chûjô and Goecke (1956) described a new species, *D. japana*, based on specimens collected in Japan and Korea (Unggi, Hamgyeongbuk-do), and Hayashi (2020) stated that records of this species from Korea and NE China may be misidentification of *D. aquatica* (Linnaeus, 1758). In this study, as a result of comparing specimens collected in South Korea (Gwangneung, Gyeonggi-do) with descriptions of *D. japana*, male genitalia (Hayashi, 2020) and gene sequences of COI region, we conclude that records of *D. japana* replace with *D. aquatica* in the Korean Peninsula, and *D. japana* is endemic to Japan.

Key words: *Donacia japana, Donacia aquatica,* misidentification, COI, Korea

P22

Identification of *Sympetrum depressiusculum* Sélys, 1841 in Korea (Odonata: Libellulidae) according to morphology and genetic markers

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In Korea, both *Sympetrum depressiusculum* Sélys, 1841 (Odonata: Libellulidae) and *Sympetrum frequens* Sélys, 1883 are recorded. However, the identity of Korean populations and the validity of listing the two species have not yet been settled. In this study, we collected 74 individuals from Kroea, Russia, the Netherlands, and Japan. These were sequenced for *COI*, *16S rRNA*, and ITS region. Major morphological characters and phylogenetic, network, and structure analyses all consistently suggest that Korean populations form a single species. Consequently, it could be valid to treat Korean populations as one species, *S. depressiusculum*, by applying the senior name.

Key words: Odonata, Dragonfly, *Sympetrum depressiusculum*, *Sympetrum frequens*, *COI*, *16S rRNA*, ITS, Korean Peninsula, Clinal variation

P23

Two unrecorded species belonging to *Acrobasis* Zeller, 1839 (Lepidoptera: Pyralidae) in Korea

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In the genus *Acrobasis* Zeller, 1839, there are 14 species known in Korea. In this study, we present *Acrobasis rubrizonella* (Ragonot, 1893) and *Acrobasis subceltifoliella* Yamanaka, 2006 from Korea for the first time. We hear provide diagnoses, descriptions, and images of the adults and genitalia of the two species.

Key words: Phycitinae, snout moth, new to Korea, Korean peninsula

P24

Taxonomic review of *Halictus* Latreille, 1804 and *Seladonia* robertson, 1918 (Hyemenoptera: Apoidea: Halictidae) in South Korea

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The genus *Halictus* Latreille, 1804 and *Seladonia* Robertson, 1918 are nearly cosmopolitan group, consisting of more than 206 described species worldwide except Antarctica region. In previous taxonomic and phylogenetic research, this genus regarded as a sister group of genus *Halictus*. In this study, a total of two genera seven species were reviewed from Korean peninsula (three *Halictus*, four *Seladonia*) with three new records (*Halictus hedini hedini, Seladonia confusa, S. henanensis*). A key to species and images of adult are provided.

Key words: Taxomony, Halictidae, *Halictus*, *Seladonia*

P25

Submission Error

P26

Six new species of the New Zealand genus *Physobryaxis* Hetschko, 1913 (Staphylinidae: Pselaphinae: Goniaceritae)

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Goniaceritae is the most speciose supertribe of the subfamily Pselaphinae with more than 3,000 species worldwide. Brachyglutini is the only tribe within New Zealand Goniaceritae, comprised of 8 genera. *Physobryaxis* Hetschko is monotypic genus of the subtribe Brachyglutina. Although the adults of *P. inflatus* is close to the members of genus *Gastrobothrus* Broun, 1882, it is characterized by median antebasal fovea and antebasal sulcus on pronotum. In this study, we report six species of *Physobryaxis* examining 21 specimens. Illustrations of the habitus, diagnostic characters including male genitalia, and key to the species are also provided. Additionally, we present a distributional map divided into areas based on Crosby's code.

Key words: ant-like litter beetles, taxonomy, New Zealand, endemic, new species

P27

Two new species of phoretic mites on ground beetle (Coleoptera: Carabidae)

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Beetles are one of the most effective transportation for phoretic chelicerata. They use various methods to attach themselves to their hosts, such as developing ventral sucker plates, grasping with their claws and chelicerae, or hiding beneath the elytra. Recently, we discovered new species of two genera: *Antennoseius* (Mesostigmata: Blattisociidae) and *Gaeolaelaps* (Mesostigmata: Laelapidae) which are hiding under the elytra of Carabidae hosts. In this study, digital images of the beetles, and mites, along with brief diagnostic information and line-drawing plates will be provided.

Key words: Acari, Ground beetle, Mesostigmata, New record, Phoresis

P28

Unexpected discovery of the pantropical genus *Discheramocephalus* (Coleoptera: Ptiliidae: Discheramocephalini) from Korea

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Discheramocephalus Johnson was first described from the Solomon Islands as monotypic genus. According to recent studies, this genus comprised 19 species from Afrotropical, Australasian, Indomalayan, and Neotropical realms. These ranges of distribution suggest that *Discheramocephalus* is pantropical genus. In this study, we describe a *Discheramocephalus* species from Korea and report a species new to the Palearctic realm. Illustrations of habitus, genital characters and collection localities, a distributional map, and a checklist of the genus *Discheramocephalus* are also provided.

Key words: new species, biogeography, featherwing beetles, taxonomy

P29

A new pselaphine genus from Southern Australia (Coleoptera: Staphylinidae: Pselaphinae: Faronitae) with seven new species

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The subfamily Pselaphinae is one of the largest groups in the family Staphylinidae. Pselaphine beetles consists of 6 supertribes. The supertribe Faronitae consists of 30 genera worldwide, with 14 genera in Australia and New Zealand. While examining faronite specimens, we separated 366 specimens that did not belong to any known faronite genera. Species of this genus can be separated from other faronite genera by the foveal system, features of the aedeagus, and collection localities which are only collected in the southern part of Australia. Through this study, we describe seven new species and three new combinations that previously belonged to the genus *Sagola*.

Key words: Pselaphinae; Faronini; Australasia; Taxonomy

P30

The check list of genus *Ischyja* Hübner, 1823 (Lepidoptera: Erebidae) with two new records from Vietnam

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The family Erebidae is acknowledged as a highly diverse group in Lepidoptera. The genus *Ischyja* Hübner, 1823 has been known from India, Thailand, Laos, Vietnam, southern China, Borneo, and Sundaland, predominantly in the old world tropic region. This research presents identification of two species, which have been in Vietnam for the first time. With these new findings, the total number of *Ischyja* species has increased to four. We present a checklist of them, including descriptions and illustrations of the newly recorded species.

Key words: Oriental region, Distribution, ecology, taxonomy

P31

The characterization of the entomopathogenic fungus *Metarhizium viridulum* isolate from *Cryptotympana atrata* new to Korea

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Cryptotympana atrata belongs to the family Cicadidae, has long been recognized as a damaging plant-sucking pest, and is distributed in East Asian countries. In addition, their cries cause direct harm to us through noise pollution and also reported twig damage in the forest environments. In this study, we isolated strains of the entomopathogenic fungus *Metarhizium* that occurred from *C. atrata* collected this year. Here, we provide the morphological character and molecular phylogenetic relationship of this species. This is the first record of the entomopathogenic fungus *Metarhizium viridulum* isolated from *C. atrata* in Korea and provides a candidate strain with potential use for biological agents.

Key words: *Metarhizium*, *Metarhizium viridulum*, *Cryptotympana atrata*, Entomopathogenic fungus, Korea

P32

Addition of 97 new complete mitochondrial genome sequences of the wild silkmoth, *Bombyx mandarina* (Lepidoptera: Bombycidae), from Korea and Japan for population genetic analyses

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Bombyx mandarina (Lepidoptera: Bombycidae), the presumed ancestor of *B. mori*, has long been a subject of study to illustrate the geographic relationships in connection with origin of *B. mori*. We report 97 mitochondrial genome (mitogenome) sequences of *B. mandarina* collected from Korea and Japan. Phylogenetic and population genetic analyses showed that all individuals of *B. mandarina* collected in Korean localities formed a strong group together with all individuals originated from northern China (mainly north of the Qinling-Huaihe line) and some of southern China. This group was placed as the sister group to *B. mori* strians suggesting that this group had been served as an immediate progenitor for *B. mori*.

Key words: Mitochondrial genome, *Bombyx mandarina*, Wild silkworm, Phylogeny, Population structure

P33

Complete mitochondrial genome of *Ceriagrion nipponicum* (Odonata: Coenagrionidae) and comparison to Zygoptera

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Ceriagrion nipponicum (Odonata: Coenagrionidae) is listed as climate-sensitive indicator species in Korea and now expands its range northward. In this study, we sequenced complete mitochondrial genome (mitogenome) of the species collected from South Korea for comparatively analysis in damselflies and to detect the genes suitable for subsequent population genetic study. Comparison of the mitogenomes from two geographic samples of *C. nipponicum* showed the highest variation in *ND4* and *ND1*, whereas no variation was detected in *COI*, warranting usefulness of the two genes for subsequent population-level study. Phylogenetic analysis using 13 PCGs and 2 rRNAs in Zygoptera showed non-monophyletic Coenagrionidae, forming two groups.

Key words: Mitochondrial genome, *Ceriagrion nipponicum*, Climate-sensitive species, Phylogeny

P34

Effects of pesticide exposure on task gene expression level and nursing behavior in nurse bees of honey bee, *Apis mellifera*

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The adult of honey bee, *Apis mellifera*, performs an age-dependent division of labor with nurse bees and foragers. Foragers fly outside the hive to collect pollen and nectar, while nurses feed and care for the larvae and queen inside the hive. Foragers are considered to be frequently exposed to agrochemicals, although nurses, stayed inside the hive, are potentially exposed to pesticides through application of miticides and pesticide-contaminated food provided by forager. Therefore, physiological effects of pesticides to nurses should be elucidated to understand the adverse effects of the chemicals on entire honey bee colony. In this study, we investigated the expression changes of the genes associated with labor division (task genes) and the nursing behavior of nurse bees fed four pesticides: acetamiprid (ACE), carbaryl (CB), imidacloprid (IMI), and fenitrothion (FEN). When nurses were exposed to ACE, IMI, and FEN, expression levels of task genes were up- and down-regulated, and their nursing behaviors were also suppressed and enhanced, respectively. CB did not alter the gene expression levels, however increased nursing behavior. These suggest the potential of pesticide that breaks the balance of labor distribution in honey bee colony.

Key words: *Apis mellifera*, nurse bee, pesticides, gene expression, nursing behavior

P35

Gene transcription profiles in head and abdomen of honey bee exposed to seven pesticides

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Pesticides are indispensable in contemporary agriculture but are mainly attributed to honey bee population decline. In order to understand the approximate physiological response to pesticides, honey bees were exposed to seven pesticides (Acetamiprid, Imidacloprid, Flupyradifurone, Carbaryl, Fenitrothion, Amitraz, and Bifenthrin), and expression changes of the genes categorized into four physiological functions (insecticide targets, immune-, detoxification-, and reactive oxygen species response-related gene) were analyzed in the head and abdomen of honey bee exposed to pesticides using quantitative PCR. Based on the heat map analysis, immune-related genes seem to be more up-regulated by pesticide exposure in head than abdomen. Among detoxification genes, only *cytochrome P450* families were up-regulated in head. Interestingly, regardless of the insecticide target, expressions of *Nicotinic acetylcholine receptor beta 1* and *Acetylcholinesterase 1* were notably induced by pesticide exposure in head. Heat map analysis expressing the transcription profiles of various genes in the head and abdomen of the honey bee exposed to various pesticides can be used to diagnose pesticide damage in honey bees in the future.

Key words: *Apis mellifera*, Gene expression, Heat map, Pesticide, Head, Abdomen

P36

Determination of gene expression changes in various tissues of honey bee exposed to three pesticides targeting nicotinic acetylcholine receptor

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The honey bee, *Apis mellifera*, has a defense system, including detoxification, antioxidation, and immunity pathways, against external stimulation such as chemicals, stress, and pathogens. However, pesticides, particularly neonicotinoids and butenolids, have been recently reported to alter physiological changes in honey bee. In this study, we investigated the expression levels of eight genes categorized into detoxification (*CYPQ3*), antioxidation (*CAT* and *SOD2*), and immune system (*Abaecin, Apidaecin, Defensin1, Defensin2,* and *Hymenoptaecin*), in five tissues (Head, Thorax, Gut, Fat body, and Carcass) of honey bee treated with three pesticides (Acetamiprid, Imidacloprid, and Flupyradifurone) using quantitative real-time PCR. Gene expression patterns was varied depending on the type of pesticides and tissues. However, among eight genes, the expression levels of *CYPQ3* was notably induced, but those of AMPs were generally reduced by all pesticides tested in this study in five tissues. These suggest that *CYPQ3*-mediated detoxification pathway is induced, but AMP-mediated immune system might be disrupted when honey bee is exposed to neonicotinoids and butenolid.

Key words: honeybee, neonicotinoid, expression level, detoxification, immune

P37

Tribolium castaneum TcCPAP1-C cuticular protein is required for integrity of internal tendon cuticle, limb movement and locomotion

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Structural cuticular proteins (CPs) and the liner polysaccharide, chitin, are the primary components of insect cuticle or exoskeleton. A large number of insect CP family proteins are divided into several distinct subfamilies defined by the presence of specific amino acid sequence motifs. One of these subfamilies is composed of Cuticular Protein Analogous to Peritrophins (CPAPs), containing one (CPAP1s) or three (CPAP3s) type-2 chitin-binding domains. In this study, we report a novel function of *TcCPAP1-C* from *Tribolium castaneum* in movement of legs. RNAi for *TcCPAP1-C* at larval stage has no effect on insect molting, growth and development. However, the resulting adults exhibit impaired leg movement, in which internal tendon cuticles are ruptured near the femur-tibia joint. The exoskeletal cuticle, hemiadherens junctions, microtubule array, myotendinous junctions and muscle fibers exhibit normal morphology before the tendon breakage. These results indicate functional specialization of TcCPAP1-C in structural integrity of the internal tendon cuticle, and loss of function of TcCPAP1-C caused breakage of the tendon cuticle, resulting in defective limb movement and locomotion.

P38

Laboratory evaluation of *Beauveria bassiana* ARP14 against *Aphis glycines* Matsumura (Hemiptera: Aphididae)

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Soybean aphid, *Aphis glycines* Matsumura has been identified as a pest of soybean in Korea, Japan, and China. The use of synthetic chemical insecticides is a major option to manage this pest, but the demand for environmental-friendly insecticide is increasing. Entomopathogenic fungus is one of the alternatives which is safe for the environment. In this bioassay, leaf dipping method was used to evaluate *Beauveria bassiana* (Balsamo) Vuillemin ARP14 and GHA. The mortality of both adults and nymphs was not significantly different between the two fungus strains. However, faster mortality rate in both life stages of aphid was found in ARP14 compared to GHA strain. Also, the mycosis rates of both adults and nymphs were higher in ARP14 than in GHA strain. Our results suggest that *B. bassiana* ARP14 can be an effective and an environmental-friendly control agent for *A. glycines*.

Key words: Entomopathogenic fungus, Biological control, Soybean aphid, *Beauveria bassian.*

P39

Insecticidal activity of secondary metabolites from *Streptomyces celluloflavus* against *Spodoptera exigua*

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The beet armyworm, *Spodoptera exigua*, is one of the worldwide distributed agricultural pest insects and has been known to show high resistance to conventional chemical insecticides. Since it has been reported that secondary metabolites from actinomycetes show insecticidal activities against various insect pests, actinomycetes could be a potential source of insecticidal compounds. In this study, culture extracts of *Streptomyces* strains were tested for their insecticidal activity against *Spodoptera exigua*. Among them, culture extracts of IMBL-0003 strain which was identified as *Streptomyces celluloflavus* showed a high insecticidal activity (more than 90% mortality). These results suggested that secondary metabolites of this isolate could have potentials to be a efficient eco-friendly pesticide for controling *Spodoptera exigua*.

Key words: actinomycetes, *Spodoptera exigua*, insecticidal activity, *Streptomyces* strains

P40

Optimization of the culture medium for a high toxicity *Bacillus thuringiensis* IMBL-B9 for enhanced toxin production

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Bacillus thuringiensis (Bt) is currently the most commonly used microbial pesticide. In the previous study, Bt IMBL-B9 known for its high toxicity against *Spodoptera exigua*, *S. frugiperda* and *Plutella xylostella* was characterized. To develop novel biopesticide, optimization of culture medium is required for the cost-effective mass production for toxin production of IMBL-B9. Through experimental design by Plackett-Burman design, ingredients that significantly influenced the production of IMBL-B9's toxin were selected. Using these results, the novel culture medium for IMBL-B9 was developed and the toxin yield of IMBL-B9 was significantly increased than conventional media by using this medium. These results could be useful for the development of biopesticides.

Key words: *Bacillus thuringiensis*, toxin production, media optimization, experimental design

P41

Resistance analysis of eight insecticides against *Bemisia tabaci* (Hemiptera: Aleyrodidae) collected from cucumber

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The rate of resistant pest emergence has accelerated due to the continuous use of pesticides. Therefore, it is important to formulate insecticide resistance management measures and effective control methods for pest. *Bemisia tabaci*, a greenhouse pest, causes direct damage to crops such as growth inhibition and leaf discoloration at all developmental stages except for eggs. It also indirectly damages plants by secreting honeydew, which covers surrounding leaves and fruits, leading to sooty mold development.
In this study, eight insecticides with high usage rates, categorized by their mode of action, were selected. Samples of *Bemisia tabaci* were collected from six regions, and resistance analysis were conducted. The results showed that Flonicamid exhibited a resistance ratio of 8.91 in Sejong, while Pyriproxyfen showed a high resistance ratio of 63.56 in Gunwi. Fluxametamide, Spinetoram, Cyantraniliprole, Dinotefuran, Pyridaben, and Milbemectin displayed resistance ratio ranging from 0.02 to 1.14 in most regions, except for Flonicamid and Pyriproxyfen.

Key words: *Bemisia tabaci*, Insecticide, Resistance, Greenhouse, Cucumber

P42

Spatial repellent and oviposition deterring effects of series compounds from natural products against *Tetranychus urticae* Koch (Acari: Tetranychidae)

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The two-spotted spider mite, *Tetranychus urticae* Koch, is one of the most important agricultural pests. Therefore, we screened fifteen compounds from natural products for their spatial repellent and oviposition deterrent activities against *T. urticae* in the laboratory by using two-choice and no-choice tests. In the bridge two-choice test, nine compounds showed the spatial repellent effects on *T. urticae* at 20 mg dose, resulting in reduced numbers of eggs. Among the nine compounds, at 2 mg dose, two compounds were selected as having more spatial repellent activity than the others. The two compounds also showed spatial repellent and oviposition deterrent effects in the two-choice test from hosts. In the no-choice test from a host, the spatial repellent effects of the two compounds to *T. urticae* were significantly stronger than that of controls. These results suggest that the findings can be used as potential agents for the prevention and population control of *T. urticae* in the field.

Key words: two-spotted spider mite, two-choice test, no-choice test, prevent, control

P43

Efficacy of single treatment of ethyl formate and controlled atmosphere to the red flour beetle, *Tribolium castaneum*

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Because of recent reports about phosphine resistance problem, development of effective fumigation method to control grain pests became very important. In this study, a chemical treatment, ethyl formate fumigant treatment, and a physical treatment, atmospheric control, were attempted as alternative solutions to this problem. In this study, for CA(Controlled atmosphere) treatment, 99.999% nitrogen was used to create a hypoxic condition with less than 5% oxygen, and for EF, the treatment concentration was 10 mg/L to 80 mg/L. As a result of the study, in CA single treatment, adult insects showed a mortality rate of less than 10% even after 2 weeks of treatment, and pupae and larvae showed a mortality rate 71% and 34%, but eggs showed a mortality rate of 100%. In EF single treatment, adults and larvae showed a 100% mortality rate at 80 mg/L, but eggs showed a 50% mortality rate and pupae were not affected. Considering the results, CA single treatment is not suitable for controlling *Tribolium castaneum* because of long treatment period, and in the case of EF single treatment, additional researches on longer treatment time is needed.

Key words: *Tribolium castaneum*, ethyl formate, controlled atmosphere

P44

Not Presented

P45

Transcriptome profiling of isogenic strain of emamectin benzoate resistant onion thrips, *Thrips tabaci*

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The onion thrips, *Thrips tabaci* (Thysanoptera: Thripidae), is a worldwide pest that causes serious damage to Allium crop species and acts as a vector for iris yellow spot virus (IYSV). In a previous study, we established an emamectin benzoate (EB) resistant strain (EB-R) with a 490-fold higher resistance ratio than the susceptible strain (SUS). The EB-R exhibited significantly increased transcript levels of glycine receptor alpha, glutamate-gated chloride channel (GluCl) b, and cytochrome P450 (CYP450) 6EB2 compared to SUS. To identify EB resistance-related genes that are differentially expressed genes between SUS and EB-R, we established an isogenic backcrossing strain and conducted transcriptome analysis after the 4th cycle of isogenic backcrossing. Among the 85 up-regulated genes in the transcriptome data, six cuticular protein genes showed up-regulation. Additionally, CYP450 4g15, which catalyzes the synthesis of cuticular hydrocarbons, exhibited a 6 log2-fold higher expression level in EB-R compared to SUS. Therefore, the elevated expression of genes associated with cuticle protein modification may be significantly is involved in the development of EB resistance.

Key words: *Thrips tabaci*, insecticide resistance, isogenic backcrossing, transcriptome analysis, detoxification factors

P46

Insecticide resistance in *Culex pipiens* complex from Republic of Korea

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Culex pipiens complex는 West Nile virus의 주요 매개체이며, 대한민국에는 *Cx. pipiens pallens*와 *Cx. pipiens* f. *molestus*가 서식한다고 알려져 있다. 그러나 현재까지 대한민국에서 진행된 *Culex pipiens* complex의 살충제 관련 실험은 종 수준 이하의 단계에서 비교가 이루어지지 않고 있다. 이에 본 연구에서는 대한민국의 13개 지역에서 *Culex pipiens* complex를 채집하였고, 분자 마커를 이용해 종 수준 이하 단계까지 분류를 진행한 뒤 각 분류군의 Acetylcholinesterase-1(*Ace-1*)와 Voltage-gated sodium channel(*Vgsc*) 유전자에 대한 저항성 돌연변이 존재 유무를 확인하였다. *Ace-1* 영역 확인 결과, *Cx. pipiens* f. *molestus*에서는 저항성이 확인되지 않았으며, 목포에서 채집된 *Cx. pipiens pallens* 1개체에서 저항성 개체가 발견되었다. *Vgsc* 영역에서는 저항성 유전형질을 보유한 개체가 *Cx. pipiens pallens*와 *Cx. pipiens* f. *molestus*에서 모두 발견되었으며, 다양한 지역에서 서로 다른 비율로 존재하는 것을 확인하였다. 본 조사 결과는 향후 대한민국에 서식하는 *Culex pipiens* complex의 효율적인 방제를 위한 기초자료로 활용될 수 있을 것이다.

Key words: Insecticide resistance, Voltage-gated sodium channel, Acetylcholinesterase, *Culex pipiens* complex

P47

Damage of *Anoplophora horsfieldii* (Hope) on *Celtis sinensis* in Jeju, Korea

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Anoplophora horsfieldii (Hope, 1843), 국명 노랑알락하늘소(가칭)는 아열대 지역에 주로 분포하는 종으로 2019년에 제주도 용연계곡에서 처음 발견되었으며, 2023년에 국내 정착이 보고되었다. 국내에서는 팽나무에서 발생하는 것으로 알려졌으나, 섭식방식, 산란 선호성 등 생태적 특성에 대해서는 국내외 연구가 전무하다. 따라서 본 연구에서는 노랑알락하늘소의 기초적인 생태정보를 제공하고자 실내 산란 선호성 조사 및 야외조사를 진행했다. 산란 선호성 실험은 기주식물로 알려진 팽나무, 멀구슬나무와 제주도내 대표 수종인 동백나무, 종가시나무을 대상으로 했다. 이 중 팽나무에서만 산란이 확인었으며, 상대적으로 굵은 팽나무에서 더 많은 산란이 확인되었다. 야외조사에서는 최대 발생지인 용연계곡을 기준으로 반경 3 km 내에서 노랑알락하늘소의 탈출공이 확인된 32 그루의 팽나무를 대상으로 피해를 조사하였다. 나무의 굵기는 흉고직경이 20-40 cm인 팽나무에서 탈출공이 많이 확인되었고, 높이는 지면으로 부터 0-100 cm 구간에서 가장 많은 탈출공이 발견되었다.

검색어: 하늘소, 팽나무, 해충, 피해

P48

Attraction characteristics of *Ctenoplusia agnata* caught in pheromone traps of *Agrotis ipsilon* with different component ratios

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지난 2022년 제주도 애월읍 일대에서 콩 해충으로 알려진 콩은무늬밤나방(*Ctenoplusia agnata*) 성충이 검거세미밤나방(*Agrotis ipsilon*)의 성페로몬 트랩에 대량으로 포획되었다. 검거세미밤나방 트랩은 목적 해충에 대한 포획 효율을 조사하기 위해 세 구성 성분, (Z)-7-dodecenyl acetate, (Z)-9-tetradecenyl acetate를 3:1 비율로 고정하고 (Z)-11-hexadecenyl acetate를 0, 1, 6, 10, 15로 각각 비율을 달리한 미끼를 사용하였다. 각 조성별 콩은무늬밤나방 성충 포획수를 비교한 결과, (Z)-11-hexadecenyl acetate가 첨가되지 않은 트랩에서 주당 평균 약 17.96마리로, 가장 많은 수의 개체가 포획된 것으로 확인되었다. 반면, (Z)-11-hexadecenyl acetate가 가장 많이 함유된 트랩에서 주당 평균 약 2.5마리로 가장 적은 개체가 포획된 것으로 파악되었다. 이에 (Z)-11-hexadecenyl acetate의 비율이 증가할수록, 포획되는 콩은무늬밤나방의 개체 수가 감소되는 것을 확인할 수 있었다. 검거세미밤나방 미끼의 주성분인 Z)-7-dodecenyl acetate는 기존의 콩은무늬밤나방 유인 성분 중 하나이기도 하여 해당 성분의 구성비가 유인에 영향을 미쳤다는 것을 예측할 수 있다. 추후에 해당 트랩들과 시판 중인 콩은무늬밤나방 성페로몬 트랩을 설치하여 포획 양상을 비교할 필요성이 요구된다.

검색어: 밤나방과, 채소 해충, 페로몬 조성, 성페로몬 트랩, 나방 예찰

P49

Invasion risk of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in South Korea: Predictions based on MaxEnt model

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Climate change and biological invasions are the greatest threats to biodiversity, agriculture, health and the global economy. Tomato leafminer(*Tuta absoluta*) (Meyrick) (Lepidoptera: Gelechiidae) is one of the most important threats to agriculture worldwide. This pest is characterized by rapid reproduction, strong dispersal ability, and highly overlapping of generations. Plants are damaged by direct feeding on leaves, stems, buds, calyces, young ripe fruits and by the invasion of secondary pathogens which enter through the wounds made by the pest. Since it invaded Spain in 2006, it has spread to Europe, the Mediterranean region, and, in 2010, to some countries in Central Asia and Southeast Asia. In East Asia, Tomato leafminer was first detected in China in Yili, Xinjiang Uygur Autonomous Region, in 2017. There is a possibility that this pest will invade South Korea as well. This study provides this by the use of MaxEnt algorithm for modelling the potential geographical distribution of Tomato Leafminer in South Korea Using presence-only data.

Key words: *Tuta absoluta*, MaxEnt model, Tomato leafminer

P50

Relationship the density of insect pest and damage of host plant: Case study of *Bemisia tabaci* in tomato greenhouse

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Since the importance of integrated pest management to minimize environmental damage and maximize pest control effectiveness has emerged, efforts to put it into practice have continued. To implement IPM, it is necessary to estimate the economic injury level to determine the control method by identifying pests and weeds that damage the quantity and quality of crops in the field, investigating the occurrence level, and calculating the ratio of cost and effectiveness. Also, damage to host plants caused by increased density of insect pests appears to change plant's health that key factor for managing crops. Therefore, understanding the relationship between the density of pests and the damage to the host plants is necessary. This study aims to analyze the causal relationship between the density of insect pests and damage to the host plants for estimating the economic injury level of insect pests on the host plants and investigating the possibility of pest control decision-making using plant health status.

Key words: whitefly, tomato, economic injury level, NDVI

P51

Prediction of *Frankliniella occidentalis* density using machine learning algorithms in pepper greenhouses

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A causality exists between insect density and plant health, where plant health is affected by both the plant's potential and environmental factors. In other words, causality is possible between insect density and environmental factors, allowing for the analysis of insect density based on these environmental factors. Machine learning enables studying insect density alongside environmental factors, providing insights into the causality between insects, the environment, and plant health. Machine learning is a methodology that involves the design of models by learning patterns from input data. This study aims to predict *F. occidentalis* density by sampling environmental factors and applying them to machine learning models.

Key words: *Frankliniella occidentalis*, environmental factors, machine learning algorithm

P52

Spatial analysis of *Frankiniella occidentalis* in hot pepper greenhouse using geostatistical techniques

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For effective control of *Frankliniella occidentalis*, one of polyphagous pests with resistance to insecticides, necessitates the implementation of an integrated pest management strategy. Therefore, estimation of pest density is essential and this is achieved through the application of spatial statistical analysis methods. Because traditional methods often overlook the correlation between sampling locations and data, geostatistical analysis using variogram and kriging is introduced. Variogram provides information on the independent distance between data points. Kriging is a spatial interpolation technique for estimating the values at unsampled locations. For assessing model fitness, cross-validation is used by comparing predicted values with actual observations. This study focuses on the application of geostatistical techniques to estimate *F. occidentalis* density in hot pepper greenhouse, thereby contributing to making decision.

Key words: geostatistics, variogram, kriging, *Frankliniella occidentalis*

P53

Insect pests of pin oaks planted as roadside and ornamental trees in urban landscapes

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최근 이식에 강하고 도심 환경에서의 스트레스에 강한 저항성을 지니고 있으며 병해충이 많이 없는 것으로 알려진 대왕참나무가 가로수 및 조경수로 많이 식재되고 있다. 하지만 대왕참나무의 식재량이 증가하면서 일부 지역에서 해충 피해가 보고되고 있고 이들에 대한 관리 대책 마련이 시급해지고 있다. 따라서 본 연구는 대왕참나무의 식재 환경에 따른 해충 발생 양상을 조사하기 위해 수행하였다. 2022년부터 2023년 동안 7~8월 중에 조사를 수행하였으며, 육안조사법과 고지 가위를 활용하여 줄기와 잎에서 해충의 종별 개체수를 조사하였다. 대왕참나무의 식재 환경은 도로변과 공원으로 구분하였고, 서울, 성남, 춘천, 원주, 여수, 함안, 창원 지역을 대상으로 진행하였다. 조사 결과 총 20과 34종 1,126개체가 관찰되었으며 그 중 가로수에서 15과 18종 699개체가 관찰되었고 공원 지역에서 17과 27종 427개체가 관찰되었다. 가로수에서 나비목과 노린재목 해충이 더 많았으며 공원에서는 딱정벌레목 해충이 더 많았다.

검색어: 대왕참나무, 가로수, 해충상, 식재환경

P54

Investigation of environmental/seasonal mosquito population and flavivirus detection in Gyeoungbuk, 2022

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Mosquitoes were collected from three different environments (urban area, migratory bird refuge, and cowshed) in Gyeoungbuk from March to November 2022. A total of 4,701 female mosqutoes were collected: 1,635 from urban area, 2,801 from migratory bird refuge, and 265 from cowshed. Among collected 9 species, *Aedes vexans* was the most dominant species (50.9%), followed by *Culex pipiens* complex (31.8%), and *A. albopictus* (7.1%). In urban area, *C. pipiens* complex was the dominant species at 75.5%, while *A. vexans* was the dominant species at 82.3% and 58.9% in respective migratory bird refuge and cowshed. Among 253 pools tested for flavivirus, Japanese encephalitis virus (type V) was detected in one pool of *C. orientalis* collected from the migratory refuge.

Key words: Mosquito, Gyeongbuk, Flavivirus, Japanese encephalitis virus

P55

Insect diversity and community structure depending on the landscape and habitat

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Understanding the landscapes and the elements that make up the landscapes can help us understand the entire natural ecosystems and biodiversity. Landscape ecology has been studied since the past. however, many studies are conducted on single landscapes, and comparative studies between landscapes are few. We compared insect species diversity and community structure within a single plant community across landscapes and habitat. Additionally, identify environmental factors that affect diversity. Our results showed that above-ground and below-ground insect communities were clearly distinguished. Additionally, species diversity was high below-ground in all landscapes. Insect community structures across landscapes did not differ in above-ground. However, below-ground, the urban was differentiated from the forest and agricultural land. We identified the urbanization indices GMIS and PHBASE as factors responsible for these difference.

Key words: Landscape, Urban, Insect, Diversity, Assemblage

P56

Species diversity of Genus *Culicoides* from southern part of Republic of Korea

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등에모기과(Ceratopogonidae)는 파리목(Diaptera)에 속하는 미소곤충이다. 이 중 사람과 반추류를 포함하는 척추동물을 흡혈하는 점등에모기속(Genus *Culicoides*)은 세계적으로 1,368종 이상이 보고되었으며 블루텅, 아프리카 마역 등 60여개 이상의 질병을 매개하는 것으로 알려져 있다. 현재 국내에 서식하는 *Culicoides*는 37종이 보고되어있으며, 아카바네, 츄찬 등의 질병을 매개한 기록이 있다. 이에 기후변화에 따른 개체 발생양상과 분포를 조사하고자 본 연구에서는 아열대화 및 해외유입을 고려하여 경상남도, 전라남도, 제주도 세 권역의 축사 15개 지역에서 5월부터 8월까지 유문등을 이용하여 채집하였다. 총 19종 103,365개체가 채집되었고 *Culicoides arakaawae*(83,922), *Culicoides punctatus*(11,184), *Culicoides tainanus*(3,298) 3종이 전체 채집량 중 95.2%를 차지하였다. 각 샘플을 채집시기별, 종별, 지역별로 정리한 결과, 종다양성이 가장 높은 지역은 13종이 채집된 진주, 가장 낮은 곳은 3종이 채집된 제주5 지점이었다. 보관된 샘플은 유전자원 확보 및 바이러스보유검사 등의 추가실험을 통해 국내 등에모기 연구를 위한 기초자료로 활용될 수 있을 것으로 기대된다.

검색어: 기후변화, Culicoides, 종 분포, 질병 매개체

P57

Featherlike handling and not-cheap sharpness; Introduction of the smartphone accessory for the insect tele-macro photography in the field

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Smartphone camera quality has been progressing alongside the advancement of the smartphone market. Consequently, there has sparked interest in macro photography of insects using smartphones either through using built-in "macro mode" or accessories like macro lenses, mounts, and auxiliary lighting. However, some limitations have become apparent, including challenges in capturing small insects, a short focal distance of no more than 10 cm, a narrow focus range, and lower image quality compared to dedicated cameras. We introduce an effective knowhow to these problems when taking pictures of insects in the field using a smartphone. And it provides a manual for tele-macro photography in the field, and suggestions for the future direction of smartphone and accessory development.

Key words: tool for field, smarphone tele-macro, insect photography, telephoto lens, smartphone accessories

P58

Increase of the production efficiency in baculovirus surface display system

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표면발현(surface-display system)은 세포 또는 바이러스 표면에 목적 단백질을 고정하여 발현시킴으로써 목적 단백질에 대하여 독립적인 공간 구조 및 생물학적 활성을 부여하는 단백질 공학 기술이다. 또한 이를 이용하여 높은 중화항체 유도 및 대량생산이 가능한 삼량체의 형태로 항원 단백질의 발현 또한 가능하다. BES(baculovirus expression system)에서의 표면발현 기술은 번역 후 수정과정 및 복잡한 구조의 다양한 단백질의 발현이 가능하기에 다른 숙주 기반 시스템보다 효율적이라고 보고되고 있다. 그러나 목적 단백질 외의 다른 표면 단백질과 발현 공간에서의 경쟁으로 목적 단백질의 낮은 생산량이 큰 문제점으로 지적되고 있다. 따라서, 이러한 BES에서 표면 발현의 생산 효율을 증대시키기 위하여, 동일한 표면 공간에 대한 단백질 간의 발현 경쟁에 대해 실험적으로 확인 후, 그를 해결하기 위하여 표면발현에 최적인 목적 단백질 발현을 위한 프로모터 선발 실험을 수행하였다. 이를 통해 BES에서 표면발현에 의한 목적 단백질의 생산 효율을 증대시킬 수 있음을 확인하였다.

검색어: 배큘로바이러스, 발현계, 표면발현, 목적 단백질

P59

Honey bees in crisis: Investigation of honey bee viruses in South Korea through virome analysis

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South Korea experienced a significant decline in honey bee populations starting in 2021, which continued for two years until the winter of 2022. To investigate the potential causes of this decline, we conducted a virome analysis, considering viruses as possible culprits. Samples were collected during two periods: April-May 2022 and May-June 2023. From libraries contsructed from their total RNA, we secured a total of 25 raw FASTQ files by high-throughput sequencing. In the honey bees collected in 2022, we identified eight previously unreported honey bee viruses including Lake Sinai viruses, one novel honey bee-related virus, and one novel plant-related virus. In the subsequent sampling in 2023, we found that most of the viruses identified in 2022 were still present. Additionally, the novel honey bee virus reported in 2022 was also found in the 2023 collections, along with three more honey bee-related novel viruses. Notably, numerous plant viruses were detected in honey bees collected during the flowering season. This analysis suggests that the viruses observed in South Korean honey bees are likely distributed nationwide. These findings provide fundamental data for future research on honey bee viruses in South Korea.

Key words: Honey bee, Virus, Plant virus, High throughput sequencing, Virome

P60

Development of a rapid isothermal amplification assay using the species-specific sequences of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

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The fall armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae), which is native to tropical and subtropical regions of the Western Hemisphere is now annually arrives in Korea. In this study, we developed loop-mediated isothermal amplification (LAMP) assay, one of the main merits of which is a rapid identification of target species. Five among 11 FAW-specific loci tested successfully provided a consistent reaction when ten FAWs, which were collected from eight localities in four countries were tested, whereas the 13 non-target species were not amplified. To increase in-field applicability of the method all life stages, reaction time, and different periods after death was tested using the quick extracted DNA. Our FAW diagnostic protocol can be completed within 30 min, from the process of extracting genomic DNA from an egg or a 1st instar larva to species determination.

Key words: Fall armyworm, *Spodoptera frugiperda*, Loop-mediated isothermal amplification

P61

Development of LAMP assay for rapid identification of *Spodoptera eridania* and *S. ornithogalli* (Lepidoptera: Noctuidae) using species-specific whole genome sequences

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국내 유입 가능성이 높은 검역 관리해충인 *Spodoptera eridania* 및 *S. ornithogalli*는 전 세계적으로 토마토, 콩 등 여러 종의 작물을 가해하는 광식성 해충이다. 이에 따라 국내 유입 시 해당 작물에 높은 경제적 피해를 입힐 가능성이 있으므로 신속 정확한 진단이 필요한 실정이다. 따라서 본 연구에서는 상기 두 종을 대상으로 현장 활용이 가능한 LAMP 진단법 개발을 수행하였다. 표적종 두 종 및 비표적종 11종(국내 발생 *Spodoptera* 종 및 동일 기주 가해종 등)의 전장유전체 정보를 확보한 후 비교 분석을 통해 각 표적종 별 특이적 영역을 확보한 후 해당 영역을 대상으로 LAMP 프라이머를 제작하였다. DNA 농도 10 ng/μL, 반응시간 40분을 기준으로 LAMP 진단을 수행한 결과, *Spodoptera eridania*는 5개의 LAMP 진단 마커를 개발하였고, *S. ornithogalli*는 3개의 LAMP 진단 마커를 개발하였다.

Key words: *Spodoptera eridania*, *Spodoptera ornithogalli*, LAMP, Whole genome, diagnosis method

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DNA barcoding of the 76 species of family Crambidae (Lepidoptera) in Korea

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The family Crambidae, so called as Grass moths, have been known as a difficult group in identification due to their similar wing patterns among the allied species. Some species are well known as pests to the agricultural and ornamental plants of economic importance. Therefore, this study was carried out to provide the DNA barcode and related information for distinguishing the complex species among Crambidae. In this study, we extracted and analyzed the DNA barcodes from 185 specimens of 76 species in the family Crambidae. Based on the result, one species of the genus *Schoenobius, Pagyda, Neoanalthes, Palpita, Ecpyrrhorrhoe* and *Paratalanta* area reported for the first time from Korea.

Key words: Lepidoptera, Crambidae, DNA barcode, identification

P65

Mapping the distribution of invasive forest pest in K-SDM

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금번 연구를 통해 외래산림해충 확산 분석 플랫폼 K-SDM (K-SDM)의 해충 분포 기능이 개발되었다. 해충 분포를 보여주는 기능은2가지로 구현되며, 조사 자료를 바탕으로 현재 국내의 해충 분포를 나타내는 "외래산림해충분포"기능과 데이터를 분석하여 예측되는 미래의 해충 분포를 제공하는 "외래산림해충예측"기능이 있다. "외래산림해충분포"는 조사자에 의해 현장에서 구축된 DB 현황을 지도상에 수치로 나타내며, 입력 기간, 해충 종 별로 구분이 가능하여 원하는 해충종의 분포를 선택하여 볼 수 있다. 지도 좌측에는 각 도별로 조사된 해충 개체수의 통계를 도표로 제공하여 수치상으로도 해충 분포를 파악할 수 있다. "외래산림해충예측"은 DB를 분석하고 미래 기후 시나리오를 적용하여 도출한 미래의 해충 예측 분포도를 사용자에게 제공되며, 미리보기 이미지와 함께 원본자료가 첨부되어 좀 더 자세한 정보를 열람할 수 있다. 본 플랫폼의 해충 분포 기능은 최근 기후변화 등으로 외래산림해충의 발생이 증가하는 추세에 맞춰 이들의 현재 분포와 미래의 분포양상을 조기 파악하여 이를 통한 추후 조기 방제 및 대응책 마련 등에 크게 기여할 것으로 기대된다.

검색어: 외래산림해충, 예측분포, 조기예찰, K-SDM

P66

Historical review of the subfamily Hypenodinae (Lepidoptera, Erebidae) with allied taxa from Korea

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The subfamilies Hypenodinae and Boletobiinae has various size with wingspan 5.5-28mm, belonging to the family Erebidae. They are mainly distributed the Palaearctic region, including temperate zone. Host plants of them are known as fungi and lichen etc. Some larvae live with lichen on their bodies. The subfamily belongs to subfamily is the Noctuoidea, containing more than 42,500 species. Accordingly, a unified high-level classification system could not be established due to the different opinions among the researchers and perspectives on the characteristics of each taxon. Recently, Zahiri et al. (2011, 2012) established the taxonomy of the family Erebidae, based on the molecular phylogenetic study. As we know, there has been a lot of confusion regarding the taxonomic positions of subfamily with allied taxa according to the complicated upper taxonomic system. Thus, this study is aimed to review and discuss the taxonomic history of the groups in this study.

Key words: Lepidoptera: Erebidae, Hypenodinae, Boletobiinae, Korea

P67

A new species of *Macromyzus* Takahashi (Hemiptera: Aphididae) from Laos

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The aphid genus *Macromyzus* Takahashi is a small East-Asia genus of the tribe Macrosiphini (Hemiptera: Aphidinae). Globally, there are five recognized species: *Macromyzus* (*Anthracosiphoniella*) *maculatus* (Basu), *Macromyzus* (*Macromyzus*) *indicus* David & Narayanan, *M.* (*M.*) *manoji* Raha & Raychaudhuri, *M.* (*M.*) *spinosus* Su & Qiao, and *M.* (*M.*) woodwardiae (Takahashi). In this study, we report the first record of the aphid genus *Macromyzus* Takahashi in Laos. We present a decription of a new species of this genus associated with *Diplazium esculentum* (Retz.) Sw. (Athyriaceae). Additionally, for the first time, we conducted scanning electron microscopy research on the morphology and sensilla of representative of this genus.

Key words: Aphids, fern, new taxa, SEM

P68

New distribution of reticulitermes speratus speratus (Blattodea: Rhinotermitidae) in Korea

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Reticulitermes speratus (Kolbe) is economically important pest in East Asia including Korea, Japan and China where they infest wooden structures in urban areas. In this study, we report the first record of *R. speratus speratus* from Korea, which was verified using soldier morphology and molecular characteristics obtained from a mitochondrial gene. *R. speratus speratus* Kolbe, 1885 (Blattodea: Rhinotermitidae) are found in several provinces, mainly southern regions in Korea, whereas *R. speratus kyushuensis* are distributed throughout the country. Our morphological comparison showed that *R. speratus speratus* can be distinguishable from *R. speratus kyushuensis* by the ratio of the posterior postmentum width to length. In the molecular comparison, *R. speratus speratus* revealed genetic differences of 3.06% (range 2.60–4.10%) from *R. speratus kyushuensis* using *cytochrome oxidase subunit II* gene sequences.

Key words: subterranean termite, Reticulitermes, species distribution, COII, Korea

P69

Discovery of *Thaumaglossa rufocapillata* Redtenbacher (Coleoptera: Dermestidae) from Mantis oothecae in Korea, with report of complete mitochondrial genome

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The insect industry in Korea is currently undergoing steady expansion. Among the various insects kept as pets or for educational purposes, four mantis species, including *Hierodula patellifera* (Audinet-Serville), *Tenodera sinensis* Saussure, *Tenodera angustipennis* Saussure, and *Statilia maculata* (Thunberg), are becoming increasingly popular, leading to higher demand. As we aimed to raise mantises, we collected oothecae, some of which were found to be parasitized by dermestid beetles. These parasitoids have been unequivocally identified as *Thaumaglossa rufocapillata* Redtenbacher based on morphological characters. A diagnosis, habitus photographs, and illustrations of diagnostic characters are provided to facilitate identification. We also present the complete mitochondrial genome sequence of *T. rufocapillata* for providing fundamental data for research aimed at controlling pests in the insect industry.

Key words: Dermestidae, Mantis, oothecae, taxonomic information, mitochondrial genome

P70

Updated checklist of genus *Apolygus* (Heteroptera: Mirinae) in Korea

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Apolygus is one of speciose genus in subfamily Mirinae, including more than 80 species worldwide. Most of *Apolygus* species are phytophagous, and some species are regard as severe crop pest. For that, precise diagnosis and classification for this genus is crucial. In this work, we provide checklist of Korean *Apolygus* species with a new species and new distributional records. Diagnostic characters of the new species are discussed with the illustrations of adult male, female specimen and genitalic structures. A key to the Korean *Apolygus* is also presented.

Key words: Hemiptera, Miridae, Mirinae, *Apolygus*, new species, new record

*This work was supproted by NIBR grant (NIBR202304203)

P71

First record of the genus *Daiconotrechus* (Coleoptera: Carabidae) in Korea

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The genus *Daiconotrechus* Ueno, 1971 is endemic genus of Japan with two subgenera, *Daiconotrechus* Ueno, 1971 and *Tsuiblemus* Ueno, 2007. Adults of all species in this genus are eyeless with depigmented and elongated body. These morphological features are typical characters of adaptation to subterranean environments. Distribution of all species of the subgenus *Tsuiblemus* is restricts to Tsushima Island, Japan. In this study, we report the genus *Daiconotrechus* for the first time in Korea, with a new species in the subgenus *Tsuiblemus*. Illustrations of morphological characters and habitus are also provided.

Key words: Carabidae, Trechinae, new record, taxonomy

P72

A taxonomic study of the genus *Leptogaster* (Dipetra: Asilidae) in Korea

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The family Asilidae(robber flies) is one of the representative predatory flies that hunts a variety of insects during the larval and adult stages. There are more than 7,500 known species distributed around the world, and 74 species in 30 genera are recorded in Korea. There are about 270 species of the genus *Leptogaster* recorded worldwide, and three species (*L. augusta, L. basilaris, L. dorsopicta*) are recorded in Korea. Through this study, three unrecorded species (*L. abdominalis, L. furculata, L. spadix*) were identified, and a total of six species were confirmed to be distributed in Korea. We would like to provide general information of the genus *Leptogaster*, a list of currently distributed species in Korea, photos, diagnostic traits, and so on.

Key words: Asilidae, *Leptogaster augusta, L. basilaris, L. dorsopicta, L. abdominalis, L. furculata, L. spadix,* unrecorded species, Korea

P73

Preliminary study on four similar species with oriental fruit fly (Diptera: Tephritidae)

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오리엔탈과실파리(*Bactrocera dorsalis*)는 형태학적, 생태학적으로 습성이 유사한 70여종을 포함하여 *Bactrocera dorsalis* species complex (오리엔탈과실파리종군)에 포함되어 있다. 이 종은 동남아시아와 태평양 일대에 널리 분포하며 기주범위가 넓은 다식성 해충으로 가장 많이 연구된 분류군 중 하나이다. 이 종은 여러 나라에서 검역병해충으로 지정되어 있으며, 우리나라에서는 유입될 경우 감귤류 및 여러 농작물에 심각한 피해를 줄 수 있어 금지병해충으로 지정하여 관리하고 있는 종이다. 우리는 이 종과 가장 유사한 4종(*B. carambolae, B. correcta, B. latifrons, B. verbascifoliae*)과 비교하여 형태학적 연구를 수행하였다. 본 연구에서는 각 종별 특징 및 진단형질을 제공하고, 도판을 이용하여 형태적 차이를 제시하였다.

검색어: Bactrocera dorsalis species complex, B. dorsalis, B. carambolae, B. correcta, B. latifrons, B. verbascifoliae, 진단형질

P74

A new species of the genus *Asobara* Foerester (Hymenoptera: Braconidae: Alysiinae) from South Korea

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In the genus *Asobara* Foester, 1863 (Braconidae: Alysiinae), two new species, *Asobara rotundata* sp. nov. is described and illustrated. In addition, the DNA barcode region of the mitochondrial *cytochrome c oxidase subunit I* (*COI*) were sequenced for the species. An identification key for the *Asobara* species officially recorded from Korea is provided.

Key words: Hymenoptera, new combination, new species, parasitoid wasp, taxonomy

P75

Description of a new species of the genus *Eudarcia* (Lepidoptera, Meessiidae) from Korea

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The genus *Eudarcia* belong to the subfamily Meessiinae was established by Clemens (1860), based on type species *Eudarcia simulatricella* Clemens, 1860. The genus is comprising 82 species in the world, which are wide spread and diverse throughout the Palaearctic region. Among them, nine species of *Eudarcia* are distributed in East Asia. In Korea four species of the genus *Eudarcia* have been reported to date. In the past, the subfamily Meessiinae was treated within the family Tineidae. Regier (2015) revised the addition of two families (Meessiidae, Dryadaulidae) to the superfamily Tineoidea through molecular analysis. In this study we described *Eudarcia* sp. as a new species, with illustration of adults and male genitalia.

Key words: Lepidoptera, Meessiidae, *Eudarcia*, new species

P76

Polyphagy in the genus *Paraclemensia* (Lepidoptera: Incurvariidae) with morphological and molecular variation

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Palaclemensia is a genus within the family Incurvariidae, and it has been reported to be a monophagous or narrow oligophagous genus, like other incurvariids, except for two polyphagous species, *Paraclemensia incerta* and *P. acerifoliella*. *Paraclemensia incerta* is one of the common species in Japan and Korea, and seven host plant families are recognized. However, these host records aren't based on DNA analysis or detailed morphological comparison. Therefore, it was hypothesized that there is genetic differentiation among host races in *P. incerta*. To investigate this hypothesis, DNA analysis and morphological comparison were performed on *Paraclemensia* species collected from Japan. As a result, genetic divergence among populations feeding different host plants was not confirmed. Moreover, not only *P. incerta* but also *P. caerulea* were suggested to be polyphagous. In contrast, geographic genetic divergence in *P. incerta* and *P. caerulea* was observed in Japan. Additionally, it is suggested that *P. viridis*, *P. oligospina*, and *P. cyanea*, despite external morphological differences, could be the same species.

Key words: host range, morphology, phylogeny, synonym, taxonomy

P77

Comparison of corn and rice feeding of the corn strain *Spodoptera frugiperda* for continued generations

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The fall armyworm (FAW), *Spodoptera frugiperda*, is an invasive pest species in Africa and Asia, which is native to the Western hemisphere. Invaded FAW was corn feeding strain. We study the developmental and biology of the corn strain FAW on the rice plants compare the result with corn feeding up to F2- generation. The development periods of F0, F1 and F2 generations of the rice-fed colony were 21.7%, 18.3% and 18.9% longer than corn-fed colony. The rice-fed colony was significantly lower in the body weight of larvae and pupae, and pre-adult survival rate and the fecundity than corn-fed colony. Our results showed that the corn strain FAW can survive and complete its life cycle by feeding rice plants up to several generations under laboratory condition, but their development and fecundity were reduced in comparison to the corn feeding colony. However, this study suggests potential impact of invaded FAW to the infestation of rice fields in Asian countries.

Key words: *Spodopter frugiperda*, FAW, Corn strain, Rice host, Life-table

P78

Categorization of the *Apis mellifera* gut microbiota at four essential developmental stages under natural conditions

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Honeybees are pollinating agent of economic importance, and a model organism for microbiome analysis. The microbiota plays a great role in honeybee health and development as such needs to be fully elucidated among *Apis mellifera* in Korea. using 16S rRNA gene illumina sequencing, the gut microbiota of *Apis mellifera* at four developmental stages under natural condition shows dysbiosis of essential microbiota, especially between the 5-days larvae and workers.

Key words: Honeybee, *Apis mellifera*, Microbiome, Age, *Lactobacillus*

This work was carried out with the support of Cooperative Research Program for Agriculture Science & Technology Development (Project No. RS-2023-00232749) and the Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2020R1A6A1A03041954).

P79

Intestinal *Enterococcus* population affects *Galleria mellonella* metamorphosis

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Microbes in insect gut significantly influence host physiology. While Lepidoptera is a diverse insect order, the relationship between microbial symbiosis and host development remains elusive, especially concerning role of gut-colonizing bacteria in metamorphosis. We investigated the gut microbial diversity in *Galleria mellonella* throughout its life cycle using 16S rRNA amplicon sequencing. Our findings revealed a predominance of *Enterococcus* spp. in larvae and *Enterobacter* spp. in pupae. Remarkably, removing *Enterococcus* spp. hastened the larval-to-pupal transition. Transcriptome analysis showed an upregulation of immune response genes in pupae and hormone genes in larvae. Notably, the production of antimicrobial peptides in the host gut varied with developmental stages. Some of these peptides suppressed the growth of *Enterococcus innesii*, a dominant gut bacterium in *G. mellonella* larvae. This research underscores the pivotal role of gut microbiota shifts in metamorphosis, driven by the secretion of antimicrobial peptides in the *G. mellonella* digestive system.

Key words: *Galleria mellonella*, *Enterococcus*, *Enterobacter*, Metamorphosis, Gut microbiome

P80

Effective soil population control of root-knot nematode using *Beauveria bassiana* JEF-503 with environmental safety

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Root-knot nematode (RKN), *Meloidogyne incognita*, inflicts significant greenhouse crop damage, causing over 40% economic losses. While chemical agents effectively control RKN, they leave harmful residue in soil and crops. To address this issue, we investigated soil-derived entomopathogenic fungi (EPF) in this study. We assessed the nematicidal impact of ten EPF species through *in vivo* and *in vitro* tests. *Beauveria bassiana* JEF-503 exhibited nematicidal effectiveness exceeding 65% in both experimental settings. In a semi-field test using greenhouse pots, we experimented with the application of *B. bassiana* JEF-503 suspension during tomato growth, which is an uncommon practice in comparison to chemical treatments due to residue concerns. *B. bassiana* JEF-503 was applied during transplantation, and the same application was repeated four weeks later. JEF-503 One-time and abamectin treatments were used as control groups. The JEF-503 two-time application notably reduced root damage compared to single JEF-503 or abamectin treatment. In conclusion, JEF-503 offers a promising, residue-free, and environmentally friendly alternative to chemical agents for RKN management.

Key words: Root-knot nematodes, Entomopathogenic fungi, *Beauveria bassiana*, Environmantal safety

P81

Technology for using *Ocimum basilicum* as *Orius laevigatus* banker plant (Fiber)(Hemiptera: Anthocoridae) in cucumber greenhouse

Yong-Seok Choi, Gun-Woo Lee, GyeongJu Lee and Han-Jung Na
Chungnam Agricultural Research & Extension Services

The cucumber flower does't seem to be supplying enough nectar and pollen to the natural enemies. Among the natural enemies that can be used in the cucumber greenhouse, especially *Orius laevigatus* may require flower nectar and pollen for settlement and reproduction. In our previous study, we selected basil as a natural enemy banker plant. Using this, the effect of thrips control in cucumber greenhouse was examined. The major pests of cucumber in 2023 were Aphis gossypii, Frankliniella occidentalis, Thrips palmi and Trialeurodes vaporariorum. A. gossypii occurred most frequently, and the next occurred pests were F. occidentalis and T. palmi. The densities of O. laevigatus remained stable on basil banker plants. After releasing O. laevigatus and adding the basil banker plants, the densities of T. palmi were kept low at less than 3 per leaf, and the densities of F. occidentalis were kept low at less than 10 per 3 flowers but increased slightly since late May. As a result, the density of thrips during cucumber cultivation was effectively suppressed after the use of natural enemies.

Key words: Cucumber, *Orius laevigatus*, *Ocimum basilicum*, Banker plant, Biological control

P82

Effect of temperature and humidity on the divelopment of Feltiella acarisuga (Diptera: Cecidomyiidae)

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Feltiella acarisuga(Vallot) is a common gall midge that feeds on many species of spider mites. The effect of temperature and humidity on the development of *F. acarisuga* female were determined using eggs of the twos potted spider mite, *Tetranychus urticae*(Koch), as prey under laboratory condition (27.9±0.5°C, 90% RH, and 14:10 [L:D] h). *F. acarisuga* female laid the most eggs on the 5th day after mating, and the acumulative fecundity reached it speak on the 13th day. The sex ratio of *F. acarisuga* was 6:4, male to female. The average number of eggs per day during life was 2.7 but during the egg-laying period was 3.1. The female's lifespan was about 3.5 days longer than that of the male in the adult stage but 6.2 days longer including the egg and larval period. The temperature did not affect the female survival and fecundity, but as humidity was lowered, the female's survival period washortened and fecundity decreased. When using *F. acarisuga* as natural enemies, the optimal temperature rage was 20 to 30°C and the relative humidity was 80 to 95%.

P83

Comparative transcriptome analysis of chemosensory genes in the male and female adults of *Maruca vitrata*

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In moths, mating behavior is induced by sex pheromones released by the female being recognized by the males's chemosensory systems. In this study, to understand the recognition of sex pheromones in *Maruca vitrata*, chemosensory genes were identified via transcriptome analysis of male and female antennae and heads. Approximately, 11.1Gb, 10.8Gb, 12.1Gb, and 11.6Gb of data were obtained from the antennae and heads of the male and female, respectively. Thirty-seven odorant binding proteins (OBPs), 21 chemosensory proteins, 7 sensory neuron membrane proteins, 102 odorant receptors (ORs), 36 ionotropic receptors, and 39 gustatory Receptors were identified as chemosensory genes from the *M. vitrata*. Among these genes, 5 OBPs and 4 ORs were specifically expressed in male antennae. These genes are likely to be involved in the sex pheromone recognition of *M. vitrata*.

Key words: chemosensory gene, sex pheromone, transcriptome, real-time PCR, *Maruca vitrata*

P84

Identification of attractants after injection of pheromone biosynthesis activating neuropeptide in female adults of *Bemisia tabaci*

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Bemisia tabaci is a polyphagous pest that transmits various viruses, including tomato yellow leaf curl virus (TYLCV) while feeding on crops. Prior to identifying attractants of *B. tabaci*, the pheromone biosynthesis activating neuropeptide (PBAN) sequence was obtained via transcriptome analysis of female adults. After injecting artificially synthesized PBAN into the female adults, the compounds contained in the female adults were extracted using hexane, and gas chromatography-mass spectrometry (GC-MS) was performed. As a result, 22 compounds showed quantitative differences after PBAN injection. Among them, it was confirmed that *B. tabaci* is attracted to 2-ethylhexanoic acid and phytol. These results suggest that 2-ethylhexanoic acid and phytol can be used as attractants for the control of *B. tabaci*.

Key words: attractants, pheromone biosynthesis activating neuropeptide, GC-MS, *Bemisia tabaci*

P85

The molluscicidal effect of dried powder and ethanol extracts of Styrax japonicus fruit against golden apple snail

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Golden apple snails(GAS) are native to warm regions such as Central and South America and Southeast Asia, and were first introduced as a high-protein food. GAS are omnivorous and have a habit of eating plants submerged in water, so they have been used for eco-friendly weed control in rice fields since 1992. When the GAS was first introduced, it was thought that it would be impossible to overwinter in Korea. However after 2000, overwintering individuals were founded and damage to rice occurred and the development of means to control GAS has been required. In this study, we tested the effectiveness of an eco-friendly pest control agent using *Styrax japonicus* that grow naturally in Korea. As a result of exposing GAS to *S. japonicus* fruit powder, a 100% molluscicidal effect was confirmed at 66.7ppm. To investigate the duration of effect, treatment was performed at the same concentration and molluscicidal effect of more than 90% was up to 3 days after treatment. The killing effect of each part of the *S. japonicus* was compared, and the seed extracts showed no killing effect at all concentrations, while the sarcocarp extracts showed a 100% killing effect up to 33.3ppm, and the fruit extracts showed a 100% killing effect up to 200ppm.

Key words: Golden apple snail, Styrax japonicus, eco-friendly control, plant extract

P86

Investigation of phosphine resistance of stored-product insects of collection by rice processing complex (RPC) in Korea, 2023

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Phosphine 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 resistance pests. In this study, phosphine resistance pests collected at RPC in 2023 was investigated with FAO No. 16 test, Dihydrolipomaide dehydrogenase(DLD) test and amino acid mutation analysis to identify the occurrence of phosphine resistance in Korea. Tested pests were collected in the 7 province 35 region. As a result of the FAO test of 21 regions, all sample were phosphine sensitives. In DLD test and amino acid analysis, 7 region samples were weak resistances. It is required to inspect the RPC and other grain storage continuously to inhibit the widespread of resistant pest.

Key words: Phosphine, Resistance, Rice processing complex, Fumigant

P87

Phytotoxicity of phosphine, ethyl formate, phosphine + ethyl formate and combined treatment with low-temperature on sweet peppers

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Animal and Plant Quarantine Agency

Sweet pepper(paprika) belongs to the genus Capsicum, and is one of the most important export product from Korea to Japan and Southeast Asia. So it is important to eradicate plant quarantine pests before export sweet pepper. Aphids, whiteflies and mites are major pests that can damage to sweet peppers. Fumigation is normally used to eradicate pests in plant quarantine, but phytotoxicity may can be appeared that affect the quality of the product. Low-temperature treatment, one of the most popular physical treatment, can reduce crop damage to preserve product quality, but it takes long time to kill pests, which can cause quality degradation. In this study, phytotoxicity of fumigants, phosphine(PH3), ethyl formate(EF) and PH3+EF on sweet peppers was investigated to use as basic data for physicochemical treatment. When treated with more than 35 mg/L of EF, phytotoxicity was occurred, and was not occurred with PH3. When low-temperature of 1.7 degrees treated for 15 days after fumigation, it seems to be no direct damage from low-temperature treatment. But quality of top of sweet pepper was decreased from 7 days after fumigation.

Key words: sweet pepper, ethyl formate, phosphine, low-temperature treatment

P88

Investigation of preference of *Drosophila suzukii* to table grape varieties and effect of low temperature treatment on *D. suzukii* eggs

Jinsung Yoo, Bong-su Kim and Kwang-Ok Moon
Animal and Plant Quarantine Agency

Drosophila suzukii (Diptera, Drosophilidae) can damage thin-skinned fruits (plums, cherries, peaches, blueberries, and strawberries) by laying eggs inside the fruit. In this study, a basic experiment was conducted to investigate the preference of *D. suzukii* to export table grape varieties. Four varieties of grapes (Kyoho grape, Shine muscat, Campbell grape, and Black sapphire) were placed in a cage containing more than 2,500 number of *D. suzukii* adults for 6, 8, 10, 12, and 24 hours and the egg-laying in grape has been induced. After 2 weeks, the number of pupae that emerged was counted. As a result, the largest number of pupae was generated in Kyoho grape among the four types of grapes, indicating that *D. suzukii* prefers to lay egg in Kyoho grape. Through this experiment, it was determined that 6 h was the appropriate inoculation time, and then an inoculation experiment was conducted on Kyoho grape. The total weight of the Kyoho grape used in the experiment was 36.119 kg, and a total of 2594 pupae were generated. The average number of *D. suzukii* per cluster was about 50. All stages of *D. suzukii* treated with low temperature(1℃) for 10 days were completely controlled.

Key words: *Drosophila suzukii*, Grapes, Pupa, Low temperature treatment

P89

A method of trunk injection for pest control in landscapes and urban forestry

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생활권 수목이란 주민들이 생활하는 지역에 식재된 수목으로, 가로수, 학교수목, 아파트 수목 등 종류가 다양하며 도시경관과 생활환경 개선의 이점을 제공한다. 그러므로 생활권 수목의 유지와 관리에 있어서도 인근 주민에 혐오감이나 피해가 없도록 방제를 수행하는 것이 매우 중요하다. 일반적인 경엽살포의 경우, 약액 비산에 의해 주민들의 활동 제한, 안전사고 및 재산상 피해가 발생할 수 있으므로 사용이 제한적이다. 이러한 문제를 해결하기 위해, 나무에 약제를 직접 주입하는 나무주사(trunk injection)가 보편적인 생활권 수목 방제법으로 주목받고 있으며, 이는 주입물질의 손실이 없고, 외부환경에 크게 영향 받지 않는다는 장점이 있다. 하지만 생활권 수목 전반에 대한 나무주사 처리방법이 명확하지 않아 약효가 일부 가지에서만 나타나는 등 사후 검증 및 관리가 미흡한 실정이다. 본 연구는 생활권 수목 병해충 방제 나무주사 제품의 효과제고를 위한 기존 처리방법 개선 및 최적의 약제처리 방법을 검증하였다. 느티나무외줄면충(*Colopha moriokaensis*)을 대상으로 시험을 진행하였으며, Acetamiprid을 시험약제로 사용하였다. 느티나무에 대하여 약제처리 위치, 주입량, 천공수, 주사시기에 따른 약효 및 약해를 확인하였으며, 이를 바탕으로 최적의 약제처리 방법을 제시하였다.

검색어: 생활권 수목, 나무주사, 느티나무, 느티나무외줄면충, 약효, 약해

P90

Origin of Korean brown planthopper (*Nilaparvata lugens*) populations (Hemiptera: Delphasidae)

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매년 국내로 비래해 오는 해충인 벼멸구는 그 기원이 중국 또는 중국 남부일 것으로 예상해왔으나, 이에 대한 유전학적 근거는 Mun et al. (1999)에 의해 제시된 세 가지 COI haplotype 비교가 유일하다. Mun et al. (1999)은 국내에서 확인된 두 가지 haplotype 유형이 인도차이나반도 이남의 균일한 한 가지 haplotype 집단 유형과 중국에서 확인된 또 다른 haplotype 집단 유형임을 근거로 국내 벼멸구의 기원을 중국으로 특정한 바 있다. 본 연구는 국내 및 동남아시아 5개국(부탄, 미얀마, 캄보디아, 라오스 및 태국)으로부터 직간접적으로 확보한 개체들을 대상으로 GBS (genotyping by sequencing) 및 NGS 기법을 통해 PCA를 포함한 다양한 집단유전학적 분석을 수행하였다. 그 결과 인도차이나반도의 벼멸구 집단은 크게 북부와 남부로 나뉘며, 국내 개체들은 북부에 비해 남부(캄보디아, 태국)에 더 가깝다는 사실을 확인하였다. 따라서 벼멸구의 국내 비래는 중국으로부터의 기원 이전에 장마전선이 형성될 무렵부터 인도차이나반도 남쪽의 고온다습한 서풍이 남남서풍으로 바뀌면서 중국 내륙을 거쳐 국내로 비래하는 경로를 따르는 것으로 보인다. 하지만 태안의 개체 중에는 인도차이나반도 집단들의 외군으로 확인되는 개체가 있었고, 이는 인도차이나반도 외의 샘플링되지 않은 다른 지역에서도 벼멸구가 국내로 비래할 수 있다는 가능성을 제시하였다. 따라서 국내로 유입되는 벼멸구의 유전적 기원을 확인하기 위해서는 인도차이나반도 남쪽 지역에서 시작한 동아시아 여름 몬순의 바람이 한국으로 도착하는 경로에 위치한 다른 지역에서의 추가적인 샘플링 및 지속적인 관심과 추적이 필요할 것이다.

검색어: 벼멸구, GBS, 집단유전학, 인도차이나반도, 비래경로

P91

Not Presented

P92

Olfactory responses of three *Spodoptera* Moth species to host and non-host plant volatiles

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담배거세미나방(*Spodoptera litura*), 열대거세미나방(*Spodoptera frugiperda*) 및 파밤나방(*Spodoptera exigua*)은 광식성 해충이지만, 종특이적인 기주범위를 갖는다. 이들이 기주식물을 찾아가는 과정에 냄새감각이 어떤 역할을 하는지 알아보기 위해, 기주 및 비기주 식물에서 발산되는 46가지 휘발성 물질을 선정하여, 이들에 대한 나방 3종의 냄새반응을 GC-EAD(gas chromatography-electroantennogram detection)를 통해 확인하였다. 그 결과, 46가지의 식물유래화합물 중 9가지 물질이 3종의 나방 모두에서 냄새활성을 나타냈으며, 2가지 물질은 담배거세미나방과 열대거세미나방에만 냄새활성을 나타냈고, 다른 몇 가지 물질은 담배거세미나방에만 냄새활성을 나타냈다. 이 결과는 세 종 나방이 식물냄새물질 탐지를 위해 유사한 냄새감각세포를 가지며, 일부 종에서는 종특이적인 냄새감각세포가 존재한다는 것을 보여준다. 이 결과를 바탕으로 냄새활성을 나타낸 물질들의 나방 3종에 대한 행동활성을 야외트랩실험을 통해 확인할 예정이다.

검색어: 담배거세미나방, 열대거세미나방, 파밤나방, 식물유래화합물, 냄새감각세포, 냄새활성, GC-EAD

P93

Predicting distribution changes of *Argynnis nerippe* using ensemble model

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본 연구는 남한 지역에서 서식하는 멸종 위기 종 2급인 왕은점표범나비의 기후 변화에 따른 서식지 변화를 분석하고자 한다. 이를 위해 단일모델의 장단점을 보완하기 위해서 생물 보전과 동물 생태학 분야에서 널리 사용되는 앙상블 모델을 활용하여 기후변화 시나리오 자료를 이용하여 현재와 미래 기후 조건에서의 잠재적 서식지 변화를 평가하였다. 연구 결과에 따르면, 미래에는 왕은점표범나비의 서식지가 줄어들 것으로 예상되며, 이 변화는 기온과 강수량 모두에 영향을 받을 것으로 나타났다. 특히 강수량의 계절적 변동이 가장 큰 영향을 미칠 것으로 분석되었다. 이러한 결과는 기후 변화로 인한 생물종의 서식 분포의 이해를 향상시켜 멸종 위기 종 관리와 생태계 복원과 같은 다양한 분야에서 생물다양성 증진을 위한 중요한 기초 데이터로 활용될 것으로 기대된다.

검색어: Ensemble Model, 기후변화, 왕은점표범나비, 서식분포변화

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Predicting changes in the distribution of *Parnassius bremeri* according to climate change using MaxEnt model

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기후변화에 따른 서식지 감소는 생물다양성의 커다란 위협 요소 중 하나이고 생물종이 서식하는 공간적 분포에 대한 이해는 멸종위기종 관리, 생태계 복원 등 다양한 분야에서 매우 중요하다. 본 연구는 남한지역에서 서식하는 멸종위기종 I급으로 지정된 붉은점모시나비를 대상으로 기후변화에 따른 서식분포변화를 분석하고자 한다. 이를 위해서 최근 보전생물학, 동물생태학 등 다양한 분야에서 널리 활용되는 MaxEnt 모델을 현재시기와 미래시기의 생물기후변수에 적용하여 잠재적 서식지 분포 변화를 평가하였다. 붉은점모시나비는 미래시기에 서식지가 감소하는 경향으로 예측되었고, 기온보다 강수량에 의한 영향이 크고, 특히 강수량 계절성에 영향이 가장 클 것으로 분석되었다. 분석결과는 국내 생물다양성 증진에 필요한 기초자료로서 활용할 수 있을 것으로 기대된다.

검색어: MaxEnt, 기후변화, 붉은점모시나비, 서식분포변화

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Predicting distribution changes of *Cigaritis takanonis* due to climate change

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기후 변화로 인한 서식지 감소는 생물다양성에 대한 중대한 위협 요인 중 하나이다. 생물종의 공간 분포를 이해하는 것은 보호지역에서 멸종 위기 종 관리와 생태계 복원과 같은 다양한 분야에서 매우 중요하다. 본 연구는 남한지역에 서식하는 멸종 위기 종 II급인 쌍꼬리부전나비의 기후 변화에 대한 서식지 분포 변화를 분석하는 것을 목표로 한다. 이를 위해 보전 생물학, 동물 생태학 등 다양한 분야에서 널리 사용되는 MaxEnt 모델을 현재와 미래 기후 조건에 적용하여 잠재적 서식지 분포 변화를 평가하였다. 연구 결과, 미래에 쌍꼬리부전나비의 서식지가 증가할 것으로 예측되며, 기온과 강수량 모두에 영향이 있을 것으로 나타났다. 특히 더운 시기의 평균기온의 영향이 가장 클 것으로 분석되었다. 이러한 결과는 국내 생물다양성 보전을 강화하기 위한 중요한 기초 데이터로 활용될 것으로 기대된다.

검색어: MaxEnt, 기후변화, 쌍꼬리부전나비, 서식분포변화

P96

The effect of overwintering on the larval growth of *Callipogon relictus*

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Callipogon relictus, a natural monument, is an insect whose life cycle was assumed to take more than 5 years in nature. Winter is a very harsh season, but it is known to be a crucial condition for many insects' growth. However, no information is known about the overwintering condition and its effects on *C. relictus*. To understand the overwintering effects on the growth of *C. relictus*, we investigated the growth patterns of its larvae in indoor conditions after chilling treatment. The larvae were induced to dormancy at low temperature (4°C) for two months, and put them into 10°C for two weeks to break dormancy. After awakening, the temperature was increased 15°C, 20°C to 25°C at a time, and the larvae were kept for two weeks at each temperature. The larvae were divided into 3 groups (3rd to 5th instar, 6th to 8th instar, 9th to last instar). Lastly, head width and weight of the larvae were measured every 30 days under 25°C condition, and mortality and deformity were counted as well. The mortality and deformity rates were the highest in the first group, and the rates decreased toward the last group. On the other hands, growth rate appeared opposite to mortality and deformity rate of each larval group.

Key words: Hibernation, Ecological research, *Callipogon relictus*, larval growth

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Seasonal occurrence of *Synanthedon bicingulata* (Lepidoptera: Sesiidae) associated with cherry tree species in sphere of living in Jeollanam-do

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벚나무류 수목은 생활권 수목(도시공원, 가로수 등)으로 전국에서 가장 많이 식재되고 있으며 전라남도 또한 벚나무류 수목이 가로수 중 가장 많은 비율을 차지하고 있다. 복숭아유리나방은 농업환경 외에도 생활권 녹지공간에서도 벚나무류 수목을 가해하여 피해를 발생시키고 있는 것으로 보고되고 있으나, 생활권 수목과 산림에서의 관련 연구는 그 필요성에 비해 미흡한 상황이다. 본 연구는 전라남도 내 생활권 수목을 기주로 하여 발생하는 복숭아유리나방의 발생소장을 조사하여 생활권 녹지공간을 관리하는 기초자치단체들의 효용성 있는 방제 전략 수립에 기여하고자 한다. 복숭아유리나방의 발생 확인을 위해 육안 확인이 용이한 피해흔을 세 가지로 분류하였으며, 성페로몬 루어와 트랩으로 복숭아유리나방 성체를 유인·채집하였다. 그 결과, 4월 중순 첫 우화를 확인하였으며, 5월 중순과 8월 중순에 2번의 우화 최성기를 확인하여 이때의 유효적산온도를 조사하였다. 또한, 채집된 개체들의 종 확인 및 유전적 다양성 확인을 위해 mitochondrial 내 cytochrome oxidase subunit I (*COI*) 유전자 염기 서열의 분석을 수행하였다.

검색어: 복숭아유리나방, 벚나무, 발생소장, 생활권 수목, mitochondrial DNA

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The possibility of virus transmission from viruliferous *Rhizoglyphus robini*

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뿌리응애류는 양파, 마늘, 생강, 백합 등의 뿌리를 가해한다. 최근 백합재배지에서는 질경이모자이크바이러스(Plantago asiatica mosaic virus, PLAMV)에 의한 잎의 괴사 피해가 확산되고 있다. 태안 백합재배지에서 PlAMV가 감염된 백합을 채집하여 구근을 조사한 결과, 식물체 당 뿌리응애 100개체 이상이 발견되었으며 *Rhizoglyphus robini*로 동정되었다. 이 종이 PlAMV의 보독여부를 확인하기 위해 채집된 *R. robini*에서 RNA를 추출하여 RT-PCR로 진단한 결과, 모든 개체에서 PlAMV가 확인되었다. 본 연구는 뿌리응애가 백합 구근 뿌리를 먹으면서 만든 상처를 통해 PlAMV가 전염될 수 있다는 가능성을 제시한다.

검색어: 뿌리응애, potexvirus, PLAMV, 매개

P99

Parasitism and haplotype survey of *Anastatus orientalis* (Hymenoptera: Eupelmidae), released for biological control of spotted lanternfly by RDA

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Parasitic rate of *A. orientalis* was calculated and compared with parasitic rate five years ago, immediately after release, and parasitic rate was also compared according to the distance away from the release point. In addition, haplotype of *A. orientalis* was confirmed and the association with life cycle characteristics was decided. The survey was conducted in 2022 and 2023. The parasitic rate of release point in Buyeo increased significantly from 3.6% in 18 years to 91.21% in 22. And the parasitic rate by distance from release point is 91.21% (200m), 44.46% (12km), and 65.75% (46km). At all points of survey, only haplotype C and D were found, and there was no significant difference between haplotype C and D in the parasitic rate and sex ratio.

Key words: egg parasitoid, parasitic rate, haplotype

P100

Occurrence pattern of Metcalfa pruinosa (Say)(Hemiptera: Flatidae) in Chugcheongnam-do

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미국선녀벌레(*Metcalfa pruinosa*)는 2009년 최초 보고된 외래해충으로 지속적으로 발생 밀도 및 면적이 증가했고 산림뿐만 아니라 과수, 원예작물 등에서도 큰 피해를 야기하고 있다. 충청남도에서 발생한 미국선녀벌레의 밀도에 따른 시간적-공간적 분포 특성을 조사하고, 발생 면적을 추정하였다. 충청남도 내 미국선녀벌레의 밀도는 증가하는 추세였으며 실제 조사된 발생지점의 비율도 증가하였고, 추정 분포면적은 2011년에 비해 2014년에 크게 증가하였으며 2017년부터는 43개 조사지점을 모두 포함한 다각형 면적에 도달해 충남 전역에 퍼진 것으로 추정되었다. 충청남도 내 농경지에서 실제 발생면적률은 연도별로 뚜렷한 증가 추세를 보였으나, 비농경지에서의 발생면적률은 연도별로 큰 차이를 보이지 않았다. 따라서 충남 전역으로 확산된 미국선녀벌레는 발생면적이 정점에 도달했으며, 밀도가 지속적으로 증가할 것으로 예상된다.

검색어: 미국선녀벌레, 충청남도, 발생현황, 발생패턴

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Damage analysis of Ricania shantungensis (Hemiptera: Ricaniidae) in persimmons

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신종 갈색날개매미충은 과실류에 대하여 심각한 경제적 피해를 야기한다. 국내에서는 이종의 관리를 위해 화학약제를 사용하고 있다. 그러나, 이 해충에 대한 살충제의 사용시기과 종류는 꿀벌 개체군에 악영향을 일으킨다. 그러므로, 본 연구는 감에 있어 살충제의 사용을 감소시키고 효과를 증대시킬 수 있는 방제의사결정 수준을 평가하였다. 공간분포 분석을 통하여 감귤의 피해관련 요소인 신초, 과실형성수, 수확량에 어떤 발육단계가 영향을 주었는지를 확인하였다. 갈색날개매미충 알의 분포는 감 열매 수와 공간적으로 관련되어 있었다. 그러나 갈색날개매미충 알의 밀도와 감의 피해와 관련된 요인들 간에 어떠한 선형 관계를 발견하지는 못했다. 그러나 갈색날개매미충의 밀도와 산란된 죽은 가지와의 상관성은 확인되었다. 난괴 밀도에 근거한 죽는 가지 추정 발육 모델(Developed model of branch death possibility)로부터 새롭게 발달된 가지당 5.75개의 난괴가 방제의사결정 수준으로 제안되었다. 위의 결과들은 과원내 갈색날개매미충 관리의 효과를 높임과 동시에 다른 곤충에 대한 방제의사결정수준을 개발하는데 도움을 줄 수 있을 것이다.

검색어: 갈색날개매미충, 감, 공간분포, 피해분석, 의사결정수준

P102

Investigation on domestic occurrence patterns and migration routes of *Ctenoplusia agnata* (Lepidoptera: Noctuidae)

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Ctenoplusia agnata (Lepidoptera: Noctuidae) is a polyphagous pest that damage on crops belonging to the Fabaceae and Brassicaceae, and it is known as a migratory pest. In this study, we investigated pattern of occurrence to trace invasion characteristics using sex pheromone traps and conducted genetic analysis of captured individuals while also exploring their correlation with air currents. Our findings suggest that *C.agnata* exhibits an annual occurrence of four generations in Korea, with the second or third generation, primarily active from July to September, posing a significant threat to soybean. Genetic analysis revealed the presence of 17 haplotypes, and trajectory modeling confirmed the influence of air currents from Kyushu, Japan and Zhejiang, China etc. These results are expected to be used as a comprehensive management of *C.agnata* and other migratory moth species.

Key words: *Ctenoplusia agnata*, Migration, Occurrence pattern, Genetic analysis, Air currents

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Effects of drone aerial spary on honey bees and honey colonies during the rice blossom flowering period

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본 연구는 벼 화분에 잔류한 네오니코티노이드계 약제가 꿀벌 봉군 내로 유입하여 만성적으로 피해를 주는지에 대해 실험적으로 검증하고자 한다. 벼 꽃 개화기에 맞춰 논 인근의 세 지역에 각 6개 봉군을 설치하였다. 3개의 지역 중 두 지역은 벼 꽃 개화기 항공 방제 수행지역이고, 1개 지역은 미수행 지역이다. 지역마다 봉군 3개에는 채분기를 설치하여 벌통 내 화분 유입을 차단한 그룹과 미설치 그룹 간 봉세와 꿀벌 면역 및 수명 관련 유전자 발현량을 비교하였다. 약제 방제가 수행된 지역에서 채분기를 설치한 봉군의 봉세는 미설치 봉군보다 상대적으로 강한 것을 확인하였다. 또한, 약제 처리 지역에서 채분기 설치 봉군에서 채분기를 설치한 봉군의 봉세는 미설치 봉군보다 상대적으로 강한 것을 확인하였다. 또한, 약제 처리 지역에서 채분기 설치 봉군에서 채집된 꿀벌의 면역 및 수명 관련 유전자 발현량이 미설치 그룹과 차이가 있는 것을 확인하였다.

검색어: 네오니코티노이드계, 채분기, 꿀벌스트레스, 만성독성

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Not Presented

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Odor characteristics during resource recovery process of good waste using Black Soldier Fly (*Hermetia illucens* (L.))

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아메리카동애등에(*H. illucens)*는 음식물 폐기물 등 유기성 폐자원을 효율적으로 처리할 수 있는 능력을 가지고 있어 전세계적으로 주목받고 있는 환경정화 곤충이다. 하지만 유기성 폐자원을 처리 시 가장 큰 문제는 아메리카동애등에가 먹이인 유기성 폐자원을 소화시킬 때 발생되는 악취이다. 국내에서 현재 아메리카동애등에를 사육하고 있는 농가는 223호로 조사되고 있지만 이중 악취발생 저감장치 등을 설치한 농가는 10%가 안되는 것으로 생각된다. 따라서 국내에서 동애등에 먹이로 가장 많이 사용되는 습식사료를 먹이로 사용하였을 때 농가 사육장 안에서 발생되는 복합악취와 지정악취 22종에 대하여 분석하였다. 그 결과, 복합악취는 249배였으며, 지정악취는 22종 중 7종(암모니아, 메틸메르캅탄, 트라이메틸아민, 아세트알데하이드, 프로피온알데하이드, 뷰틸알데하이드, *i*-발레르알데하이드)가 검출되었다. 이중 가장 높은 농도를 나타낸 악취물질은 암모니아로 98.4ppm이 분석되었다. 또한, 아메리카동애등에를 사육 시 가장 많이 발생되는 암모니아의 발생시기는 사육초기인 1~4령보다 5령 이후 전생육기 중의 대부분을 발생시키는 것으로 조사되었다. 이러한 결과는 암모니아 저감을 위한 적정시기를 설정하는데 도움이 될 것으로 생각된다.

검색어: 아메리카동애등에, 유기성폐자원, 악취, 암모니아

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Study on breeding according to overwintering conditions of *Prosopocoilus astacoides blanchardi* larva

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두점박이사슴벌레는 2012년 5월 31일부터 환경부 지정 멸종위기야생생물 2급으로 보호받고 있는 딱정벌레목의 사슴벌레과 톱사슴벌레속의 곤충으로 우리나라에는 제주도 숲에서 자생하고 있다. 보통 검정색 사슴벌레와는 달리 황갈색의 이국적인 색상을 지니고 있으며, 가슴 양쪽에 2개의 검은색 점이 있는 것이 특징이다. 본 연구는 아열대기후의 특정 서식지에서만 살아가는 두점박이사슴벌레의 산업곤충으로써 가치성과 희귀성을 고려하여 인공증식 사육기술을 개발하였으며, 이 과정 중 점차적으로 온도를 낮춰가며 영상 8℃에서 90일간의 월동처리 하였고, 이러한 월동처리의 유무과정이 두점박이사슴벌레 유충기의 생육에 어떠한 영향을 미치는지 조사하였다. 비월동시 수컷 249일, 암컷 239일이었고, 성별간 수컷이 암컷보다 약 10일정도 더 길었으며, 암수 평균 유충기간은 245일이었다. 그리고 월동시에는 수컷 309일, 암컷 280일로 수컷이 약 30일정도 길었으며, 암수 평균 유충기간은 290일이었다. 월동처리 유무에 따른 두점박이사슴벌레 유충기간의 차이는 비월동 개체가 월동 개체보다 수컷은 약 60일, 암컷은 약 40일정도 짧았으며, 암수 평균 유충기간은 약 45일정도 짧았던 경향을 보였다. 또한 유충의 생육특성 중 두폭은 처리간 서로 유사하였던 반면, 암수 무게는 월동 개체가 비월동 개체보다 모두 높게 나타났다. 우화의 경우 암컷이 비월동과 월동 개체에서 모두 수컷보다 빨랐던 경향을 보였다. 추후에는 월동 유무에 따른 성충 산란량과 사육 키트 개발을 위한 사육상자 크기 및 배지 높이별 성충 산란량, 온도 및 사육상자 크기별 유충 생육 등의 연구를 추진할 계획이다.

검색어: 두점박이사슴벌레, 멸종위기야생생물, 인공증식, 월동, 사육

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Distribution of queen wasps in spring at the major beekeeping areas in Chungcheongnam-do

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우리나라에 서식하는 주요 말벌류는 벌목(Hymenoptera)의 말벌아과(Vespinae)에 속하는 종들로 10종의 말벌속(Vespa) 중 8종[장수말벌(*V. mandarinia*), 꼬마장수말벌(*V. ducalis*), 등검은말벌(*V. velutina nigrithorax*), 좀말벌(*V. analis*), 말벌(*V. crabro flavofasciata*), 검정말벌(*V. dybowskii*), 털보말벌(*V. simillima simillima*), 황말벌(*V. simillima xanthoptera*)]이 주를 이루고 있다. 특히 2003년 부산에서 처음 발견되었던 등검은말벌이 급속도로 확산되어 우리나라 양봉산업에 치명적인 피해를 주고 있는 현실이다. 이에 본 연구는 충남 주요 양봉지역인 공주, 청양, 논산에서 말벌 유인액을 주입한 포획기를 이용하여 4월부터 6월까지 봄철 출현하는 여왕말벌의 포획된 말벌류 개체들을 조사하여 분포도와 특성을 알아보았다. 말벌 포획 개체수 조사결과, 등검은말벌의 분포율이 공주 76.3%, 청양 74.1%, 논산 58.0%로 가장 큰 비율을 보였으며, 꼬마장수말벌이 다음으로 공주와 청양지역은 밤나무 숲으로 12.4~16.0%를 보였던 반면, 소나무 숲을 이룬 논산에서는 31.8%로 최대 2.5배 정도 높은 분포 비율을 나타냈다. 그리고 장수말벌은 5.2~8.6%의 분포율을 보였으며, 다른 지역보다 해발이 높았던 청양지역에서 장수말벌이 많게 조사되었다. 봄철 3개 지역에서 포획된 여왕말벌류의 총개체수(266마리)에 대한 평균 분포 비율은 등검은말벌 69.5%, 꼬마장수말벌 19.9%, 장수말벌 6.8%, 말벌 2.6%, 그리고 좀말벌 1.1% 순으로 조사되었다.

검색어 : 양봉, 말벌, 여왕말벌, 충남, 분포도서

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Influence of the beebread feeding applied with processed by-product Red Ginseng Powder on swarming honeybee

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최근 몇 년 전부터 우리나라의 양봉농가에는 전에 경험하지 못했던 이상기후 악재와 초비극 상황인 꿀벌 군집 붕괴현상(Colony collapse disorder, CCD)으로 인하여 최대 60% 이상의 꿀벌이 폐사하거나 사라지는 등 양봉산업의 막대한 손실을 초래하였다. 본 연구는 복잡하고 다양한 원인으로 약해진 꿀벌의 면역력과 봉군 세력을 향상시키기 위하여 농업부산물 홍삼박을 활용한 화분떡을 자가제조하여 꿀벌 사양 먹이를 통한 봉군 세력에 어떠한 영향을 미치는지를 구명하고자 수행하였다. 가공부산물 홍삼박을 건조하여 130 mesh 이상 초미립자로 분쇄하였으며, 조사포닌 725 mg 100^{-1}을 함유하였고 화분떡 총중량의 0.5, 1.0, 2.5, 5.0, 10.0%로 첨가하여 완전하게 혼합 배합하여 화분떡을 제조하였다. 분봉벌은 4월 분봉한 봉군으로 이용하였으며, 2달 동안 1주일 간격으로 대조구 화분떡과 제조한 홍삼박 화분떡 5처리구에 급이하여 봉군의 세력을 조사하였다. 사양 먹이로 급이한 화분떡은 30일간 달관조사에서 대조구와 처리구 모두 꿀벌 먹이로 거부반응은 없었다. 봉군 세력 조사로 4월 분봉벌의 봉군은 1매 2갈로 시작하여 약 한 달 후에 6매 봉판으로 증소되었으며, 이때 조사된 봉군별 봉개율은 대조구 55%(100 기준) 대비 홍삼박 0.5~1.0% 처리구는 58~60%로 +(5~9)% 향상되었던 반면, 홍삼박 2.5% 이상 첨가한 처리구에서는 봉개율이 -(9~20)% 감소하는 경향을 보였다. 그리고 화분떡 먹이 소모량을 조사한 결과, 대조구 평균 96.9%(100) 소모율 대비 홍삼박 0.5% 처리구는 97.7%로 다소 높았으나 홍삼박 2.5% 이상 처리구에서는 점점 감소하는 경향을 보였다.

검색어 : 꿀벌, 분봉벌, 가공부산물, 홍삼박, 화분떡

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Developmental characteristics of *Teleogryllus emma* Ohmachi et Matsuura and *Loxoblemmus doenitzi* Stein according to rearing temperature conditions

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The growth characteristics according to temperature conditions were investigated in the breeding room of the Sericulture & Entomology Experiment Station for Oriental garden crickets(*Teleogryllus emma* Ohmachi et Matsuura) and Modeagali-crickests(*Loxoblemmus doenitzi* Stein) collected from the lawns of Byeonsan-myeon, Buan-gun, Jeollabuk-do. The temperature conditions were 6 treatments from 15°C to 40°C at 5°C intervals using a multi-incubator, and the development period and mortality rate by age were compared using the 28°C breeding room conditions as a control. For *T. emma*, the higher the temperature, the shorter the total development period was, and the same trend was observed for the growth period by age stage. However, at low temperatures of 15°C and 20°C, all died after the third instar, and at high temperatures above 35°C, all died during development. At 25°C and 30°C, they developed normally, and the mortality rate was about 25%. The *L. doenizi* had the same tendency as the *T. emma*, with the higher the temperature, the shorter the development period. The total development period was 57.7 days at 25°C, which was similar to the *T. emma*'s 55.9 days, and the mortality rate was the lowest at 44% at 25°C.

Key words: *Teleogryllus emma* Ohmachi et Matsuura, *Loxoblemmus doenitzi* Stein, Breeding temperature,

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Necrophagous insect fauna on carcasses relative to the decomposition stages in Daejeon area

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닭 사체를 이용하여 장소, 기온, 습도별 시식성 곤충상을 파악하기 위해 대전광역시 전민동 일대의 3개의 장소를 선택하여 닭 사체별로 유인되는 곤충의 종류와 군집 상의 차이와 출현양상을 조사하였다. 이를 위해, 닭 사체에 유인되는 곤충을 주기적으로 채집하고 해당 일자의 온도와 습도를 조사하여 기록했으며, 채집한 곤충들은 외부형태적 특징으로 분류하고 개체수를 확인했다. 조사결과, 딱정벌레목과 파리목의 개체가 가장 많았고, 그 외에 바퀴목, 벌목, 노린재목 분류군에 속하는 다양한 곤충들이 유인된 것을 확인할 수 있었다. 본 연구 결과는 법곤충 시식성 곤충을 연구하는데 중요한 기초자료로 활용될 수 있도록 결과를 종합정리하였다.

검색어: 법곤충, 부패단계, 곤충상, 시식성

P111

Taxonomic review of the tiny sand beetle Psammodiini (Coleoptera: Scarabaeidae: Aphodiinae) in Korea

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A taxonomic study of Korean Psammodiini is present. Seven species [*Rakovicius coreanus* (Kim), *Leiopsammodius japonicus* (Harold), *Psammodius flavolittoralis* Kim, *Psammodius hangangensis* Kim, *Psammodius sungshinarum* Kim, *Rhyssemus inscitus* (Walker), *Trichiorhyssemus asperulus* (Waterhouse)] belonging to five genera are recognized based on morphological characters. A pictorial key, habitus photographs and illustrations of the diagnostic characters of Korean Psammodiini species are provided to facilitate identification.

Key words: Scarabaeidae, Psammodiini, Korea, taxonomy, review

P112

First report of root-knot nematode, *Meloidogyne hapla*, on roots of *Adenophora triphylla* var. japonica in Korea

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A survey of plant-parasitic nematodes (PPNs) was carried out in medicinal crop cultivated fields from July to August in 2023. Three-leaf ladybell, *Adenophora triphylla* var. *japonica* is a highly valued medicinal plant that is used to treat or prevent bronchitis, cough, cancer, and obesity in Korea. *A. triphylla* plants with small root-galls were observed in a field of Yeongju Agricultural Technology Center, which were identified as a root-knot nematode. Additional morphological and molecular analyses studies were performed and identified as *Meloidogyne hapla,* Northern root-knot nematode. Population densities of *M. hapla* ranged from 20~30 nematodes per 100 cm3 of soil. *M. hapla* was detected at lower densities in soil compared to other infected host crops, but there are concerns about damage to *M. hapla* since *A. triphylla* is cultivated for more than two years once planted. Our results indicate that *A. triphylla* roots damage by *M. hapla* were identifed, it is necessary to prepare control methods such as registration of applicable nematicides and crop rotation.

Key words: Medicinal plant, Three-leaf ladybell, *Adenophora triphylla* var. japonica, Northern root-knot nematode, Meloidogyne hapla, Identification

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Primer set for identification of *Nilaparvata lugens* and *Sogatella furcifera*

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주변 국가인 태국, 캄보디아, 베트남, 라오스 등에서 벼멸구(*Nilaparvata lugens*)와 흰등멸구(*Sogatella furcifera*)를 채집하던 중, 벼멸구와 형태가 아주 유사한 이삭멸구(*N. muiri*)와 벼멸구붙이(*N. bakeri*), 그리고 흰등멸구와 형태가 아주 유사한 흰등멸구붙이(*S. kolophon*), 피멸구(*S. vibix*) 그리고 애멸구(*Laodelphax striatellus*)가 동시에 채집이 되는 등 형태적 차이점이 거의 없어 전문가도 쉽게 구분하지 못하는 문제가 있음이 확인되었다. 따라서 형태가 유사한 상기 멸구류의 종 동정을 확실히 할 수 있는 PCR용 프라이머의 개발을 위해 벼멸구 및 흰등멸구의 미토콘드리아 내 COI 영역을 특이적으로 검출할 수 있는 프라이머 세트를 제작하고 종 동정 효과를 확인하였다.

검색어: 벼멸구, 흰등멸구, 종 동정, PCR

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The first record of *Icerya seychellarum* (Westwood, 1855) (Hemiptera: Coccomorpha: Monophlebidae) from South Korea

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The genus *Icerya* Signoret, 1876 has 38 species distributed in the world, and some are known to cause damage to valuable crops. The Seychelles scale, *Icerya seychellarum* (Westwood) (Hemiptera: Coccomorpha: Monophlebidae) was found on *Cycas revoluta* located in the province of Seogwipo-si, Jeju Island, South Korea. This species is highly polyphagous and has been reported to attack host plants of 136 genera, it is widely distributed in tropical and subtropical regions. In South Korea, the species was presently considered a quarantine pest and it seems that control is needed. In this study, *I. seychellarum* is recorded for the first time in South Korea, we provide information on the distribution, host plants, and description of this species.

Key words: Monophlebidae, first record, *Icerya*, Korea

P115

The first report of the genus *Kurahashiodes* (Diptera: Sarcophagidae) from Korea

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The genus *Kurahashiodes* is a monotypic genus that only recorded in Japan with *Kurahashiodes suenagai*. This species was first known by *Wohlfahrtiodes suenagai* in 1994, but reorganized with the new genus *Kurahashiodes* by Verves in 2001. *Kurahashiodes* was close to genus *Wohlfahrtia* but can be distinguished by R_1 haired, surstylus narrow, phallus without ventral protuberance. This genus is reported for the first time in Korean fauna. The diagnosis and photographs of the *Kurahashiodes suenagai* are provided herein.

Key words: Taxonomy, Insecta, Diptera, Sarcophagidae, *Kurahashiodes*

P116

Taxonomic review of the tribe Tropidocephalini (Hemiptera: Delphacidae: Delphacinae) from South Korea

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The tribe Tropidocephalini Muir, 1915 (Delphacidae: Delphacinae) comprised 37 genera 204 species worldwide. In Korea, only three species, *Epeurysa nawaii* Matsumura, 1900, *Tropidocephala brunnipennis* (Distant, 1906), *T. nigra* (Matsumura, 1900), have been reported. In this study, one species, *Epeurysa distincta* Huang & Ding, 1979, is reported for the first time from Korea. We provide the morphological characteristics, photographs and taxonomic keys of the four species belonging to the tribe Tropidocephalini.

Key words: Delphacidae, Tropidocephalini, new record, *Epeurysa distincta*, taxonomy

P117

Population genetics analysis and molecular epidemiological investigation for 15 populations of the invasive pest Red imported fire ant (*Solenopsis invicta*) in Korea, Since 2017

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Solenopsis invicta, known as the red imported fire ant, is an insect native to South America. This species was unintentionally introduced into Australia, New Zealand, several Asian countries, Caribbean countries, and the United States. It shows a high survival rate and settlement potential in human-habitable and non-living areas such as tropical rainforests, disturbed areas, deserts, grasslands, and roads. In Korea, invasions of red fire ants have been reported every year since 2017, and two invasions were discovered in 2023. Quarantine agency analyzing the haplotype and colony social type of *S. invicta* for surveillance and control. Population genetic analysis using Microsatellite Alleleic data of 66 loci to trace the origin of the invasion. Through research cooperation with the United States Department of Agriculture (USDA), we have received samples and expanded our genetic information database. This study analyzed genetic differences between 15 invasive populations and 44 reference groups. As a result of microsatellite analysis, the domestic invasive population showed a genetic structure similar to those in Guangzhou, China, and Florida, USA.

Key words: *Solenopsis invicta*, microsatellite, population, invsion, loci, international joint research

P118

Comparision of genetic differences between Fall armyworm (*Spodoptera frugiperda*) captured in Korea and China, using *COI* haplotype analysis and Z-chromosome

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Fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is a polyphagous agricultural pest that damages about 80 species of plants. It mainly damages Poaceae and plants used as food resources for humans. Its original habitat is the American continent, but it unintentionally settled in tropical and subtropical Asia, including Africa, India, and Sri Lanka. It occurs every year even in southern China, which is geographically adjacent to the Korean Peninsula, causing damage to crops. In Korea, it was first discovered on Jeju Island in June 2019 and is being discovered every year in Jeju and some inland areas. In 2023, there were a total of 13 discoveries, including those in the Jeju and Jeonbuk regions. Quarantine agency identified the maternal genotypes of all currently discovered individuals using *COI* and identified differences in genetic traits between individuals using the sex-related Z-chromosome. For comparison with the information on the individuals that invaded the country, 15 individuals from Guangxi and Guangdong provinces in China were collected and secured. Through the analysis of overseas samples, a database has been added to compare genetic information with domestic invasive species, and the reliability of the analysis is expected to increase.

Key words: fall armyworm, microsatellite, population, invsion, loci

P119

Monitoring reports about *Bactrocea doraslis* of South Korea in 2023

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최근 기후변화, 국제교역량, 여행객 및 외국 이주민 증가 등으로 고위험 식물병해충의 유입이 증가하고 있으며, 고위험해충에 대한 국내 유입여부를 상시 조사하여 외래식물해충을 발견하고 발생시 조기 대응하는 전문지식과 경력을 갖춘 민간 전문가를 활용한 예찰시스템 구축의 필요성이 요구되고 있다. 침입우려 고위험 해충인 오리엔탈과실파리(*Bactrocera dorsalis*)는 광식성 해충으로 파프리카, 망고, 바나나, 감귤류 등 약 80종의 과실 농작물에 피해를 입히고 있으며, 해당 종의 국내정착 시 큰 경제적 피해를 입을 것으로 예상된다. 2023년 조기 방제 및 선제적 대응과 국내 확산 정착을 방지하기 위해 4개도(강원, 전북, 전남, 경남) 18개 시군 90개소에 유인트랩(스테이너)을 설치하여 설치장소별 월 1회 정밀조사를 실시하였다. 트랩에 포획된 해충을 수거 후, 동정한 결과 오리엔탈과실파리는 발견되지 않았다.

검색어: 고위험해충, 예찰조사, 오리엔탈과실파리

P120

The first record of the genus *Acymatopus* Takagi (Diptera: Dolichopodidae) from Korea

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The genus *Acymatopus* Takagi is reported for the first time from Korean fauna along with two nominate species, *A. minor* Takagi, 1965 and *A. takeishii* Masunaga, Saigusa & Yang, 2005. This genus belonging to the subfamily Hydrophorinae in the family Dolichopodidae, is comprised of only six species in the world and distributed only in Japan and China yet. Both adults and larvae of this genus are known to be found on rugged and rocky marine shores of the tidal zone. The authors found the first recorded species in the west seaside of Korea, where many barnacles are inhabited. The descriptions and illustrations of external features including male genitalia of newly recorded species are provided here.

Key words: Aphrosylini, coastal species, Dolichopodidae, Hydrophorinae

*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 (NIBR202231206).

P121

Rhynchaenus maculosus Yang and Zhang (Coleoptera: Curculionidae: Rhynchaeninae) new to Korea

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The Genus *Rhynchaenus* Clairville, known as a significant pest group with distribution of worldwide. 40 and 11 species were reported in Japan and China, repectively. Members of *Rhynchaenus* are usually known as flea weevils and leaf-miners on laval stage. While working on Insects founa of Island, we discovered one species, which is a newly added to the Korean founa (*Rhynchaenus maculosus* Yang & Zhang). This species was newly emerging pest severely Oak in China. The diagnosis, photographs of habitus and diagnostic characters are provided to facilitate identification.

Key words: flea weevils, leaf-miner, *Rhynchaenus*, Rhynchaeninae

P122

Checklist of subtribe Olethreutae (Lepidoptera: Tortricidae: Olethreutinae) from Korea

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According to Diakonoff (1973) subtribe Olethreutae is classified into a total of 27 genera and three genera groups: *Olethreutes, Hedya, Apotomis*. Up to data, 62 species belonging to 11 genera of Olethreutae have been reported in Korea(KSAE & ESK, 2021). In this study, we provide a checklist of subtribe Olethreutae with illustrations of adult, and genitalia of example species of each genus group.

Key words: Tortricoidea, Palearctic Region, Taxonony

P123

Taxonomic notes of the tribe Eucosmini (Lepidoptera: Tortricidae: Olethreutinae) in Korea

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Eucosmini Meyrick, 1909 is one of the largest groups in subfamily Olethreutinae, with more than 1,650 species of 128 genera. In Korea, 96 species of 26 genera have been recorded by several authors (Park, 1981, Bae, 1992, *et al*.). In this study, we provide a brief overview and a checklist of Eucosmini, with illustrations of adults and genitalia for examined species.

Key words: Lepidoptera, leaf roller moth, host plant, taxonomy

P124

Two new species of the genus *Stericta* Lederer (Lepidoptera, Pyralidae, Epipaschiinae) from Laos and Cambodia

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Two new species, *Stericta jaeshini* Kim & Bae, sp. nov. and *S. atroaurantiaca* Kim & Bae, sp. nov. are described from Laos and Cambodia. About 50 species of the genus *Stericta* have been recorded from Southeast Asia, but it has not been recorded to occur in Laos and Cambodia previously. We record the presence of this genus in these two countries for the first time in this study. Illustrations of adults and genitalia of examined species are provided.

Key words: Pyraloidea, Oriental Region, taxonomy, moths, new records.

P125

Description of the larvae of *Silpha* (*Silpha*) *koreana* Cho & Kwon, 1999 (Coleoptera: Staphylinidae: Silphinae)

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The genus *Silpha* Linnaeus, 1758 in Silphinae includes 33 species worldwide. This group is flightless and known to feed on invertebrate carcasses from the ground surface. In South Korea, 3 species have been recorded, and *S. koreana* Cho& Kwon, 1999 is an endemic species, distributed only Mt. Taebaek and Mt. Mindung. Up to date the immature stages of the species has never been studied although the species has significant value as an endemic species. The present study is the very first one ever conducted describing the larval morphological characters of *S. koreana* along with images of larval stages. Furthermore, we report observations on developmental lengths for each stages of the species.

Key words: Silphinae, *Silpha*, larval description, endemic species.

P126

Larval redescription of *Necrophila* (*Calosilpha*) *brunnicollis brunnicollis* (Kraatz, 1877) (Coleoptera: Staphylinidae: Silphinae)

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Necrophila (*Calosilpha*) *brunnicollis brunnicollis* (Kraatz, 1877) is a common necrophagous beetle in the Palaearctic region. The species is often encountered on the corpses of large vertebrates, such as human and pig, and is well recognized as a potentially group of beetles in forensic entomology. All of the developmental stages can be found in the corpse and under the soil near a corpse, which can be used to reconstruct the site, such as estimating **PMI**(Postmortem interval). However, its larval instar stages were never thoroughly described for identification. In this study, we redescribe the morphological characters of all larval stages of *N. brunnicollis* for quantitative and qualitative morphological information. In addition, we provide the images of larvae and an indentrifiaction key to larval instars.

Key words: *Necrophila*, larvae, forensic entomology. Silphinae

P127

The complete mitochondrial genome sequence of the red wasp, *Vespula rufa* (Hymenoptera: Vespidae)

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Vespula rufa (Linnaeus, 1758), known as the red wasp, is a social wasp species. We analyzed the complete mitochondrial genome of *V. rufa* from South Korea, for an ongoing systematic study of the Korean Vespidae. This species is distributed in northern parts of North America, northern and central Europe, and parts of Asia. It can be distinguished from other species of the genus by usually having reddish brown areas on the 1st and 2nd tergites. The mitogenome is 17,663 bp in length, includes 13 protein-coding genes, 24 transfer RNA genes, and two ribosomal RNA genes. The nucleotide composition is 40.5% adenines, 43.00% thymines, 6.1% guanines, and 10.4 % cytosines.

Key words: Hymenoptera, Vespidae, Mitochondrial genome, *Vespula rufa*

P128

First record of Curtonotidae Duda, 1934 (Diptera: Brachycera) from South Korea

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Curtonotidae, known as the quasimodo flies, in Diptera currently includes about 100 described species in five genera (*Axinota* Wulp, 1886; *Curtonotum* Macquart, 1844; *Cyrtona* Séguy, 1938; *Depressonotum* Grimaldi & Kirk-Spriggs, 2012; *Tigrisomyia* Kirk-Spriggs, 2010) worldwide. Curtonotid species have great potential as case studies for biological diversity, evolution, and zoogeography based on wide distribution and sufficient diversity. In the present study, *Curtonotum maritimum* Ozerov, 2007 is newly added to Korean insect fauna. This is also the first record of Curtonotidae from the country. We here provide morphological diagnosis and images including genitalic structures for accurate identification.

Key words: Diptera, Curtonotidae, *Curtonotum*, New record, Taxonomy

P129

First record of the genus *Desmometopa* Loew, 1866 (Diptera: Milichiidae) from South Korea

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Milichiidae Schiner, 1862 is a small family of Diptera, with 19 genera and 360 described species worldwide. In Korea, only two species in a single genus, *Aldrichiomyza* Hendel, 1914, have been recorded. Milichiid species, small-sized acalyptrate flies, are generally associated with decaying plants and animals. In particular, *Desmometopa* Loew, 1866 in the family has a commensalistic habit, more precisely the phoretic relationship, that has been observed with predacious insects and spiders, in which adults feed on the juices of the prey. In this study, we recognized *Desmometopa microps* Lamb, 1914 for the first time in the Korean Peninsula. This is also the first record of the genus from the country. Herein, we provide diagnosis of *D. microps* based on the Korean specimens with images.

Key words: Diptera, Milichiidae, *Desmometopa microps*, New record, Taxonomy

P130

The first record of the family Periscelididae Oldenberg (Diptera: Opomyzoidea) from Korea

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The family Periscelididae Oldenberg is reported for the first time from Korean fauna along with three nominate species, *Cyamops hotei* Sueyoshi, 2004, *Stenomicra angustiforceps* Sabrosky, 1965 and *S. fascipennis* Malloch, 1927. *Stenomicra* have been collected at grassy areas, whereas *Cyamops* have been founded near wet habitats. The descriptions and illustrations of external features of these species are provided here.

Key words: Opomyzoidea, Periscelididae, Stenomicrinae

P131

Genetic lineage of *Thrips tabaci* (Thysanoptera: Thripidae) and their haplotypes in South Korea, using mitochondrial COI gene sequences

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The onion thrips, *Thrips tabaci*, is a serious global pest attacking many agricultural crops such as onion and Welsh onion. The thrips, assumed to originate in the Mediterranean region, has been reported for a long time in South Korea. According to worldwide molecular works, the species composes of three genetic lineages (LI, L2 and T) which related to reproductive mode (arrhenotoky vs. thelotoky). To understand the genetic diversity of *T. tabaci* in South Korea, we investigated genetic lineage and haplotype composition, using about 80 mitochondrial COI gene sequences (369bp) along with foreign sequences from GenBank and BOLD. The COI gene analysis shows that both of thelotokous L1 and arrhenotokous L2 population distribute in South Korea. Among 97 COI-haplotypes worldwide, only six haplotypes are found and thelotokous H1 dominantly distributes.

Key words: *Thrips tabaci*, genetic lineage, COI haplotypes, agricultural pest

P132

Nesendaeus monochrous Voss, 1953 (Coleoptera: Curculionidae) on the bud of *Glochidion chodoense* from Jin-do Island of South Korea

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Until now, in case of Palaearctic region, only one species, *Nesendaeus monochrous* in this genus was recorded from China. but the biology and life cycle are not clearly known, yet. This species collected from the bud of *Glochidion chodoense* in Korea for the first time and closely related to *Heterochyromera imerodeus* Kojima & Morimoto which was recorded only in Japan,. But *Nesendaeus monochrous* is easily distinguishable from *H. imerodeus* by the relatively longer elytra with bisinuately round apices. *Heterochyromera imerodeus* Kojima & Morimoto can be found from *Eurya emarginata* and *Glochidion obovatum* in Japan. So, this two species are closely related each other and need more taxonomic study about the generic synonymy or changing the generic position.

Key words: *Nesendaeus monochrous*, *Heterochyromera imerodeus*, *Glochidion chodoense*, Host, new record

P133

Molecular characterization and phylogenetic position of *Rotylenchus pini* Mamiya, 1968 (Nematoda: Hoplolaimidae) from Korea, with remarks on its morphology and morphometrics

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Rotylenchus pini Mamiya, 1968 was reported from rhizospheric soils of *Zoysia japonica* in Korea. Females and males of the characterized population conform to the original species description from Japan and also to other subsequent species descriptions with variations in a few details in morphometrics including the existence of pharyngeal gland overlap in some specimen. Bayesian analysis of all the three DNA markers consistently grouped *R. pini* together with *Rotylenchus* species including *R. zhongshanensis,* a morphologically close species. Additionally, the newly obtained sequences of *R. pini* were found to be almost identical to the sequences assigned to *Rotylenchus aff. devonensis* in GenBank. These *Rotylenchus aff. devonensis* isolates might be representatives of *R. pini* populations. The current and previous phylogenetic studies supported by the recorded morphological plasticity within populations of the genus validate the proposed synonymy of *Pararotylenchus* with *Rotylenchus.*

Key words: DNA barcodes, morphology, *Pararotylenchus,* phylogeny

P134

Genetic variation of *Frankliniella occidentalis* and *Thrips tabaci* on imported cut flowers

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최근 주요 절화 수입량이 증가하면서 외래 병해충 유입률 또한 증가하고 있다. 농림축산검역본부 병해충정보시스템(PIS)에 따르면 최근 10년간(2011-2020년) 수입된 절화류에서 검출된 총채벌레목은 총 43종 6,734건이다. 그중 가장 많이 검출된 총채벌레는 *Frankliniella occidentalis* (2,526건), *Thrips tabaci* (1,470건)로 전체 검출건수의 59% 이상 차지한다. 본 연구에서는 수입 절화류에서 검출률이 가장 높은 총채벌레 두 종의 미토콘드리아 DNA COI 유전자를 이용하여 염기변이에 의한 국가별 다양성과 유전적 다양도 분석을 실시하였다. 네덜란드, 중국 등 7개국에서 검출한 *Frankliniella occidentalis* 184개 개체에서 9가지의 단상형(haplotype)이 관찰되었다. 또한 페루, 네덜란드 등 6개 국가에서 검출된 *Thrips tabaci* 80개 개체에서는 7가지 단상형이 보였다. 본 연구에서 검출한 mtDNA내 염기서열 다형성은 총채벌레 집단의 국가적 변이성 추정 및 연관성 분석에 기초자료로 활용할 것으로 기대한다.

검색어: 식물검역, *Frankliniella occidentalis*, *Thrips tabaci*, haplotype

P135

Composition analysis of commercial lures to develop an effective Codling moth (*Cydia pomonella*) pheromone lure

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코드린나방은 사과, 배, 복숭아 등의 과실류를 비롯한 다양한 작물의 해충으로써, 국내에서는 검역 대상으로 금지해충에 속해있다. 코드린나방이 속한 잎말이나방의 유충은 과실 속으로 파고 들어가 살기 때문에 살충제로 방제하기가 어려운 해충이다. 따라서 철저한 수입식물 검역과 예찰을 통해 국내로의 유입을 막는 것이 최선이다. 현재 잎말이나방류에 대한 예찰용 페로몬트랩이 사용되고 있지만 개별 종에 대한 표적 예찰은 이뤄지지 않고 있다. 본 연구에서는 코드린나방의 성페로몬을 이용한 유인제 개발을 위한 기초연구로써, 현재 상용화되어 미국, 유럽, 중국 등에서 사용하고 있는 다양한 유인제의 조성성분을 분석하였다. 전세계적에서 대표적으로 사용되는 4종류의 코드린나방 루어를 GC-MS/MS를 이용하여 물질의 종류와 구성비율을 분석하였다. 본 연구의 결과는 향후 코드린나방의 최적 예찰을 위한 성페로몬 유인제 선발의 기초자료로 활용될 예정이다.

검색어: 코드린나방, 유인제, 금지해충

P136

Function of epidermal groups I and II chitinases in cuticle turnover during molting in a wood-boring beetle, *Monochamus alternatus*

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Insect cuticle is an extracellular matrix formed primarily from two different biopolymers, chitin and protein. During each molt cycle, a new cuticle is deposited simultaneously with degradation of the old cuticle by molting fluid cuticle degrading-enzymes, including epidermal chitinases (CHTs). Insect CHTs, belonging to family 18 glycosylhydrolase (GH18), have been classified into at least eleven subgroups based on phylogenetic analyses, and group I (CHT5) and group II (CHT10) epidermal CHTs present in molting fluid. In this study we report the physiological function of MaCHT5 and MaCHT10 in the Japanese pine sawyer, *Monochamus alternatus*. RNAi for either *MaCHT5* or *MaCHT10* resulted in larval-pupal and pupal-adult molting defects, in which the insects were unable to shed completely their old cuticle and died entrapped in their exuviae. Furthermore, TEM analysis revealed a failure of degradation of the old cuticle in both MaCHT5- and MaCHT10-deficient pharate adults. In the old pupal cuticle, the chitinous horizontal laminar and vertical pore canal essentially remained intact in the endocuticular layer. These results indicate that both CHTs are required for turnover of the chitinous old cuticle, which is critical for completion of insect molting. We also discuss the possible function of two spliced variants of MaCHT10, MaCHT10a and MaCHT10b.

P137

Plant-derived metabolites as juvenile hormone disruptor in *Spodoptera frugiperda* larvae

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During the larval development process of insects, juvenile hormone (JH) is essential for regulating various aspects of larval life, including growth, reproduction, and behavior, throughout their larval stage. The larval stage of *Spodoptera frugiperda*, when it consumes plant-derived metabolites, develops into pupae, but these pupae are unable to molt successfully. In this way, plant-derived metabolites contain or produce inhibitors of juvenile hormone, thereby disrupting the development of insect larvae and making them vulnerable to harm. Therefore, in this study, we established an in vitro screening system using yeast cells transformed with the Met-SRC juvenile hormone receptor of *S. frugiperda*. Through this system, we were able to identify juvenile hormone disruptors from plant-derived metabolites and confirm their developmental inhibitory effects on the larvae of *S. frugiperda.*

Key words: *Spodoptera frugiperda*, Juvenile hormone, Methoprene-tolerant, SRC, Plant extract

P138

Mamesastra brassicae was captured its pheromone trap installed on *Machilus thunbergii*

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Machilus thunbergii (Laurales: Lauraceae, 후박나무) is planted as a street tree in Jeollanamdo and Jeju Island. *Orthaga olivacea* (Lepidoprate: Pyralidae, 제주집명나방) is known as a major pest of *M. thunbergii*. For managing *O. olivacea* by eco-friendly control method, the mating disruption would be expected. The sex pheromone of *O. olivacea* was identified as a mixture of (*Z*)-11-hexadecenyl acetate (Z11-16Ac), (*Z*)-11-hexadecenal (Z11-16Ald), and (*Z*)-11-hexadecenol (Z11-16OH) at a ratio of 100: 0.1:0.1 by Chinese research group. Before applying mating disruption, confirmation of its attraction in Korea was essential. The pheromone traps composed of Z11-16Ac alone and the blend of three components (100:0.1:0.1) were installed in Haenam, Jeollanamdo in 2021, and Jeju and Seogwipo, Jeju in 2022. In field attraction test, no *O. olivacea* was attracted to any trap. However, *Mamesastra brassicae* (Lepidoptera: Noctuidae), which was not intended, was caught in both years in the trap. Total of 19 in Haenam between September 23 and 30, total of 11 in Jeju between September 30 and October 28, and total of 108 in Seogwipo between September 15 and November 11 were caught to the trap lured with Z11-16Ac. While in the trap lured with the blend, total 1 and 6 were captured in Haenam and Seogwipo, respectively.

Keywords: *Machilus thunbergii*, *Orthaga olivacea*, *Mamesastra brassicae*, pheromone

P139

Not Presented

P140

Selection of organic agricultural matarials effective in controlling *Myzus persicae* for sesame cultivation in rain shelters

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참깨는 건전 유기 종자생산을 위해서는 *Corynespora cassicola* 등과 같은 종자전염 병원균의 감염을 최소화해야 하므로 비가림하우스 내에서의 종자생산이 필수적이다. 그러나 비가림하우스 재배 시 진딧물의 대발생으로 참깨의 생산량 저하 되므로 본 연구에서는 참깨 비가림하우스 내 유기 재배 시, 진딧물에 대한 효과적인 유기농업자재를 선발하고자 한다. 등록된 유기농업자재 8종 중 4종을 기내에서 선발하였으며 선발된 유기농업자재 4종을 참깨 재배기간 중 주 1회 처리한 결과, 처리 간 유의한 차이가 나타났다. 수확기인 8월 3일 기준 무처리구 대비 데리스추출물 70%와 데리스 20%+시트로넬라 30%+계피추출물 10%은 12.3%, 9.0%만이 고사하여 우수한 방제효과를 나타냈다. 본 연구 결과는 참깨 재배 시 농림현장에서 발생하는 복숭아혹진딧물에 대한 유기농업자재 효과를 검정함으로써 유기재배 농가의 자재 선택에 대한 정보를 제공하고자 한다

검색어: 참깨, 비가림하우스, 복숭아혹진딧물, 유기농업자재

P141

An optimal standardized *in vitro* bioassay to evaluate susceptibility of green peach aphid, *Myzus persicae* (Sulzer) (Insecta: Hemoptera: Aphididae), to aphicides

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Leaf-spray in vitro bioassays appraise new aphicidal formulations for managing deleterious plant-feeding aphids. The formulation may utilize alternative and integrated strategies. However, leaf spraying even under controlled conditions may affect aphid reproduction and mortality. This study examines leaf spray applications for optimum and reproducible aphicidal results using tobacco leaves overlaid on cotton fabric or water agar surfaces. Infestation of the undersides of tobacco leaves with nymphs of green peach aphids was used in the assays. Spray distance and volume were optimized using water-sensitive paper to ascertain the best surface coverage. Overlays of the leaves on water agar caused less mortality and greater reproduction than the use of cotton fabric. The relative humidity of the insect-rearing chambers changed with the watering regime for the insect - rearing chambers with cotton fabric; 60% relative humidity was optimal. Relative humidity was not affected by the concentration of agar in the water agar chambers. Applications of the chemical aphicidal standard, Sulfoxaflor, under the optimized conditions exhibited similar times for lethality although the rate was faster with leaves on the cotton fabric than on water agar. These studies establish reproducible and sensitive techniques for assessing the lethality and effects on reproduction of potential aphicidal products.

Key words: aphicides, leaf spraying assay, cotton fabric, water agar, mortality

P142

Determination of lethal concentrations and lethal times of extracts from *Tanacetum cinearaiaefolium*, *Derris elliptica*, and *Sophora flavescens*, to control green peach aphid, *Myzus persicae*

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Botanical extracts are employed in management of aphids. Extracts from *Tanacetum cinearaiaefolium*, *Derris elliptica*, and *Sophora flavescens* are widely used to control various insects. In this study, we determined concentrations of active insecticidal compounds (Ais) in commercial botanical extracts of these plants, and we investigated the time and concentration for lethal results with the green peach aphid, *Myzus persicae*. The concentrations of Ais, pyrethrins from *T. cinearaiaefolium*, rotenone from *D. elliptica*, and matrine and oxymatrine from *S. flavescens*, were determined after their fractionation by liquid chromatography followed by mass analysis and comparison with standard compounds. The extracts were tested for lethality in a bioassay with green peach aphids. Sprays at defined doses were applied to tobacco leaves infested with aphid nymphs. The lethal concentrations (LC50) were 20.4 ppm for pyrethrins, 34.1 ppm for rotenone, and 29.6 ppm for matrine at 48 h after treatments. At 100 ppm application levels, the lethal time LT50 was 13.4 h for pyrethrin, 15.1 h for rotenone, and 14.4 h for matrine. Kaplan - Meier analysis indicated the lethal times for the three botanical extracts at 100 ppm were significantly faster than application of a chemical insecticide, Sulfoxaflor, applied at the recommended level. These results provide baselines to develop and formulate single or mixed preparations containing botanical extracts to control green peach aphids on commercial crops.

Key words: green peach aphid, probit, pyrethrins, matrine, rotenone

P143

Insecticidal activity of 4 insecticides to winter- and summer-form adult of pear psylla, *Cacopsylla jukyungi*

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배에 피해를 주는 해충 중 하나인 주경배나무이는 2~3월 경 배나무의 거친껍질 밑에서 겨울을 난 후 나무 위로 올라가 산란하는데, 이 때를 월동 후 방제적기로 한다. 월동 후 방제에는 주로 기계유유제를 사용하고 있으나 저온피해가 자주 발생하거나 나무의 세력이 약한 농가는 방제 후에 언피해 발생을 우려하여 살충제를 살포하거나 방제를 하지 않는다. 월동 후 발생밀도를 조절하지 못할 경우 생육기에 피해가 커지기 때문에 기계유유제를 대체할 수 있는 약제를 확인하고자 하였다. 또한 2023년 2월 EU 수출 대상 농가에는 아바멕틴 성분의 살충제 사용을 제한하는 규제가 발표되어 생육기에 발생하는 주경배나무이 여름형 성충에도 아바멕틴 성분을 대신하여 적용 가능한 약제를 선정하고자 하였다. 주경배나무이 대상 등록 약제 중 아바멕틴, 아세타미프리드, 이미다클로프리드, 설폭사플로르를 시험약제로 선정하였으며, 약제검정 결과 겨울형 성충에는 아세타미프리드 > 아바멕틴 > 이미다클로프리드 > 설폭사플로르, 여름형 성충에는 아바멕틴 > 설폭사플로르 > 이미다클로프리드 > 아세타미프리드 순으로 살충률이 확인되었다. 살충력 추가 검정 및 여름형과 겨울형 성충의 충체 특성을 비교한 후 기계유유제 및 아바멕틴 성분 대신 사용이 가능한 약제 성분을 권장할 수 있을 것으로 사료 된다.

검색어: 배. 해충, 주경배나무이, 약제검정

Acknowledgements: This research was supported by the research program of RDA (PJ01509505).

P144

Metabolic profiling in *Drosophila suzukii* under combined treatment with a fumigant and low temperature

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Although ethylformate and phosphine fumigants are widely used for pest quarantine, studies related to their mechanism of action and metabolic physiological changes in *Drosophila* models are still unclear. In this study, we investigated how key metabolites altered by fumigants and cold treatment are associated with and affect insect physiology by comparative metabolome analysis. Fumigant treatment significantly altered cytochrome P450 and glutathione metabolites involved in the detoxification mechanism and showed lower expression of PGF2α involved in the immune response compared to the control. Additionally, most of the metabolites functioned in metabolic pathways related to the biosynthesis of amino acids, nucleotides and cofactors.

Key words: *Drosophila suzukii*, ethylformate, phosphine, cold treatment, metabolomics

P145

Occurence of Sporadic and subtropical insect pests in Gangwon state

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강원특별자치도 18개 시군을 대상으로 감나무와 콩에 발생하는 미국선녀벌레, 썩덩나무노린재, 담배거세미나방의 발생을 조사하였다. 돌발해충인 미국선녀벌레는 약충기인 6월과 성충기인 10월에 발생조사를 진행하고 남방계해충인 담배거세미나방과 썩덩나무노린재는 7월과 9월 콩 재배기에 발생조사를 진행하였다. 미국선녀벌레는 강원지역에 있는 감나무에서 발생을 확인할 수 없었고. 감나무 주변 기타 수목에서 가지당 평균 6.7마리 발생하였다. 담배거세미나방은 7월, 속초를 제외한 모든 시군에서 발생이 되었으며, 춘천, 횡성에서 트랩당 60마리가 넘는 발생밀도를 보였으며, 원주, 강릉, 화천 등 에서는 트랩당 1마리로 낮은 발생밀도를 나타냈다. 썩덩나무노린재는 7월 춘천, 속초, 홍천 등 7개 시군을 제외한 11개 시군에서 트랩에 포획되는 것을 확인하였으며, 화천에서 트랩당 26마리로 최고발생밀도를 보였다.

검색어: 돌발해충, 남방계해충, 미국선녀벌레, 썩덩나무노린재, 담배거세미나방

P146

Occurrence status of three major insect pests in orchards in Chungbuk province from 2021 to 2022

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The occurrence status of eggs and adults of *Pochazia shantungensis*, *Lycorma delicatula, and Lymantria dispar* was investigated in the Chungcheongbuk-do region. The results showed that the overwintering eggs of *P. shantungensis* occurred in 24.2% of the region in 2021 and 22.1% in 2022, while adults occurred in 25.2% in 2021 and 24.3% in 2022, indicating the highest occurrence among the pests studies in this research. The occurrence of overwintering eggs of *L. delicatula* was relatively low, with 2.6% of the region affected in 2021 and 1.9% in 2022. Adults of *L.delicatula* occurred in 3.2% of the region in 2021 and 3.6% in 2022, while they were not undiscovered in Jeungpyeong, Jincheon, Goesan, and Danyang areas. Their area of occurrence was less than 3% of the region, and the volume of occurrence was not very large. Overwintering eggs of *L.dispar* occurred in 4.1% of the area in 2021 and 1.7% in 2022, showing a decreasing tendency compared to the previous year, and their occurrence was only low to middle in terms of the degree of occurrence.

Key words: occurrence status, insect pests, *Lycorma delicatula, Pochazia shantungensis, Lymantria dispar*

P147

Control effect of *Scotinophara lurida* (Hemiptera: Pentatomidae) in a drained- and irrigated-paddy field after spraying an organic material including garlic bulb extracts

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Because *Scotinophara lurida* has the habit of living under the rice plant, an introduction of a method for efficient control when spraying eco-friendly organic materials is needed. In this study, we investigated the density of *S. lurida* in drained- and irrigated-paddy field after spraying an organic material containing garlic bulb extracts, which has high insecticidal activity in *S. lurida* in direct spraying test in glass tube. As a result, an irrigated rice paddy showed a control effect of 66.4% after 3 days of spraying and 86.2% after 7 days, while a drained rice paddy showed a control effect of 33.9% after spraying and 61.9% after 7 days. These results suggest that effective control can be achieved in irrigated rice fields if organic farming materials are evenly sprayed and reach to the body of *S. lurida*. It is remained to study how irrigated water do contribute to increase the insecticidal effect in the future.

Key words: *Scotinophara lurida*, rice paddy, environment-friendly organic material, irrigation, control effect

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Preliminary study on the nymphal development of *Scotinophara lurida* (Hemiptera: Pentatomidae) on several Poaceae grasses

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Scotinophara lurida is one of major sap-sucking pests in an organic rice farming paddy fields in Korea. Several Poaceae grasses (e.g, rice, barley etc) have been known as a host plant. To find out a true host plant of *S. lurida*, the developmental characteristics such as weight gain and developmental duration were checked on total eight grasses species including rice and corn. In the results, weight of the fifth nymphal stage was the highest value in the barnyard millet and rice plant. In addition, nymphal duration was the shortest value in the barnyard millet and rice plant. But, in corn and common millet plant, *S. lurida* nymphs could not complete the development to the adult stage. These results suggest that six Poaceae grasses including rice and barnyard millet out of eight test grasses are close related to true host plants of *S. lurida*.

Key words: *Scotinophara lurida*, host plant, development, nymphal duration, weight gain

P149

Development of ensemble background selection method for enhancing the performance of machine learning-based species distribution models

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A machine learning-based algorithms have used for constructing species distribution models (SDMs), but their performances depend on the selection of backgrounds. This study attempted to develop a noble method for selecting backgrounds in machine-learning SDMs. Two machine-learning based SDMs (MaxEnt, and Random Forest) were employed with an example species (*Spodoptera litura*), and different background selection methods (random sampling, biased sampling, and ensemble sampling by using CLIMEX) were tested with multiple performance metrics (TSS, Kappa, F1-score). As a result, the model with ensemble sampling predicted the widest occurrence areas with the highest performance, suggesting the potential application of the developed method for enhancing a machine-learning SDM.

Key words: background selection, MaxEnt, Random forest, model performance

P150

Insecticidal activity of pyrethrum against *Myzus persicae*

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The development of biochemical pesticides to replace existing chemical pesticides and the search for new substances with potential insecticidal ability are continuously required. The purpose of this study is to control *myzus persicae* with pyrethrum biochemical pesticide containing of high concentration of pyrethrin as an active ingredient. Pyrethrum dried powder was extracted with 95% ethanol for different periods of time and it was confirmed that the pyrethrin content increased as the extraction period increased and the extraction conditions for 20 days had the highest yield with 0.2% pyrethrin. We produced a prototype containing 0.13% pyrethrin content (pyrethrin II: 0.06%, pyrethrin I: 0.06%). and in 200 fold dilute spray condition. It showed a 77.2% corrected mortality against *myzus persicae* which is comparable to chemical pesticide. We are continuously researching to reduce the decomposition of active ingredients and look for additives to increase the insecticidal activity.

Key words: *myzus persicae,* pyrethrin, corrected mortality, insecticidal activity

P151

HIPVs enhanced biocontrol potential of a larval parasitoid, *Exorista japonica*

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We investigated the behavioral attractive responses of a lepidopteran larva parasite, *Exorista japonica* to 10 synthetic herbivore-induced plant volatiles (HIPVs). These synthetic HIPVs have been revealed the attractive effect on several parasites. For each of the HIPVs, we asked the following two questions : (1) Which volatiles show the attractiveness to this parasitoid, (2) Whether the attractant directly or indirectly affects the host settlement and parasitism of the parasitoid. To experimentally address these questions, we performed 2 and 4 choice indoor cage tests. *E. japonica* adults were significantly attracted to benzaldehyde and (*Z*)-3-hexen-1-ol showing higher settlement and parasitic rates on *Spodoptera litura* of treatments. Compared to the untreated plots, the average parasitism of *E. japonica* on *S. litura* larvae in the benzaldehyde treatments increased by approximately 20%.

Key words: tachinid flies, HIPVs, Attractant

P152

Eco-friendly control of *Bemisia tabaci* using insecticide-treated tobacco plant in tomato greenhouse cultivation

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This study aimed to develop a new eco-friendly control method of *B. tabaci* using a trap plant treated with systemic insecticide. Due to high preference, tobacco plant was selected as a trap plant among solanaceous plants. Out of all 6 systemic insecticides, dinotefuran WG showed the highest mortality (> 97.3 %) against *B. tabaci*. The concentrations of dinotefuran in tobacco leaves after systemic treatment showed the sharp increase in the pesticide from 2 hrs until 48 hrs (2 d) and steady increase over 35 d. The mortality of *B. tabaci* in tobacco leaves was about 80% at 9 hrs after treatment and over 90% at 1, 2, 3, 6, 9, and 35 d after treatment. The number of *B. tabaci* was counted every week after dinotefuran-treated tobacco pots were placed in the tomato greenhouse cultivation. The density of the insects with 3 tobacco plants was app. 75% lower than the control (w/o tobacco plant).

Key words: *Bemisa tabaci,* trap plant, tobacco plant, tomato greenhouse

P153

Natural enemy utilization technology for environment-friendly strawberry production in greenhouse

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2022년 10월부터 2023년 5월까지 친환경 딸기재배 농가에서 점박이응애는 칠레이리애응애와 사막이리응애, 진딧물은 콜레마니진디벌을 대상으로 하는 천적처리구와 유기농자재를 사용하는 관행방제구에서 천적의 해충 밀도억제 효과를 조사하였다. 천적처리구에서 점박이응애 성충 밀도는 잎당 1.5마리 이하, 알은 4개 이하로 관리되었고, 사막이리응애는 잎당 최대 0.4마리까지 증가하여 점박이응애 밀도억제에 많은 영향을 미친것으로 보인다. 반면, 관행방제구에서 점박이응애 밀도는 천적 방사구에 비하여 오히려 많은 발생량을 보였지만, 3월 9일부터는 사막이리응애의 증가와 유기농자재의 효과로 점박이응애 밀도는 급격하게 감소하였다. 진딧물 천적처리구에서 진딧물 밀도는 1월부터 발생하였으며 3월 상순에 잎당 0.3마리까지 증가하였으나 이후 감소하였고, 콜레마니진디벌은 진딧물 발생이 많지 않아 3.9마리/㎡(2회) 방사하는 데 그쳤다. 한편, 관행방제구 포장의 진딧물은 유기농자재의 영향으로 거의 발생하지 않았다.

검색어: 딸기, 점박이응애, 진딧물, 칠레이리응애, 사막이리응애, 콜레마니진디벌, 밀도

P154

Development of insecticide resistance management platform via recommending alternative insecticide

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농가 현장에서는 미소 해충의 약제저항성 발달로 인하여 방제에 어려움을 겪고 있다. 본 연구는 약제저항성 수준을 효율적으로 진단하고, 화학적 방제 의사결정을 지원할 수 있는 약제저항성 관리 플랫폼을 구축하고자 수행하였다. 플랫폼은 크게 i) 농가 맞춤형 약제 추천, ii) 지역별 약제저항성 지도로 구성되어 있다. 이용자는 잔류접촉법 기반의 생물검정법 RCVpW(Residual Contact Vial plus Water) 결과를 현장에서 입력하면 PLS에 부합한 약제 정보를 제공받을 수 있다. 또한 생물검정 결과는 DB화를 통해 지역별 약제 저항성 정보 지도를 보여줌으로써 해충별, 작물별, 연도별 저항성 패턴 결과를 확인할 수 있다. 본 플랫폼을 활용한다면 약제의 오남용을 줄임은 물론 해충의 약제저항성 발달 지연 및 약제저항성 발달 양상을 확인할 수 있어 향후 방제전략 수립에 활용할 수 있을 것으로 생각된다.

검색어: 약제 저항성, 플랫폼, 잔류접촉법, 해충관리

P155

Insecticidal resistance mornitoring of *Thrips tabaci* local population with residual contact vial method

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2022년 국내 노지 마늘, 대파, 양파, 부추 작물재배지에서 채집한 파총채벌레 지역집단들에 대하여 살충제 저항성을 조사하였다. 제조사 추천약량에서의 살충력은 acrinathrin SC를 제외한 6종 약제들이 안성 등 8개 집단에서 모두 90%이상을 보였으며, Spinetoram SC와 fluxametamide EC는 추천농도의 100배 희석농도에서도 전 지역 집단에 걸쳐 높은 살충력을 보여주었다. 미리 저항성 진단농도로 코팅한 바이알을 이용한 지역집단의 저항성 검정을 실시한 결과, emamectin benzoate의 저항성이 신안 등 9개 지역집단에서 매우 높았으며, chrantraniliprole은 부산 등 4개 , spinetoram은 의성 등 3개, actamiprid와 chlorfenapyr는 각각 1개의 지역집단에서 저항성이 높게 발달하고 있는 것을 확인할 수 있었으며, 지역별로는 주요 대파 및 양파 재배지인 안성, 서산, 진도, 신안 지역의 저항성이 모든 약제에 대하여 전반적으로 높게 나타났다. .

검색어 : 파총채벌레, 살충제, 저항성, 바이알법

P156

Ecofriendly Fall webworms management tools

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Recently, the occurrence of the fall webworm, one of the foreign invasive pests, is rapidly increasing due to the increase in average annual temperature due to global climate changes. In this study, we are presenting diverse eco-friendly technologies to control the fall webworm. (Grant No. PJ014845032023).

Key words: Fall webworm, invasive pests, food additives, ds-RNAs

P157

Integrated pest management of *Tyrophagus putrescentiae* (Schrank) using heat, acaricides, ultrasound and essential oils

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긴털가루진드기(*Tyrophagus putrescentiae*)는 주로 실내에 서식하며 알레르기 및 호흡기 질환을 일으키는 주요 해충이다. 주로 침구류에서 발생하며, 사람이나 동물로부터 떨어진 각질과 비듬 또는 저장 곡식 등을 주요 먹이원으로 한다. 암컷 한 마리가 일생에 200~300개의 알을 산란하기 때문에 빠르게 번식할 수 있으며, 육안으로 확인할 수 없는 크기이기 때문에 관찰 및 관리가 불가능하다. 하지만 긴털가루진드기로 인해 발생하는 알레르기에 관한 연구는 환자의 치료에 초점이 맞춰져 있기 때문에, 근본적으로 알레르기를 발생시키는 원인을 해결할 수 있는 방안이 부족한 상황이다. 본 연구에서는 가정에서 발생할 수 있는 긴털가루진드기를 효과적으로 방제하기 위한 통합적 방제 전략을 제시한다. 열, 살비제(Chlorfenapyr, Spiromesifen, Pyflubumide), 초음파, Essential oil(Lemongrass, Peppermint)을 사용하여 살비 및 기피 효과를 확인하였다. 고온 노출은 100% 살비 효과를 보여주었으며, 살비제는 3시간 동안 90% 이상의 살비 효과를 보여주었다. 긴털가루진드기가 초음파에 노출되었을 때 23%의 기피 행동을 관찰하였으며, Essential oil(Lemongrass, Peppermint)을 유인용 먹이에 처리했을 때, 긴털가루진드기 97%의 접근을 차단하였다. 본 연구를 통해 실내 알레르기의 가장 중요한 원인으로 주목받는 긴털가루진드기에 대한 체계적인 방제 전략을 적절한 환경에 적용시킴으로써, 집먼지진드기로 인한 알레르기 및 호흡기 질환 발생을 감소시키고 안전한 주거 환경을 조성할 것으로 기대한다.

검색어: 집먼지진드기, 긴털가루진드기, 고온, 살비제, 초음파, Essential oil

P158

Strategy for managing *Scirtothrips dorsalis* on tropical/subtropical fruits in post-harvest storage condition using ethyl formate fumigation

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As global warming and consumer's preference for tropical/subtropical fruits increase, the number of orchards cultivating tropical/subtropical fruits in Korea is increasing. Accordingly, concerns about the introduction of exotic invasive pests that host tropical fruits. In this study, efficacy of ethyl formate(EF), as alternative to methyl bromide(MB), was evaluated. Commercial trial of EF was conducted in mango post-harvest storage conditions for controlling *Scirtothrips dorsalis*. Application of 10 g/m^3 of EF for 4 hours at 10 ℃ showed proven efficacy on *S. dorsalis* without any phytotoxic damage on mango fruits in that condition.

Key words: mango fruit, ethyl formate, alternative, *Scirtothrips dorsalis*, quarantine disinfestation

P159

Strategy of phytosanitary treatment on export sweet persimmon for controlling *Asiacornococcus kaki* using ethyl formate

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Sweet persimmons are valuable commodity in the export market. However, present of insect pest such as *Asiacornococcus kaki* can cause limit to many export markets. In this study, ethyl formate(EF), as alternative to methyl bromide(MB), was used in scale-up commercial trial(20ft reefer). Application of 50 g/m^3 of EF for 6 hours at 5 ℃ showed proven efficacy against all developmental stages of *A. kaki* without LLDPE-packaging fruits and no phytotoxic damage on sweet persimmons. This study demonstrated that EF fumigation can be effectively control to target *A. kaki* before packaging with LLDPE-film of fruits.

Key words: Sweet persimmon, ethyl formate, *Asiacornococcus kaki*

P160

Application of artificial neural network to predict occurrence of pine wilt disease

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Pine Wilt Disease (PWD) is a disease causing mass deaths of pine trees in South Korea, and the dead trees serve as breeding grounds for insect vectors responsible for spreading the disease to other host trees. Because the PWD requires early monitoring to minimize its damage on domestic forestry, this study aims to develop a species distribution model for predicting the potential distribution of PWD by using artificial neural network (ANN) with time-series data. Among the architectures, the Convolutional Neural Network exhibited the highest performance, achieving a validation accuracy of 0.854 and a cross-entropy loss of 0.401, and the InceptionTime model emerged as the second-best performer. This study identified the best-performing ANN architecture for a spatiotemporal evaluation of PWD occurrence, emphasizing the importance for determining hyperparameters with ecological characteristics and data types to apply deep learning into SDMs.

Key words: artificial neural network, deep learning, pine wilt disease, species distribution modeling, time series data

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Occurrence pattern and biological management on *Scotinophara lurida* (Pentatomidae, Hemiptera) in Korea

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먹노린재의 방제시기 설정을 위하여 서식지 내 발생 양상을 조사하였다. 전라남도를 중심으로 돌발 대량 발생한 먹노린재의 발생 조사는 2023년도 벼의 모내기가 완료된 시점부터 전남 곡성군 석곡면과 여수시 화양면 일대의 친환경단지에서 주 1회 실시하였으며, 벼의 수확이 완료되는 시점까지 진행될 예정이다. 금년도 발생 조사 결과는 지난 2021년도 결과와 비교하여 분석하고자 하였다. 현제까지의 결과, 여수시의 친환경단지 내 먹노린재의 발생은 모내기가 완료된 이 후 2주 경과 시점에서 발견되었으며, 곡성군은 4주 경과 시점에서 발견되었고, 발생 최고점은 여수시의 경우 모내기 후 6주 경과 시점으로, 곡성군의 경우 5주 경과 시점으로 나타났다. 먹노린재의 대발생이 지속되던 2021년도의 결과와 비교하였을 때, 2023년도 결과도 유사한 것으로 나타났다. 이에 따라, 먹노린재 친환경제재 살포 시기는 모내기 후 2주 경과 시점이 적절한 것으로 나타났으며, 2차 방제 시점에 대해서는 추가 조사를 통해서 제안하고자 한다.

검색어: 먹노린재, 발생소장, 돌발해충, 친환경단지, 방제시기

※ 본 연구는 중소벤처기업부 지역특화산업육성+(R&D) 사업(과제번호 : S3363156)의 지원을 받아 수행되었음을 고지합니다.

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Attraction effects of sticky traps on thrips by color in *Mangifera indica*

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최근 기후변화에 따라 아열대 작물 재배가 증가하면서 경남지역 망고 재배면적도 크게 증가하고 있다. 하지만 망고에 발생하는 병해충 발생 정보가 부족하여 2022년부터 현재까지 경남지역에 있는 망고농장을 조사하였으며, 그 결과 병해 6종, 해충 8종 발생을 확인하였다. 특히 경남지역 망고 포장에서 꽃노랑총채벌레, 대만총채벌레, 볼록총채벌레 등의 발생을 확인하였고, 통영, 함안, 밀양 등에서 총채벌레류에 의한 피해가 발생하였다. 많은 농가에서 총채벌레류 방제를 위해 화학농약에 의존하고 있으나 총채벌레는 반복적인 약제 노출시 빠른 세대 진전으로 인해 저항성 발달이 쉽기때문에 방제에 어려움을 겪고 있다. 이러한 문제를 해결하고자 색상별 끈끈이 트랩의 총채벌레류 유인효과를 확인하였으며, 꽃노랑총채벌레는 노랑, 주황, 연두, 대만총채벌레는 빨강, 노랑, 파랑, 볼록총채벌레는 파랑, 노랑, 빨강 순으로 유인효과가 높은 것을 확인하였다.

Key words: *Mangifera indica, Frankliniella occidentalis,* Sticky trap

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Major pest and organic agricultural materials for control in *Sophora flavescens*

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유기농업자재 제조 원료가 되는 주요 식물인 제충국, 고삼, 데리스, 님 등은 대부분 수입에 의존하고 있는 실정으로 제품수급, 효용성 및 안전성 등에 빈번한 문제가 발생되고 있다. 이러한 문제점을 해결하기 위하여 국내 자생식물을 추출물 원료로 이용하기 위한 연구를 수행하고 있다. 이중 마트린이 함유되어 살충제로 이용되고 있는 고삼에 흰가루병, 총채벌레, 줄붉은들명나방, 담배거세미나방, 거품벌레류가 발생하여 피해를 주었다. 특히 줄붉은들명나방(*Uresiphita prunipennis*)은 7월 하순부터 9월 중순까지 발생하여 엽육을 갉아먹고 엽맥만 남기는 피해를 주었고, 피해주율은 11% 였다. 이를 방제하기 위해 18종의 유기농업자재의 살충효과를 조사한 결과 주성분이 마늘추출물 80%, 데리스추출물 70% 등인 자재 6종이 80% 이상의 살충률을 나타내었다.

검색어: 고삼, 줄붉은들명나방, 유기농업자재

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Occurrence and insecticidal effect of fall armyworm, *Spodoptera frugiperda* at corn fileld in Jeonbuk

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열대거세미나방이 2019년 국내에 첫 비래한 이후 매년 비래하고 있으며 옥수수 등에서 피해를 주고 있음에 따라 전북지역 주요 옥수수 재배지역에서의 열대거세미나방 발생양상과 약제방제 효과를 조사하였다. 2022년도에 성페로몬트랩을 이용하여 성충유인량을 조사한 결과 7월 1일 첫 채집되었으며 8월 중순이후 채집량이 증가하여 9월 중순과 10월 중순에 발생최성기를 보였으며 11월 상순까지 유인되었다. 2022년과 2023년에 식용 옥수수 재배지역에서 열대거세미나방 유충 피해 조사 결과 6월 수확하는 옥수수에서는 열매피해가 없었으나 9월에 수확하는 옥수수에서는 피해열매율이 30% 이상인 포장들이 관찰되어 재배시기에 따라 피해 정도 차이가 매우 큰 경향이었다. 옥수수 포장에서 열대거세미나방 유충 방제를 위해 2~3령기에 인독사카브 액상수화제를 7일 간격으로 2회 살포한 결과 처리 7일 후 방제효과는 91.7%로 높았다.

검색어: 열대거세미나방, 페로몬트랩, 피해, 방제

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Nanoparticle-Shielded dsRNA enhance the stability of dsRNA in the honeybee, *Apis mellifera*

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The ectoparasitic mite, *Varroa destructor* is one of the most destructive pests of the honeybee (*Apis mellifera*) leading to the collapse honey bee colony in many regions of the world. RNA interference (RNAi) is a novel approach recently proposed for insect pest control. However, the efficiency of RNAi in insects is low due to the lack of effective delivery methods for dsRNA and sensitivity to nuclease degradation. Therefore, the success of RNAi technology largely depends on the stability of dsRNA. To explore the possibility of using RNAi to control varroa mite, we determined the effects of dsRNA targeting a subunit of the cytoplasmic coatomer protein complex B2, D, and E subunits on target gene expression for varroa mite. We observe that dsRNA ingested by bees is transferred to the varroa mite, resulting in knockdown of COPB2 expression. Furthermore, we demonstrate that chitosan nanoparticles-dsRNA complexes were more stable for 7 days in honeybee tissue fluids. The dsRNA-conjugated with chitosan was protected from degradation in hemolymph, fat body, and midgut extracts collected from the honeybee. These results possibly suggest that nanoparticles-dsRNA complexes might be horizontally transferred from treated honeybee to varroa mite, in which case the honeybees could serve as RNAi vectors. We confirmed, moreover, dsRNA fed nontarget insects, honeybee, were unaffected, and no toxicity was observed for honeybee. Overall, these data suggest that dsRNA-conjugated with chitosan help escape effectively from degradation by honeybee tissue fluids and could improve RNAi efficiency in varroa mite.

Key words: RNA interference (RNAi), *Apis mellifera*, *Varroa destructor*, Coatomer protein, Chitosan

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Characteristics of entomopathogenic nematode *Heterorhabditis megidis* (Rhabditida: Heterorhabditidae) GJ1-2 from Korea

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곤충병원성 선충인 *Heterorhabditis. megidis*(큰형광병원선충)는 참나무 군락지(광주광역시 소재) 사양토에서 분리 동정되었고, 곤충병원성을 가지는 공생세균은 *Photorhabdus temperata*로 분리 동정되어 각각 GJ1-2로 명명하였다. *H. megidis* GJ1-2는 고추(녹광), 애호박(농우), 오이(백다다기), 참외(금싸라기), 토마토(베타티니) 유묘기 경엽처리와 배추(씨알천하일품), 상추(진청맛), 완두(청진주), 수박(삼복꿀), 무(서호) 유묘기 관주처리에서 21일차까지 기준량과 배량에 대하여 약해(약해 판정기준결과: 0)가 나타나지 않았다, *H. megidis* GJ1-2는 배추 파밤나방에 대한 방제 효과는 이천시(경기도 소재)와 수원시(경기도 소재)의 시설재배 포장에서 각각 경엽처리 3일차 71.8%. 73.9%, 7일차 86.2%, 84.6%로 나타났으며, 옥수수 열대거세미나방에 대한 방제 효과는 제주시(제주특별자치도 소재)의 노지(미사질 양토)에서 경엽처리 7일차 82.6%로 나타났다. 그리고 *H. megidis* GJ1-2는 랫드를 이용한 급성경구와 급성경피 독성시험 반수치사농도(LD_{50}) 값은 2,000 mg/kg B.W 초과로 IV급(저독성)으로 구분되었고, 토끼를 이용한 피부와 안점막에 자극성이 없는 것으로 구분되었다. 그리고 담수어류(송사리)에 대한 급성독성시험 반수치사농도(LD_{50}) 값은 영향을 미치지 않는 기초시험농도 100 mg/L를 초과하였다.

검색어: 곤충병원성 선충, 큰형광병원선충, 공생세균, 파밤나방, 열대거세미나방, 방제 효과, 독성

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Attractive effect of a combination treatment of aggregation pheromone and kairomone against Asian Longhorned Beetle, *Anoplophora chinensis*

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최근 친환경 노지 감귤원을 중심으로 알락하늘소 피해가 증가하고 있지만 효과적인 예찰 방법이 없는 실정이다. 본 연구에서는 알락하늘소 성충 예찰을 위하여 카이로몬을 선발하였고, 알락하늘소가 다발생(>100마리)한 과원 3개소에서 유인력을 평가하였다. 시험 결과, 집합페로몬 단독처리 시 알락하늘소 암컷 성충에 대한 유인효과를 확인할 수 있었지만 소수 개체만 유인이 되었고, 카이로몬(Kairomone) 단독 처리 시 알락하늘소 성충 포획수가 증가하는 것을 확인할 수 있었다. 집합페로몬과 카이로몬을 동시 처리 시 알락하늘소가 대량으로 유인되는 것을 확인할 수 있었다. 이는 알락하늘소가 종내신호물질(집합페로몬)을 인지할 때 서식지로서 적합한지 판단의 기준으로 기주식물의 존재여부를 동시에 확인하기 때문인 것으로 판단된다.

검색어: 알락하늘소, 카이로몬, 집합페로몬, 방출기

*본 성과물은 농촌진흥청 연구사업(과제번호: PJ01361802)의 지원에 의해 이루어진 것임

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Investigation of the pest control effect using bulbill deeping methods

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마늘은 백합과 알리움속에 속하는 영양체작물로 누대재배시 수확량이 감소하는 특성을 보인다. 마늘의 화경 끝에는 주아가 생성되는데, 주아를 파종하여 2년이상 누대재배시 수확량이 약 15% 이상 증가하기 때문에 주아재배를 통한 종구 갱신이 필요하다. 마늘 주아를 수확 후 저장시 파총채벌레, 파좀나방 등이 발생하며, 저장 중 주아는 매년 평균 20% 이상의 부패한다. 주아재배를 원활히 하기 위해 주아 저장 시 해충의 방제를 통해 부패율을 줄이는 것이 중요하다. 본 연구에서 주아에서의 해충 발생밀도 및 방제방법에 대한 연구를 진행하였다. 연구결과 주아에서 파총채벌레는 7월 3주차, 파좀나방은 7월 2주차에 각각 발생최성기를 보였으며, 약제 침지시 방제가가 90% 이상 관찰되었다. 약제 침지된 주아 파종시 약해는 발생하지 않아, 주아 해충 방제시 침지법을 활용하여 해충의 밀도를 조절 할 수 있을 것으로 판단된다.

검색어: 마늘, 건조, 저장, 주아 , 파총채벌레, 파좀나방

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Survey on the storage efficiency of northern type garlic against drying methods

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마늘은 백합과 알리움속에 속하는 작물로 약용, 양념채소로 많이 소비되어져 왔다. 마늘은 6월에 수확하여 1개월 간의 건조과정을 거치게 되는데 보통 장마기와 겹치게 되어 연평균 부패율은 5%이상으로 높다. 마늘의 저장중 병해충은 뿌리응애, 마늘혹응애, 마른썩음병 등으로 섭식에 따른 부패를 유발하며, 건조시기를 단축하고 효율적인 건조를 통하여 감모율을 줄이는 것이 중요하다. 마늘의 병해충 피해를 줄이기 위해 개발한 열풍 흡기식 건조장치를 포함하여 관행, 열풍 건조기, 흡기식 건조 등 4가지 방법으로 마늘을 건조하였으며, 방법별 건조소요일수, 부패율 등을 조사하였다. 연구결과 열풍-흡기식 건조장치의 순환 공기의 온습도는 외기대비 7.8℃ 높았고, 28.6% 낮았으며, 건조 소요일수는 관행건조 대비 31% 수준으로 우수하였다. 또한 병해충 피해 양상은 관행 건조 대비 4.4%p낮아 건조 기간 및 정상품율이 관행 대비 우수하여, 관행 건조를 대체 가능할 것으로 생각된다.

검색어: 마늘, 건조, 저장, 뿌리응애, 마늘혹응애

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A effective *Neodryinus typhlocybae* adult female production method

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미국선녀벌레는 2009년 발견이후 현재 131개 시군에 15,730ha가 발생되고 있다. 주로 단감 등 10여종 이상의 작물을 흡즙하여 피해를 준다. 2017년 이탈리아 파도바 대학에서 천적인 선녀벌레집게벌(*Neodryinus typhlocybae*)을 도입하여 국립농업과학원에서 생태특성 조사, 대량사육 기술개발 및 미국선녀벌레 발생 현장에 방사하고 있다. 선녀벌레집게벌은 미국선녀벌레 어린약충(1~3령)에 기생하면 암컷의 비율이 낮고 수컷은 2화성 개체가 많아져 생산이 비효율적이다. 본 연구에서 어린약충에 기생할 때 보다 노숙약충에 기생할 경우 3배정도 암컷생산의 비율이 높아졌고, 월동하고 있는 고치들을 5월 중순 무렵에 20℃의 서늘한 곳에 보관하면 우화시기를 상온에 놓아둔 것에 비해 10일 이상 늦추는 결과를 얻었다.

검색어: 미국선녀벌레, 선녀벌레집게벌, 생산방법

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Effects of temperature on functional response of *Aphidius colemani* Viereck (Hymenoptera: Braconidae) on the green peach aphid, *Myzus persicae* (Sulzer)

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We investigated the functional response of aphid parasitoid, *Aphidius colemani* Viereck (Hymenoptera: Braconidae), on the green peach aphid, *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) at four different constant temperatures (15, 20, 25 and 30°C). Seven host densities (2, 4, 8, 16, 32, 64, and 128) were used during a 24-h period. A type III functional response for *A. colemani* was fit separately at each constant temperature. The estimated handling times at 15, 20, 25, and 30°C were 0.85, 0.61, 0.41 and 0.88 day, respectively. The proportion of aphids that were parasitized showed the similar characteristics curve at four different constant temperatures.

Key words: *Aphidius colemani*, *Myzus persicae*, functional response, temperature, attack rate, handling time

Acknowledgments: This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ01606002)" Rural Develpment Administration, Republic of Korea.

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Oviposition characteristics of *Bactrocera dorsalis* (Hendel) on host fruits and vegetables

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The oriental fruit fly, *Bactrocera dorsalis*, is one of important agricultural pests that attack a wide range of fruits and vegetables. Adult female can cause direct damage by laying eggs under the skin of fruits and vegetables. The eggs hatch into larvae that feed in the decaying flesh of the agricultural crops. Damaged fruits and vegetables quickly become inedible or dropto the ground. We investigated the oviposition characteristics of *B. dorsalis* on twelve fruits and seven vegetables. *B. dorsalis* marked the oviposition places on every crop tested. *B. dorsalis* laid eggs into the fruits and vegetables except lemon and passionfruit. We examined the adult emergence from infested crops.

Key words: *Bactrocera dorsalis*, adult emergence, host crop, oviposition

Acknowledgments: This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ01672001)" Rural Develpment Administration, Republic of Korea.

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Surveillance of hard ticks in southern part of Gyeongsangbuk-do in Republic of Korea, 2023

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SFTS(Severe Fever with Thrombocytopenia Syndrome)는 참진드기에 의해 전파되며 한국에서는 제3급 법정 감염병으로 지정되어 있다. SFTS 감염 시 치사율이 높은 편이며, 현재까지도 백신과 치료제가 없다. 이러한 참진드기의 발생 및 분포 조사와 SFTS 감염 여부를 확인하기 위해 2023년 4월부터 8월까지 김천시와 군위군 4곳의 환경(무덤, 산길, 잡목림, 초지)에서 Dry ice trap으로 채집을 진행하였다. 김천시에서는 총 1,444마리의 참진드기가 채집되었으며, 잡목림에서 571마리(39.5%)로 가장 많이 채집되었다. 군위군에서는 총 3,914마리가 채집되었으며, 무덤에서 2,701마리(69.0%)로 가장 많이 채집되었다. 참진드기의 종별 분포를 조사한 결과, 외형 동정이 어려운 유충을 제외하고 김천시에서는 *Haemaphysalis longicornis*가 1,160마리(99.3%)로 가장 많이 채집되었고, 군위군에서는 *Haemaphysalis longicornis*가 1,414마리(98.6%)로 역시 가장 많이 채집되었다. 채집된 참진드기의 SFTS 보유 여부를 확인하기 위하여 Nested PCR을 이용해 조사한 결과, SFTS를 보유한 참진드기는 발견되지 않았다. 본 조사에서는 SFTS에 감염된 참진드기 개체가 발견되지 않았지만, SFTS에 감염된 환자가 2016년부터 매년 160명 이상 발생하고 있으므로 체계적인 감시와 조사가 필요할 것으로 생각된다.

검색어: 참진드기, *Haemaphysalis longicornis*, SFTS

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Attractiveness of *Dioryctria abietella* (Lepidoptera;Pyralidae) pheromone trap according to tree height

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솔알락명나방(*Dioryctria abietella*)의 유충은 잣나무 구과를 가해 하는데, 피해를 심하게 받은 구과 종자의 손실량은 20.3%이며, 잣나무에서 구과피해율이 평균 25.7%에 달하여(이성찬, 2014), 잣 생산에 막대한 영향을 미치고 있다. 잣나무에서 페로몬 트랩의 설치 높이에 따른 솔알락명나방의 유인 효과 조사를 위하여 고가작업차를 이용하여 잣나무림 지상부, 수관하부, 수관중부, 수관상부에 페로몬 트랩을 설치하였다. 페로몬은 케이아이피에서 구입 하여 사용하였으며 트랩은 델타트랩을 설치하였다. 4월 26일에 최초 설치를 시작하여 기상상황에 맞게 10~15일 간격으로 수거하여 유인된 개체수를 조사하였다. 5월 초순에 4개 개체가 채집되기 시작하였으며, 6월 하순에 136개체가 채집되어 최대 밀도가 채집되었으며, 이후 점차 밀도가 감소하다가 8월 부터 밀도가 다시 증가하였다가 8월 중순 이후부터 다소 감소하기 시작하였다. 6월 초순에는 채집개체가 전혀 없었는데 이는 5월 하순부터 잣나무 송화가루가 날리면서 끈끈이트랩을 오염시켜 끈끈이트랩의 접착력이 떨어진 것에 기인한 것으로 판단되었다. 수고별 솔알락명나방 페로몬 트랩 유인효과는 채집된 개체의 99.0%가 수관 상부에서 채집되었으며, 2개체만이 수관중부에서 채집되었다. 수관하부와 지상에 설치된 트랩에서는 전혀 채집이 되지 않아 페로몬 트랩의 설치 높이에 따라 유인 효과가 매우 다른 것으로 나타났다.

검색어: 잣나무, 솔알락명나방, *Dioryctria abietella,* 페로몬 트랩, 수고, 델타트랩

P175

Effects of host plant on the development and reproduction of *Agrotis ipsilon* (Lepidoptera: Noctuidae) on horticultural crops

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One of cosmopolitan pest, *Agrotis ipsilon*, causes serious economic damages in horticultural crops. This study compared the host fitness of *A. ipsilon* among nine major horticultural crops in Korea. Among the nine crops, the population of *A. ipsilon* failed to complete its development in spinach, cucumber, melon, and kidney bean. The host effects on development and reproduction of *A. ipsilon* were further investigated in the remained five crops. Host plants significantly ($P < 0.05$) affected the development-related factors of *A. ipsilon* eggs, larvae, and pupae. They also affected the adult reproduction-related factors including preoviposition period, oviposition period and number, and longevity except for the prepupa stage. A positive relationship was found be tween biological factors. Among the nine crops in this study, napa cabbage showed the highest suitability for the *A. ipsilon* populations. These findings in this study would be helpful to understand the ecology and develop the man agement tactics of *A. ipsilon* in horticultural crops.

Key words: *Agrotis ipsilon*, host effect, host fitness, horticultural crop

P176

Temperature and relative humidity mediated life processes of Spodoptera species (Lepidoptera: Noctuidae)

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Spodoptera species (*S. exigua* and *S. litura*) are important pests of several crops and vegetables in Korea. We investigated development processes of Spodoptera species under constant temperatures (20, 25 and 30 °C) regimes and relative humidity (RH) (30-35, 50-55, 70-75, and 90-95%) conditions. We collected eggs of Spodoptera species by releasing them into a rectangular box inner walls covered with a sheet of white paper. Temperature and RH significantly impacted on oviposition, immature survival, adult emergence and longevity of Spodoptera species. Maximum number of eggs, shorter developmental time, higher adult emergence with longer longevity were reported in 70-75% at 30 °C. Minimal eggs and larval survival were recorded in 30-35% and 90-95% RH, respectively. This results suggest that temperature and RH had individual apparent effect on the developmental processes of Spodoptera species instead interactive effect. Therefore, there is chance to cause a significant damage to field crops and vegetables in 70-75% at 30 °C.

Key words: Polyphagus pests, developmental processes, interactive effects, management, climate change

P177

Occurrence of *Ricania sublimata* (Hemiptera: Ricaniidae) and study of surveillance at Omija (*Schizandra Chinesis* Baillon) orchard in Gyeongbuk Province

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Ricania sublimata are insects invaded in South Korea from China 2011. It has been happening continuously since invaded and It is established and continues to increase and occur in various crops such as persimmons, peaches, and apples. The nymphs and adults of *R. sublimata* causes damage by sucking the stems and leaves of trees. Yellow, blue, and white sticky traps (25x15cm) were installed in the 1000m^2 Omija(*Schizandra Chinesis* Baillon) orchard september 2020 and the trap captures by color was investigated. In addition, yellow sticky traps were installed at heights of 1m, 1.7m, and 2m, and the trap captures according to the height was investigated. As a result of attraction according to the color of the sticky trap, yellow trap was the most attractive, blue and white traps had little attraction. And result of capture according to the yellow sticky trap height the most were caught at 1.7m height, followed by 1m and 2m in that order. Therefore, it is considered reasonable to investigate the density and monitoring of *R. sublimata* using yellow sticky trap.

Key words: *Ricania sublimata*, Omija(*Schizandra Chinesis* Baillon), occurrence, control, oversea invasive

P178

Ecology and control timing of Pale green plant bug occurrence in vineyards

Myungkyu Song[1], Yeuseok Kwon[1], Changwon Jeong[1], Eunjin So[1], Doyeon Cho[1], JaeCheol Hwang[1], Yunsang Lee[1], Joohyung Kim[1] and Gilha Kim[2]

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2022년 캠벨얼리 재배면적은 4,397ha(32.7%)으로 샤인머스캣에 이어 두 번째로 많이 재배하는 품종이다. 포도 과원에서 보고된 장님노린재에는 애무늬고리장님노린재와 초록장님노린재가 있으며, 포도 신초를 가해해 잎이 자라면서 구멍이 나고, 포도알을 흡즙해 포도알 표피를 코르크화해 상품성을 떨어뜨린다. 애무늬고리장님노린재는 약충은 3~4mm, 성충은 4~5mm 정도이며, 몸 색깔은 엷은 녹색을 띄고, 다리(설상부) 끝이 검어 초록장님노린재와 구분된다. 조사지점에서는 애무늬고리장님노린재만 채집되었으며, 나무당 0~4.8마리가 발견되었다. 4월 하순 상대습도 40% 이상이고, 일평균기온이 13℃ 이상 10일 정도 경과하였을 때 알에서 부화해 신초를 가해하기 시작했다. 5월 하순부터 성충이 되며, 포도원 살충제 살포로 인해 개체수가 감소하였다가 7월 초경에 초목성 식물에서 포도원으로 들어와 새로 나오는 포도 부초를 가해하였다. 방제시기에 따라 상품과일 무게가 차이가 났는데 잎전개기, 꽃송이분리기, 착과기 3회 방제시 수량감소율이 1%인데 비해 잎전개기에만 방제시 3.5%, 꽃송이분리기에만 방제시 7.9%, 무처리구에서는 15.6%로 방제 시기에 따라 상품과일 감소량이 차이나는 것을 알 수 있었다.

검색어: 포도, 장님노린재, 피해, 발생, 밀도

P179

Ecology and control timing of grape leafroller in “Campbell early” and “Chungrang” vineyard

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2022년 캠벨얼리 재배면적은 4,397ha(32.7%)으로 샤인머스캣에 이어 두 번째로 많이 재배하는 품종이다. 또한 충랑은 2018년에 품종등록된 3배체(캠벨얼리×고치) 포도로 신품종 연구가 필요한 품종이다. 연무늬들명나방(*Syllepte pallidinotalis*)은 캠벨얼리와 신품종 충랑에서 잎의 가장자리를 말고 그 속에서 잎을 갉아먹는 해충으로 잎에 피해가 관찰되었다. 연중 포도원에서 연무늬들명나방의 밀도는 7월 중순과 9월 하순에 2번의 peak를 보였다. 알에서 부화한 유충이 2령이 되면 잎을 말고 안에 숨기 때문에 잎을 말은 이후 약제 살포시 잎 안에 잘 묻지 않아 방제가가 떨어졌다. 특히 생물농약인 비티제를 이용해 방제를 할 경우 잎을 말기 직전인 6월 중순에 살포했을 때 93.5%의 방제가를 보였으나, 5월 하순이나 7월 초순 방제할 경우 73.9, 43.6%로 낮은 방제가를 보였다. 따라서 잎을 말기 직전인 6월 중순, 8월 하순에 방제를 하는 것이 효율적임을 알 수 있었다.

검색어: 포도, 들명나방, 캠벨얼리, 방제, 생태

P180

Comparison of the effect of attractants and straps on *Bactrocera dorsalis*

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Fruit Flies (Diptera: Tephritidae) are polyphagous, highly invasive pests in which female adults lay eggs under the skin of fruit and larvae damage the fruit. Among them, the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) was first reported in Taiwan and is distributed throughout much of Southeast Asia, including Vietnam, as well as on the African continent and in the Pacific region. In order to prevent the introduction of pests into country, the Animal and Plant Quarantine Agency has designated them as prohibited pests and is conducting surveillance and investigation on their occurrence. The experimental countries were Taiwan and Vietnam, and statistical analysis was conducted based on the number of *B. dorsalis* caught by setting up traps for about 8 months. Methly eugenol (ME; 4-allyl-1,2-dimethoxy-benzene) is a widely distributed natural plant and is used because it strongly attracts males of *B. dorsalis*. The experiments aimed to verify the effect of attractant formulations (liquid, solid, wax) and traps (Delta trap, Lynfield trap, Steiner trap) on *B. dorsalis*.

Key words: *Bactrocera dorsalis*, fruit fly, oriental fruit fly, male lure, trap, methly eugenol

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Characteristics of insect appearance during wheat cultivation in an organic Soybean-Wheat production system

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유기농 논이용 콩-밀 생산체계에서 재배유형별 밀 파종 전 경운여부에 따라 경운/무경운 처리, 콩 재배시 비닐 피복 여부에 따라 피복/무피복 처리, 논의 생태적 개선 여부에 따라 개선/대조구 처리로 시험구를 조성하여 밀 재배 중 곤충자원의 출현 및 분포특성을 조사 비교하였다. 출현 곤충의 총 종수는 20종으로 경운 14종, 무경운 14종으로 차이는 없었고 피복 14종, 무피복 16종이었으며 개선구 18종, 대조구 13종으로 개선처리에서 곤충 출현 종수가 많았다. 출현 곤충의 총개체수는 경운 124개체, 무경운 76개체로 경운처리에서 많았고, 피복 100개체, 무피복 100개체로 차이가 없었으며 경운-무피복-개선에서 40개체로 가장 많았다. 유기농 밀에 피해를 주는 해충으로 노린재류는 갈색날개노린재가 가장 많이 발생하였고, 메추리노린재, 시골가시허리노린재도 출현하였으며 재배유형별 발생 개체수는 경운 81마리, 무경운 39마리로 경운에서 많았고, 무경운-피복-대조(7) = 무경운-무피복-대조(7) < 무경운-무피복-개선(9) < 경운-피복-개선(12) < 경운-무피복-대조(13) < 무경운-피복-개선(16) < 경운-피복-대조(27) < 경운-무피복-개선(29) 순으로 발생하였다.

검색어: 유기농, 논, 곤충, 콩, 노린재류

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Distribution characteristics of aquatic insect ecological resources in rice fields of organic ecological agricultural complex

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유기농 생태농업단지 논에서 출현하는 수서곤충의 생태자원 분포 특성을 비교하고자 유기농 단지 논에 둠벙이 있는 조건과 둠벙이 없는 조건에서의 수서곤충상을 조사하여 관행 논의 분포 특성을 비교하였다. 수서곤충 출현은 둠벙이 있는 유기농 논 5목 15과 26종 413개체, 둠벙이 없는 유기농 논 5목 14과 22종 236개체, 관행 논 5목 11과 16종 155개체로 유기농 논에서 관행 논에 비해 수서곤충의 출현 과, 종 및 출현 개체수가 많았고, 유기농 논에서도 둠벙이 있는 조건에서 종수 및 개체수가 많음을 확인하였다. 특히 잠자리목의 경우 유기농 논 4과 8종 134개체, 둠벙이 없는 유기농 논 3과 5종 35개체, 관행 논 2과 4종 12개체로 전체 출현 종의 발생특성과 유사한 경향을 보였는데, 유기농 재배의 특성상 농약의 피해로부터 수서곤충에 안전한 환경이 조성된 점과 둠벙의 담수 및 다양한 수서생물의 발생으로 수서곤충의 서식조건에 유리하게 작용되었다고 보인다. 반면 파리목에서는 둠벙이 있는 유기농 논 3과 3종 18개체, 둠벙이 없는 유기농 논 3과 3종 25개체로 관행 논 2과 2종 24개체보다 발생양상이 다른 수서곤충에 비해 상대적으로 낮고, 관행 논보다 깔다구류의 개체수 19개체보다 각각 6개체, 12개체로 적게 출현한 점에서 유기농 재배유형과 둠벙의 서식처 제공이 수서곤충의 출현 및 분포에 건전성을 조장하는 방안이라고 판단된다.

검색어: 유기농, 생태농업단지, 논, 수서곤충, 분포

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Seasonal occurrence and distribution of insect pests and their natural enemies in Paprika Greenhouses

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Seasonal occurrence and distribution of insect pests and their natural enemies were investigated in several Paprika greenhouses(different pest control histories). Even in the environmental-controlled greenhouses with natural enemies for controlling insect pests, there were differences in occurrence and distribution of insect pests and natural enemies by season. From March after planting, aphids and whiteflies(*Myzus persicae* and *Bemisia tabaci*) had partially occurred in all experimental greenhouses. During summer season, whiteflies and leaf mites primarily occurred and insect pest species occurred in this season were more diverse than the winter season. In the winter season, whiteflies predominantly occurred in both natural enemies and pesticide-treated Paprika greenhouses. Predatory mite, *Amblyseius swirskii* was difficult to maintain their populations under an average temperature below 18℃ and relative humidity below 60%.

Key words: sweet bell pepper, *Amblyseius swirskii*

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Study on spatail and temporal changes in butterfly communities in Mt. Hallasan

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나비류는 서식 환경의 변화에 따라 발생 양상과 개체군의 군집구조가 달라지기 때문에 기후변화를 감지하는 지표종으로 이용된다. 본 연구는 2018년부터 2022년까지 5년간 한라산 아고산지역에 서식하는 나비 개체군의 분포를 파악하기 위해 영실에서 백록담까지 9개 구간을 선조사법을 이용하여 월별 조사를 실시하였다. 조사결과 확인된 나비목 곤충의 출현 종수와 개체수는 총 5과 35종 15,943개체로 나타났으며 2018년이 다른 해에 비해 가장 많은 종수와 개체수가 출현하는 것으로 확인되었다. 구간별로는 선작지왓부터 윗세오름 통제소까지 구간(D)에서 29종, 남벽통제소부터 백록담까지 구간(H)에서 4,590개체로 가장 많은 종수와 개체수를 보였다. 우점도 지수는 A구간과 6월, 풍부도 지수는 D구간과 7월, 균등도 지수는 G구간과 7월이 각각 가장 높게 분석되었다. 종다양도 지수는 A구간이 가장 낮은 반면 그 외 구간은 상대적으로 높게 유지되었고, 월별로는 7월이 가장 높았다. 기상자료를 바탕으로 8개의 생물기후인자를 분석한 결과 주요 출현종의 분포는 강수량과 강수 일수가 개체수 변동에 영향을 미치는 것으로 해석되었다.

검색어: 한라산, 아고산지역, 기후변화, 나비, 생물기후인자

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3D plant-centric insect detection and monitoring solution for preliminary ecological study: A case study of brown planthopper

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Insects, including aphids, caterpillars, and beetles, have a significant impact on biodiversity, ecology, and the economy by consuming various plant tissues like leaves, stems, and fruits, leading to issues such as holes, defoliation, and impaired growth. Consequently, our study's primary goal was to establish a model system capable of identifying and tracking insects, covering aspects like their behaviors, movements, sizes, and patterns. Our research has successfully produced a 3D monitoring system specifically designed for continuous insect tracking by applying it to brown planthopper. This technology allows for in-depth exploration of insect behaviors and their interactions with plants and crops. The potential applications of this technique are highly promising, offering valuable assistance to researchers in unraveling insect behavior and ecological dynamics and driving further advancements in these crucial research areas.

Key words: brown planthopper, 3D reconstruction, behavior analysis, monitoring

P186

Growth period by temperature of *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae)

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Spodoptera litura is an omnivorous pest that damages more than 120 types of crops. It is widely distributed throughout the tropics, subtropics, and temperate zones. It is a major pest that causes damage by explosively increasing in density in a short period of time due to its excellent mobility and reproductive ability. *S. litura* was studied at five constant temperatures (15.0, 20.0, 25.0, 30.0, and 35.0°C), 65±5% relative humidity (RH), and 14L:10D photoperiods. The development period for eggs and larvae tended to become shorter as temperature increased. The growth period of egg, larva, and pupa by 25°C temperature was 4.0, 32.3, and 12.6 days, respectively.

Key words: *Spodoptera litura*, Growth period, Survival period

P187

Surveilance of sporadic insect pests in Jeonbuk

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The occurrence level of *Metcalfa pruinosa*, *Halyomorpha halys*, and *Spodoptera litura* was investigated in persimmon tree and bean cultivation fields in 14 cities and counties of the Jeonbuk region in June and July. *Metcalfa pruinose* was visually inspected, while *Halyomorpha halys* and *Spodoptera litura* were investigated by installing pheromone traps and counting the number of captured individuals once, seven days after trap placement. *Metcalfa pruinose* nymphs occurred in eight cities and counties, which showed an increase compared to the previous year, and *Halyomorpha halys* nymphs had higher occurrences in the plains, with an average count of 5.5. The average count of *Spodoptera litura* was 26.7, which was lower than the previous year.

Key words: *Metcalfa pruinosa, Halymorpha halys, Spodoptera litura*

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Adult emergence model of *Helicoverpa armigera* (Lepidoptera: Noctuidae) from overwintered pupae and its field validation

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왕담배나방은 기주범위가 넓은 다식성으로 토마토, 옥수수, 담배, 해바라기, 땅콩, 면화, 콩 등 다양한 작물에 피해를 주는 해충이며, 장거리 이동성 해충으로도 유명하다. 본 연구에서는 기존 자료를 바탕으로 월동번데기의 성충으로 우화모델(2종)를 작성하고 포장 실측자료와 비교하여 평가하였다. 월동 번데기는 휴면을 종료한 후 안점소실 과정을 거쳐 정상의 번데기로 이행되고 비로소 성충으로 우화하는 것으로 가정하였다. 첫 번째 모형(모형 1)은 2단계 휴면후발육 우화모형으로 안점소실에 필요한 적산온도 59.9DD (발육영점온도 15.9℃)와 번데기 발육완료에 필요한 192.3DD (발육영점온도 10.2℃)로 구성하였다. 두 번째 모형(모형 2)은 온도자극 우화모형으로 17.63℃의 온도자극 이후에 번데기 발육을 개시하는 모형이었다. 적산온도는 단순 평균온도법과 사인곡선법으로 계산하여 비교하였다. 포장자료와 비교 결과 모형 1에 사인곡선법을 적용했을 때 실측치와 편차가 3일보다 작거나 차이가 없었다. 반면 사인곡선법을 적용한 모형 2는 3~6.5일의 편차가 있었다. 평균온도법을 적용한 경우 두 모형 모두 실측치와 편차가 증가하였다. 모형을 활용하여 예측 우화시기와 트랩유살자료를 비교하여 왕담배나방의 비래 가능성에 대하여 고찰하였다.

검색어: 왕담배나방, 발생예측모형, 적산온도, 우화모형, 비래해충

P189

Comparison of community structures of Gound Beetle (Coleoptera) between forest genetic resource reserve and biosphere reserves

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경상북도에 위치한 산림유전자원보호구역내 2개 지역(영주지역의 신갈나무, 울진지역의 소나무)과 경기 포천시에 위치한 생물권보전지역내 2개 지역(포천지역의 신갈나무와 소나무)에서 2016년부터 2017년까지 함정트랩(Pitfall trap)을 매년 5회씩 5반복하여 각각 비교하였다. 그 결과 산림유전자원보호구역에서는 27과 106속 160종 2,665개체가 확인되었으며, 종풍부도는 20.28, 종균등도는 0.266, 종다양도는 1.355, 우점도는 0.265로 우점종은 납작먼지벌레속 sp.2 (*Synuchus* sp.2)이였다. 또한, 생물권보존지역에서는 16과 49속 77종 4,834개체가 확인되었으며, 종풍부도는 8.958, 종균등도는 0.301, 종다양도는 1.31, 우점도는 0.669로 우점종은 윤납작먼지벌레(*Synuchus nitidus*)였다. 산림의 중요 지역 간에 지표성 딱정벌레의 군집을 비교함으로써 환경변화에 따른 산림보존 프로그램을 수행하는데 유용한 기초 자료로 활용될 것이다.

검색어: 산림유전자원보호구역, 생물권보전지역, 지표성딱정벌레, 군집분석

P190

Surveilance of sporadic and subtropical insect pests in Gyeongnam province

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기후변화와 세계시장 개방에 따른 외래 및 돌발해충의 종류는 다양해지고 밀도는 지속적으로 증가하고 있지만 발생 실태에 관한 자료는 미흡하다. 본 연구는 경남지역 돌발 및 남방계 해충의 발생과 피해조사를 위해 미국선녀벌레, 썩덩나무노린재, 담배거세미나방 등 3종을 경남 18시·군에서 조사하였다. 미국선녀벌레는 약충기(6월), 성충기(9월) 조사를 진행하였고, 길이가 50cm 이상되는 가지의 밑동에서 위쪽으로 50cm 내 개체를 육안조사하였다. 썩덩나무노린재는 콩 개화기(7월), 등숙기(9월) 조사를 진행하였고 지점당 집합페로몬 트랩 1개를 설치하고 1주 후 채집된 마리 수를 조사하였다. 담배거세미나방은 성페로몬 트랩 1개를 설치한 뒤 1주 후 채집된 마리 수를 조사하였다. 미국선녀벌레는 의령, 함안, 함양 등에서 발생이 많았고, 전년대비 발생이 소폭 감소하였다. 썩덩나무노린재는 합천, 밀양, 함양 등에서 발생이 많았고, 담배거세미나방은 전시군에서 발생이 확인되었으며, 특히 함양, 산청, 사천, 고성 등에서 밀도가 높았다.

검색어: 경남지역, 돌발해충, 남방계해충, 발생조사

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Lepidopterous insect composition of the pine tree forest in Korea

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본 연구는 우리나라 소나무림 내 나방류 곤충의 분포상을 파악하기 위해 수행되었다. 우리나라 산림면적은 634만 ha로 국토의 약 63.2%를 차지하고 있으며, 그중 소나무림의 면적은 총 156만 ha로 산림면적의 25.9%를 차지하고 있는 중요 수종이라 할 수 있다. 우리나라 주요 소나무림의 나방류 조사를 위해 지형특성별로 동해안 산림, 내륙지대 및 해안지대로 먼저 구분하였고, 이들 지역 중 소나무림 19개소를 조사대상지로 선정하여 2021년 4월부터 2022년 9월까지 수행되었다. Moonlander Moth Trap과 버킷식 유아등 트랩을 이용하여 나방류를 채집하였고, 본 연구에서 확보된 연구재료 이외에도 과거에 소나무림에서 채집된 한남대학교 동물분류학연구실 소장 나방류 표본을 포함하였다. 조사 결과, 총 32과 407속 589종의 나방류 곤충이 조사되었으며, 이 중 소나무를 섭식하는 등 소나무류와 직접적으로 관련되는 나방류는 총 10과 26속 30종으로 파악되었다.

검색어: 나비목, 나방분포상, 소나무림, 기주식물

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Spatial and temporal changes in Ground Beetle community of the Gwangneung forest

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We analyzed comparatively the ground beetle communities of 1993 and 2023, with 30 year interval, in broadleaf and coniferous stands of the Gwangneung forest, a biosphere reserve in South Korea. 2,906 individuals (53 species, 38 genera, and 15 families) were collected from broadleaf stands and 1,782 individuals (36 species, 32 genera, and 14 families) from coniferous stands in 1993. The dominant species was *Synuchus cycloderus* in both stands. In 2023, 1,682 individuals (110 species, 78 genera, 21 families) were collected from broadleaf stands and 990 individuals (92 species, 67 genera, 22 families) from coniferous stands. In 2023, the dominant species were *Eucarabus* (*Parhomopterus*) *sternbergi sternbergi* in broadleaf stands and *Coptolabrus jankowskii jankowskii* in coniferous stands. Species richness (R'), species evenness (E'), species diversity (H'), and dominance (DI) were all higher than in broadleaf (R'=15.472, E'=0.336, H'=1.601, and DI=0.371) and coniferous (R'=13.756, E'=0.369, H'=1.324, and DI=0.326) forests in 2023.

Key words: ground beetle community, gwangneung forest , broadleaf forest, coniferous forest, dominant species

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Community analysis of Korean Vespidae (Hymenoptera) based on forest geospatial information

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Vespidae are social insects and crucial predators that prey upon various insects. In particular, *Vespa velutina nigrithorax,* as a representative predator of honey bees, inflicts huge economic damage on apiary. Therefore, it is essential to investigate the national distribution of vespid wasps. In this study, collection was made, in 73 study sites, using hornetluring traps and malaise traps in Gangwon-do, Gyeonggi-do, Gyeongsang-do, Chungcheong-do, and Jeju-do from 2019 to 2022. As a result, a total of 24,974 individuals of 24 species, 5 genera, and 2 subfamilies were collected, with the largest number of species collected in Gangwon-do (22 species, 5 genera, and 2 subfamilies). Also, *Vespa simillima simillima* (38.2%), *Vespa crabro flavofasciata* (25.1%), *Vespa crabro flavofasciata* (23.8%), *Vespa velutina nigrithorax* (27.5%), and *Vespa simillima xanthoptera* (54.6%) are the dominant species in each province, respectively. Species richness (R') and species evenness (E') were highest in Gyeonggi-do (R'=2.712, E'=0.978), and species diversity (H') was highest in Gyeongsang-do (H'=2.981). Dominance was highest in Jeju-do (DI=0.719). Herein, we provide basic data needed in development of vespid damage management systems using regional sampling data and forest geospatial information in the study area.

Key words: Korean Vespidae, Vespinae, Polistinae, community analysis

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Comparison of pollinator inflow characteristics of *Allium ulleungense* H.J.Choi & N.Friesen planted in different environments on the Korea National Arboretum

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본 연구는 주변 환경의 차이에 따른 화분매개곤충의 유입 특성을 파악하기 위하여 국립수목원 내 진화속을걷는정원과 부추속전문전시원에 식재된 울릉산마늘의 화분매개곤충을 조사하였다. 2023년 5월 22일부터 6월 2일까지 꽃이 70% 이상 개화하였을 때 포충망을 활용하여 8일간 곤충을 채집하였고, 각 전시원 별 식생(피도), 기후(온도·습도·조도)를 조사하였다. 조사 결과 진화속을걷는정원에서 피도 60% 온도 26.4℃, 습도 31.5%, 조도 40953.6lx, 화분매개곤충 20과 450개체, 부추속전문전시원은 피도 90%, 온도 25.6℃, 습도 31.6%, 조도 6387lx, 화분매개곤충 15과 196개체로 나타났다. 온도와 조도가 상대적으로 높은 진화속을걷는정원이 채집된 곤충의 다양성과 방문 빈도가 높았다. 시간대별 곤충의 방문 빈도를 비교해본 결과 온도와 조도는 개체수가 증가할 때 같이 증가하는 경향을 보였으며, 습도는 반대의 경향을 보였다.

검색어: 화분매개곤충, 울릉산마늘, 미기후, 식재 환경

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Analysis of *Mythimna separata* migration origins from China in early-summer using the HYSPLIT model

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멸강나방은 중국 내 개체군이 북쪽 지역으로 2차 이주를 할 때, 봄철 제트기류를 타고 국내로 유입되는 비래해충이다. 집단으로 발생 시 벼, 옥수수, 수수 등 여러 작물에 큰 피해를 준다. 2020년과 2021년 북방접경 세 지역(백령도, 연천, 고성)과 수원 지역에서 성페로몬트랩을 이용하여 멸강나방의 성충 발생 시기를 탐지하였다. 일반적으로 수원지역은 4월 하순 혹은 5월 상순에 최초 유인되었으나 두 해 여러 지역에서 공통적으로 탐지되는 시기는 6월 초중순이었다. 미국 해양대기청(NOAA)에서 제공하는 역궤적 분석프로그램(HYSPLIT)을 이용하여 각 지역에서 멸강나방이 포획된 날짜 별 지상 300, 500, 700, 1000 m의 36~72시간 역궤적 분석을 수행하였다. 이후 같은 시기에 중국 내 멸강나방이 분포할 가능성이 높은 지역(32~40 ºN)을 비래 근원지로 추정하였다. 2021년 수원과 백령도에서 공통적으로 산둥성(山东省)이 근원지로 추정되었다. 공통적으로 산둥성(山东省)과 장수성(江苏省)이 주 비래지로 추정되었고, 추가적으로 백령도는 허베이성(河北省), 수원은 안후이성(安徽省), 허베이성(河北省), 저장성(浙江省)도 가능성이 있는 지역으로 추정되었다.

검색어: 멸강나방, 비래해충, 비래근원지

P196

Insect pests occurring on green bean (*Phaseolus vulgaris*) in Jeonbuk

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기후변화 대응과 새로운 소득작물로 아열대작물이 도입되어 재배면적이 증가하고 있다. 그린빈은 아메리카 중남부가 원산지인 콩과 작물로 미성숙 꼬투리를 다양한 요리에 이용하는데 최근 수요가 증가하면서 재배면적이 확대되고 있다. 새로운 작물이 도입됨에 따라 안정재배를 위한 방제 대상 해충을 설정하기 위하여 재배시기별 해충 종류와 피해정도를 조사하였다. 4월 중순에 파종한 그린빈에서는 생육초기부터 총채벌레 발생이 많았으며, 5월 하순 이후 발생밀도가 급격하게 증가하는 경향을 보였다. 7월 상순에 파종한 그린빈에서는 8월 하순부터 아메리카잎굴파리 피해가 증가하여 9월 상순에 피해엽률이 50% 이상으로 발생이 심하였으며, 응애류와 총채벌레류 발생이 많은 경향이었다.

검색어: 아열대채소, 그린빈, 해충, 총채벌레, 아메리카잎굴파리

P197

Seasonal occurrent pattern of thrips and Tomato spotted wilt virus on pepper open field in Jeonbuk province

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토마토반점위조바이러스(TSWV)는 총채벌레가 매개하는 대표적인 바이러스로 고추 등 여러작물에서 심각한 피해를 준다. 노지고추에서 토마토반점위조바이러스 발생 경감을 위한 총채벌레 방제시기를 설정하고자 시기별 총채벌레 발생량과 토마토반점위조바이러스병 발생량을 조사하였다. 2023년 전북 익산 노지 고추포장에서 청색끈끈이트랩을 이용하여 총채벌레 발생량을 조사한 결과 4월 상순부터 채집되기 시작하여 5월 하순과 6월 하순에 발생최성기를 보였다. 반면 고추 꽃에서는 정식 2주후부터 꽃당 10마리 이상 관찰되었다. 토마토반점위조바이러스병은 정식 30일 이후 증상이 발생하기 시작하여 빠르게 확산되는 경향이었다. 따라서 노지고추에서 토마토반점위조바이러스병 경감을 위하여 총채벌레 방제를 활착 이후부터 시작하는 것이 좋을 것으로 판단되었다.

검색어: 고추, 총채벌레, 토마토반점위조바이러스

P198

Occurrence Tendency of overwintered adults of *Scirtothrips dorsalis* to Kiwifruit in Plastic-film house in early season in Jeju, Korea

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2022년부터 2023년까지 제주도내 키위 시설재배지를 대상으로 계절 초기 볼록총채벌레 발생 경향을 확인하기 위해서 토양 표면의 잡초, 토양 표면 상단으로부터 60cm, 키위나무를 유인한 덕 상단 15cm에서 10일 간격으로 발생 조사하였다. 하우스 내부에서 발생하는 잡초 10종을 채집하여 조사한 결과, 갈퀴덩굴, 광대나물, 개불알풀, 별꽃, 뽀리뱅이, 황새냉이 6종에서 볼록총채벌레가 지속적으로 관찰되었다. 계절 초기 월동 성충의 비산시기를 확인하기 위해 토양 표면 60cm 위쪽에 설치한 황색 끈끈이트랩에서 2월 하순~3월 중순부터 볼록총채벌레의 발생을 확인하였다. 시설하우스 내부(덕 상단 15cm)와 외부(측장 높이)에 설치한 황색 끈끈이트랩을 비교해보면 시설 내·외부의 볼록총채벌레의 밀도가 증가하고 감소하는 시기가 유사하였다. 종합적인 고찰을 통하여, 발생 양상을 고려한 적절한 방제전략 수립이 요구된다.

검색어: 볼록총채벌레, 키위, 생태, 월동

P199

Assessment of indigenous species using IUCN Red List Categories and Criteria

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국립생물자원관은 2010년부터 우리나라 생물종을 대상으로 IUCN 적색목록 범주에 따른 종 평가를 실시하여 국가생물적색자료집을 발간하여 왔다. 2010년부터 2014년까지 관속식물, 척추동물, 무척추동물 등 주요 분류군에 대해 평가를 실시하여 총 10권의 자료집을 발간하였고, 2019년부터는 기존 평가 종을 대상으로 재평가를 실시하여 지금까지 총 9권의 자료집을 재발간하였으며, 내년에 거미류 자료집 발간으로 재평가를 마무리할 예정이다. 현재까지 총 4,353종에 대한 IUCN 적색목록 범주에 따른 평가를 완료하였으나 이는 전체 자생생물종 58,050종 대비 약 7.5%에 불과하다. 따라서, 2024년부터는 평가가 이루어지지 않은 신규 분류군에 대한 평가를 수행할 예정이다. 또한, 2019년부터는 IUCN 적색목록팀과 함께 우리나라 고유종에 대한 평가를 수행하여 IUCN 적색목록에 등재하는 작업을 수행하였고, 이를 통해 총 150종의 고유종을 IUCN 적색목록 사이트에 등재를 완료하고 보고서를 발간하였다.

검색어: 적색목록, IUCN,, 국가생물적색자료집

P200

Psychological effects of insect ecological healing program in Insect ecological garden - Case of Family -

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This study was to psychological effects of insect healing programs in Insect ecological garden. A sample of participated 9 families and non-participated 9 families in the survey from near study area in Sangju and Mungyeong, Gyeongbuk. The nine families in the experimental group participated in an insect experience activity healing programs using emotional insects(butterfly, beetle and endangered insect) and edible insect. All the participants were examined to psychological effect with major family strength, PANAS, POMS-B, PSS, CES-D and GAD-7 in before and after the program. The results of this study showed that the healing program of insect experience activities had a positive effect on the participated families of Family strength, PANAS, POMS-B, PSS, CES-D and GAD-7. The participated families preferred insects more than before healing program of insect experience activities. And participated families in the insect healing program showed high satisfaction. As a result, we were going to investigate the effect of the family type insect healing program in this study. In the future, the insect ecological healing program will be able to be applied to various subjects. These result reveals that the insect healing program performed in insect ecological healing program may improve stress, depressive and anxiety disorders symptoms of people.

Key words: Stress, depressive, anxiety disorders, Emotinal insect

This study was supported by a grant from the Rural Development Administration(RDA, PJ015738) of the Republic of Korea.

P201

Study on the immature stages of the butterfly *Hypolimnas bolina* (Linnaeus, 1758) (Lepidoptera : Nymphalidae) in Korea

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The developmental biology and morphological characteristics of the immature stages of *Hypolimnas bolina* were studied in the laboratory using host plant, *Ipomoea batatas* (L.) Lam. This species has six larval stadia, with an egg period of 2.4 ± 0.54 days, a larval period of 16.8 ± 2.3 days, and a pupal period of 10 ± 1 days. It takes approximately 30 days to mature from egg to adult. Illustrations and descriptions of the various immature stages and their behaviors are provided.

Key words: biology, immature stages, *Hypolimnas bolina*

This study was supported by a grant from Ministry on Enviroment of the Republic of Korea.

P202

Confirmation of the potentiality of night-time insect collecting activities as an agro-healing program – for elementary and middle school students

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곤충생태원에서 진행되는 진로체험프로그램의 일환으로 '곤충 캠프, 파브르의 하루' 프로그램을 개발하여 시범 적용하였다. 참가자는 전주시 지역에 거주하는 초등·중학생 16명이며, 야간시간(19:00-23:00)대에 활동이 이루어짐에 따라 사전에 보호자로부터 참여 동의를 획득하였다. 야외 활동은 각 개인별로 랜턴과 채집 도구를 지참하였으며, 4-5명씩 한 조를 이루어 담당 교사와 보조 교사가 동행하였다. 주된 활동은 야간등화, 통나무 무더기, 야생의 서식지, 미리 설치한 곤충 트랩 속 곤충 찾기, 스탬프 미션활동 등으로 구성되었다. 실내활동으로는 곤충 동정하기, 곤충 관찰 수첩, 나만의 곤충도감 만들기 등을 진행하였다. 효과를 분석하기 위해서 프로그램이 진행되기 전과 끝난 후에 설문조사를 실시하였다. 분석 결과, 참여자의 평균 연령은 12.8세이며, 프로그램 참여를 통해 자아존중감의 향상(3.34점→3.61)과 진로인식 향상(3.40점→3.66)에 긍정적인 변화를 가져왔다($p<0.05$). 야간에 이루어지는 활동으로 고려해야 할 사항이 많기는 하지만, 참여자의 재참여 의도가 90점으로 만족도가 높은 것으로 나타났기에, 향후 추가적인 연구 및 새로운 시도가 필요할 것으로 보인다.

검색어: 곤충채집, 진로체험, 자아존중감, 진로인식

P203

Confirmation of the potentiality of night-time insect collecting activities as an agro-healing program – for college students

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농가에서 곤충자원을 활용한 치유농업프로그램의 개발 요구가 증가함에 따라 기존 곤충 돌보기 중심의 치유프로그램과 더불어 활용할 수 있는 야간 곤충채집 활동을 치유농업프로그램으로 개발하고 시범 적용하였다. 야간곤충채집 활동은 대학생 9명에게 사전에 참여 동의를 획득하고, 전남대학교 학술림(장성)에서 1박 2일간 진행하였다. 18시부터 24시까지 야간 채집 활동과 익일 오전에는 채집한 곤충을 이용한 곤충 표본 제작 활동으로 프로그램을 구성하였다. 프로그램의 효과 분석을 위해 사전(활동 전), 중간(채집활동 직후), 사후(표본제작 직후)에 뇌파, 맥파 검사 그리고 설문조사를 실시하였다. 뇌파 분석 결과, 야간 채집활동 직후 뇌파의 기초율동이 향상(10.67→11.44)하였다($p<0.05$). 요인분석을 통한 스트레스 분석 결과, 내적 스트레스는 3.22(사전)→2.96(사후)로 감소($p<0.1$)하였고, 문제수행능력 관련 스트레스는 2.92(중간)→2.70(사후)로 감소하였다. 이러한 결과는 야간 채집 활동 속에서 이용되는 근육의 움직임이 뇌 기능 향상과 스트레스 감소에 영향을 줄 것으로 생각된다. 참여자가 적은 연구의 한계를 극복하기 위해 향후 연령대별, 성별 등 다양한 참여자를 대상으로 추가적인 채집 프로그램의 개발 및 적용이 필요하다.

검색어: 곤충채집, 뇌파, 스트레스, 치유농업

P204

Development of bioinsecticides using a entomopathogenic fungus, *Beauveria bassiana* 331R

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Entomopathogenic fungi are used to produce raw materials by applying solid culture technology using grains. But there are various problems such as low production efficiency and cross-contamination. Solvum Co., Ltd. conducted research on liquid culture technology to develop a method that can overcome these shortcomings of solid culture technology. We conducted research and development on using *Beauveria bassiana* 331R to observe the culture according to the seed inoculation amount in a 30 L fermenter, it was carried out at 1.0 % (v/v) and 10.0 % (v/v). Although there was a difference of 1 day, 1.0 %(v/v) seed inoculation was observed to be more than twice that, and active blastospores and yield were observed at over 95.0 %. As a results, it was determined that cost and efficient production would be possible during the culture process in mass production. Based on these experiments, a 300 L fermenter was cultured with 1.0 % (v/v) seed inoculation, resulting in a yield of 1.24E+09 CFU/mL on the 6th day of cultivation. As a result of freeze-drying using the final culture medium, it was confirmed that the production yield was improved by 113.0 % compared to the control.

Key words: Entomopathogenic fungus, *Beauveria bassiana* 331R, liquid culture technology, Production Yield

P205

Trend of plant quarantine pests on imported seedlings (40 items) in Korea

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We analyzed trend of plants (40 items) on imported seedlings using the Pest Information System (PIS) for the past 20 years. 530 species (9 order 336 genus) were found among 40 items on imported seedlings including Rosaceae, Arecaceae, Crassulaceae, and Fabaceae. Hemiptera were the most expected to be detected pest as 52%, followed by Coleoptera as 16%, Lepidoptera as 11%, and Diptera as 8% in potential detection rate. For prohibited pests, Tephritidae are the most common pests as 86% in approximately 60 prohibited species, including *Bactrocera dorsalis*, and *Bactrocera tryoni* in Diptera and *Cydia pomonella* in Lepidoptera.

Key words: plant quarantine, seedlings, quarantine pests, identification manual, PIS

P206

Photography techniques for securinng high-resolution images

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When shooting an object with a microscope, the size of the object is large, so it may not be captured on one screen, or the results may not be good due to dust. It is intended to provide a high-resolution image photographing method and correction method using Photoshop 5.0 program. In particular, when the object is large, a method of synthesizing after split photographing when it is not visible on one screen during micrographing will be provided. In addition, when the background is dark, a background color correction method and a color correction method after imaging are also provided. The photographing method and correction method are presented based on Lepidoptera, Diptera, and Coleoptera. The high-resolution images were taken using Nikon D500 16-80mm VR Kit or Leica M205C, Dhyana400DC.

Key words: High-resolution image, Photography Techniques

P207

Molecular basis of memory enhancement in mild cognitive impairment rodent model with enzyme digested HongJam

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The enzyme digestion of foods is known to have certain advantages, such as enhancing health improvement functions of functional foods. In this study, we investigated whether the memory enhancement effects of HongJam could be enhanced by enzymatic digestions. We found that enzyme digested HJ had more enhanced functionality than undigested HJ. We also found the molecular basis of memory enhancement by performing various biochemical and molecular biological experiments. (Grant No. PJ016908032023)

Key words: HongJam, digestion, memory, mild cognitive impairment, biomarkers

P208

Enhancing innate immune response of macrophages by HongJam

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Hongjam is a natural health food that has been shown to have various health-promoting effects, but studies on immunity enhancement have not been done so far. In this study, we investigated whether HongJam extracts could be enhancing innate immunity by protomoting proliferatin of macrophages and their phagocytic or pinocytic abilities to pathogens. (Grant No. PJ017024022023)

Key words: immune response, innate, bone marrow, macrophage, HongJam

P209

Enhancement of natural killer cell functions by HongJam

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Immunity is largely divided into innate immunity and adaptive immunity. We conducted a study using HongJam extract to confirm its innate immunity-enhancing effect. Our data using Natural Killer (NK) cells, which play an important role in innate immunity, confirmed that HongJam extract promotes the proliferation of NK cells and also enhances the function of NK cells to attack and destroy cancer cells. (Grant No. PJ017024022023)

Key words: HongJam, innate immunicty, Natural Killer cells, proliferation, anti-cancer

P210

Method of producing eco-friendly spawning trays to increase the spawning rate of black soldier fly (*Hermetia illucens* (L.))

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아메리카동애등에 성충은 음식물 폐자원 등 유기물이 있는 곳에 알을 낳는 습성이 있다. 대부분의 농가는 음식물폐자원을 가공한 단미사료(습식사료)를 유인배지로 활용하여 그 위에 플로랄폼(오아시스)를 놓고 알을 받는다. 그러나 플로랄폼은 재사용이 불가하고 생분해되지 않는 환경폐기물로서 처리가 곤란하며 포름알데하이드, 카본 블랙 등의 발암물질을 함유한 것으로도 알려져 있다. 이에 본 연구는 먹이원 자체를 활용하여 폐기물이 발생하지 않는 친환경 산란받이를 개발하였으며 일회용으로 사용되는 플로랄폼을 대체하였다. 먹이원으로 활용할 수 있는 습식사료와 건식사료를 주재료로 하여 제작하며, 습식사료(수분60~80%)와 건식사료(1~10%)를 1:0.5~1 비율로 혼합한 사료 혼합물과 보조첨가제와 물을 포함하여 제작한다. 친환경 산란받이는 기존 플로랄폼 대비 산란율이 34% 증가하였으며 구매비용 또한 75% 절감하였다.

검색어: 아메리카동애등에, 산란받이, 산란, 습식사료, 건식사료

P211

Effect of black soldier fly larvae manure application on Maize growth

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아메리카동애등에 유충은 유기성폐기물을 먹이원으로 하며 그 분해산물인 동애등에분은 비료원료로 활용가능하다. 그러나 농가에서 나오는 분변토는 염분함량이 높아 단독으로 사용하면 토양에 염류집적의 우려가 있다. 이에 산업곤충인 동애등에 분변토의 염분을 낮춰 퇴비로 활용하고자 옥수수(미백2호)에 5처리(무처리, 동애등에분, 동애등에분:흰점박이꽃무지분(2:8), 동애등에분:퇴비(2:8), 퇴비)로 비료를시용하였다. 옥수수 생육은 초장, 간장, 웅수장, 착수고를 조사하였고 종실은 이삭중, 이삭장, 착립이삭장, 이삭폭 등을 조사하였다. 처리구별 옥수수 수량(kg/10a)은 무처리구 702.8kg, 동애등에분처리구 835.6kg. 동애등에분:흰점박이꽃무지분(2:8) 처리구 723.7kg, 동애등에분:퇴비(2:8) 처리구 862.3kg, 퇴비 처리구 803.7kg으로 조사되었다. 동애등에 분변토를 시판퇴비와 혼합하여 퇴비로 활용하면 옥수수 생산을 증진시키는데 효과적이나 장기적인 실험을 통해 토양과 작물에 미치는 영향을 모니터링해야 될 것으로 판단된다.

검색어: 동애등에분변토, 흰점박이꽃무지분변토, 퇴비, 옥수수, 비료효과

P212

Assessment and development of different diets for mass rearing of *Zeugodacus scutellata* (Diptera: Tephritidae)

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The striped fruit fly, *Zeugodacus scutellata*., is ubiquitous in agricultural areas, making it a critical pest to monitor and manage. It is necessary to develop a technique for rearing *Z. scutellata* in the laboratory to achieve mass production for biological control. The pumpkin is an important host plant for *Z. scutellata*; females lay their eggs on the tops of pumpkin flower buds, and larvae consume the stamens from top to bottom before dropping to the ground. Several types of diets are considered in the present study, including liquid, solid, and semisolid diets. Methyl benzoate, propionic acid, sodium benzoate, and citric acid were tested for their ability to suppress microbial contamination and improve the shelf life of diets. Fresh pumpkin, pumpkin flower, and pumpkin powder were used as primary ingredient. Reared adults were tested for their egg laying and survival abilities based on different diets. Approximately 86% of adults emerged from liquid and semisolid diets. Solid diets reduce pupae production and adult emergence. The diets with a total viability of less than 75% were discarded, which is considered as a reasonable threshold to determine whether a diet is nutritionally sufficient to rear the flies. Based on the results of the present study, we have developed a diet for mass rearing in laboratories, which may assist in providing a scientific basis for the effective control of *Z. scutellata*.

Key words: Artificial diet, rearing, additives, striped fruit fly

P213

Whole-genome analysis of *Bacillus velezensis* TJS119, a biocontrol agent that protects *Protaetia brevitarsis seulensis* Larvae against insect disease

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Bacillus velezensis TJS119 was isolated from the freshwater, and antagonistic activity against of pathogenic fungi. Strain TJS119 showed a broad spectrum of antagonistic activities many fungal pathogens, including the green muscardine fungus *Metarhizium anisopliae*. The whole-genome sequence of *B. velzensis* TJS119 was analyzed using the illumina platform. The genome comprises a 3,809,913 bp chromosome with a G + C content of 46.43%, 3,834 total genes, 10 rRNA and 73 tRNA genes. The genome contained a total of 8 candidate gene clusters (difficidin, fengycin, bacillaene, macrolactin, bacillibactin, bacilysin, surfactin and butirosin) to synthesize secondary metabolite biosynthesis. Overall, our data will aid future studies of the biocontrol mechanisms of *B. velezensis* TJS119 and promote its application in insect disease control.

Key words: *Bacillus velezensis*, *Protaetia brevitarsis seulensis*, Sencondary metabolites, *Metarhizium anisopliae*

Acknowledgments: This research was supported by a grant from the environmental analysis of occurrence of major insect disease and technology development to prevent the spread (RS-2021-RD009894).

P214

Immuno-modulatory activity of hot water extracts isolated from *Protaetia brevitarsis seulensis* larvae following treatment with *Bacillus velezensis* TJS119

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Protaetia brevitarsis seulensis larvae from industrial insects are traditionally recognized as functional health foods in South Korea. We evaluated the immuno-modulatory effects of feeding beneficial microorganism (*Bacillus velezensis* TJS119) to *P. brevitarsis* larvae as a dietary source. In this study, we investigated the immune-enhancing activities of *P. brevitarsis* larvae hot-water extract (PLW) and PLW after treatment with *B. velezensis* TJS119 (PLWB) using the RAW 264.7 macrophage cell line. We examined the effects of PLWB on cell proliferation, cytokine production, and nitric oxide production in RAW264.7 cells. PLWB showed no cytotoxicity at concentrations ranging from 7.8 to 1,000 μg/mL in RAW264.7 cells. Treatment with PLWB increased the production of nitric oxide and pro-inflammatory cytokines [tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and interleukin-1β (IL-1β)] at doses of 62.5 to 1,000 μg/mL in RAW264.7 cells. As a result, PLWB exhibited a stronger immune-enhancing effect compared to PLW. In conclusion, the results of this study offer experimental evidence to support the potential utilization of PLWB as an immunity-enhancing nutraceutical ingredient.

Key words: *Bacillus velezensis*, *Protaetia brevitarsis seulensis*, immuno-enhancing activity, macrophage, pro-inflammatory cytokine production

Acknowledgments: This research was supported by a grant from the environmental analysis of occurrence of major insect disease and technology development to prevent the spread (RS-2021-RD009894).

P215

Antifungal activities of *Bacillus velezensis* TJS119 and its lipopeptides against insect pathogen *Metarhizium anisopliae* and *Beauveria bassiana*

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In this study, *Bacillus velesensis* TJS119, isolated from freshwater, demonstrated growth inhibition against insect pathogenic fungi. The culture medium of the *B. velezensis* TJS119 strain underwent sequential fractionation with n-hexane, chloroform, ethyl acetate, n-butanol, and water. Notably, the n-butanol fraction exhibited significant antifungal activity against *Metarhizium anisopliae* and *Beauveria bassiana*. LC/MS analysis of antifungal peaks identified the production of various lipopeptides by *B. velezensis* TJS119, including two types of iturin A (C_{14}, C_{15}), four types of fengycin A (C_{14}, C_{15}, C_{16}, C_{17}), and two types of fengycin B (C_{16}, C_{17}). The antifungal efficacy of Iturin A and Fengycin against insect pathogenic fungi was further validated using the paper disc diffusion method. These findings underscore the potential of *B. velezensis* TJS119 as a promising candidate for future research and applications in the realm of agricultural biological controls against fungal diseases.

Key words: *Bacillus velezensis*, surfactin, fengycin, iturinA, secondary metabolite

Acknowledgments: This research was supported by a grant from the environmental analysis of occurrence of major insect disease and technology development to prevent the spread (RS-2021-RD009894).

P216

Population genetic characterization of the pear pest, *Cacopsylla jukyungi* (Hemiptera: Psyllidae), using novel microsatellite markers

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The pear pest, *Cacopsylla jukyungi* (Hemiptera: Psyllidae), is one of the most damaging insect to commercial pears in South Korea. In this study, we developed eight microsatellite markers specific to *C. jukyungi* and genotyped 132 individuals collected from 11 localities throughout South Korea. Populations showed lower observed heterozygosity than expected heterozygosity and slightly or highly positive values of inbreeding coefficients, suggesting that *C. jukyungi* is subjected to inbreeding. The nationwide expansion of pear orchards and the replacement with a popular new cultivar during the last 50 years, which may have accompanied the spread of *C. jukyungi*-bearing pear grafts and scions, are likely sources of such facilitated dispersal. Thus, a management strategy against unintended anthropogenic dispersal of the pear psyllid will be required for better control of *C. jukyungi*.

Key words: pear pest, *C. jukyung*i, microsatellite

Acknowledgements: This research was supported by the research program of RDA (PJ01509505).

Small Group Meeting

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SG1

Moth species richness in Korea due to the climate change: Erebidae as a case study

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The Lepidoptera - moths, butterflies, and skippers, is one of the three most species-rich, studied, diverse, and widely distributed insect orders, with over 157,424 species worldwide (van Nieukerken *et al.,* 2011). Moths and butterflies serve as valuable indicator species for monitoring climate change. Conversely, the distribution of lepidoptera is actively and interactively influenced by changes in climate and land cover (Warren *et al.,* 2001). Over the last five years, there are many oriental moth species, such as genus *Stictane, Siccia, Philenora, Ammatho, Asota,* etc., have been newly recorded in Korea, since other new records are very likely yet to be discovered in this country and nearby.

Key words: Arctiinae, Aganainae, new record, distribution, Oriental region, fauna

Funding: This work supported by the Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the MInistry of Education (2020R1A6A1A03041954).

SG2

Study on the Insect fauna and the superfamily Tineoidea of Korean islands

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섬은 내륙지역에 비해 상대적으로 외부간섭이 적어 생태계가 잘 보존된 생물다양성이 높은 지역으로 알려져 있다. 하지만 우리나라의 섬 지역의 생물다양성 연구는 일부 지역 또는 한정된 분류군에 국한되어 연구한 경우가 대부분이다. 곤충은 생물다양성 연구에 필수적인 분류군으로 국내에서는 전체 생물종 58,050종의 약35%인 20,274종이 알려져 있다(환경부 2022). 우리나라 섬의 곤충은 6,117종이 알려져 있으며, 대부분 제주도, 거제도, 진도 등 크기가 큰 섬에서 조사 및 연구가 이루어져 있다(국립호남권생물자원관 2022). 국립호남권생물자원관에서는 섬 곤충다양성 연구를 위해 종목록 구축, 곤충상조사, DNA바코드 연구 등을 수행하고 있으며, 나비목 곡식좀나방상과의 신종·미기록종 발굴 및 계통분류학적 연구를 추진하고 있다. 본 발표를 통해 2021년부터 현재까지의 주요 연구 추진방향 및 연구결과를 소개하고자 한다.

검색어: 섬, 곤충상, 곡식좀나방상과

SG3

Taxonomic study of subfamily Epipaschiinae (Lepidoptera, Pyralidae) in Korea

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The subfamily Epipaschiinae belongs to the family Pyralidae in the superfamily Pyraloidea. Moths of the epipaschiine are mostly medium-sized, and around 705 species have been described worldwide, with most of them distributed in Tropical and Temperate Regions (Nuss *et al*., 2023). In this study, 24 species of 10 genera of the subfamily Epipaschiinae are identified. All of the species are accompanied by distributions, host plants, and collection site information. Illustrations of adults, male and female genitalia are provided.

Key words: Pyraloidea, taxonomy, species diversity, moths, new records

SG4

Taxonomic study of subtribe Olethreutae (Lepidoptera: Tortricidae: Olethreutinae) from Korea

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The subtribe Olethreutae Diakonoff (1973) which is one of the large subtribe in the subfamily Olethreutinae in the Tortricidae. Diakonoff classified the Olethreutae into a total of 27 genera and three genus groups: *Olethreutes*, *Hedya*, and *Apotomis*. According to the check list of insects from Korea (KSAE & ESK, 2021), 62 species from 11 genera of Olethreutae have been recorded in Korea. This study, provided with redescriptions, distribution, host plants, along with illustrations of adults, male and female genitalia are given.

Key words: Tortricoidea, Olethreutini, Palearctic Region, taxonony

SG5

Taxonomic notes of *Spilonota* Stephens and *Lepteucosma* Diakonoff (Lepidoptera: Tortricidae: Olethreutinae) in Korea

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The genera *Spilonota* Stephens, 1834 and *Lepteucosma* Diakonoff, 1971 are belonging to the tribe Eucosmini, subfamily Olethreutinae. In Korea, there are five species of *Spilonota* recorded: *S. albicana* (Motschulsky, 1866), *S. eremitana* Moriuti, 1972, *S. lechriaspis* Meyrick, 1932, *S. ocellana* ([Denis & Schiffermüller], 1775), and *S. semirufana* (Christoph, 1882). Only one species of *Lepteucosma* is recorded: *L. huebneriana* (Kocak, 1980). Both genera are agricultural pests that infest host plants belonging to the family Rosaceae, specifically causing damage to genus *Malus* (apple trees) and genus *Rubus* (blackberry plants), respectively. In this study, we provide a checklist of Korean *Spilonota* and *Lepteucosma*, with information of host plants and distribution for each examined species.

Key words: Lepidoptera, leaf roller moth, distribution, host plant, taxonomy

SG6

Introduction of the subfamily Hypenodinae (Lepidoptera, Erebidae) with allied taxa from Korea

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꼬마짤름나방아과는 날개편길이 5.5-12mm로 태극나방과 중에서는 크기가 작은 나방에 속한다. 본 아과는 주로 온대구를 포함하여 구북구에 분포한다. 기주식물은 곰팡이, 지의류 등으로 일부 알려져 있으며 이들의 생활사 등은 잘 알려져 있지 않다. 또한, 본 아과의 상위분류군은 밤나방상과로 나비목 중 가장 큰 분류군이다. 각 분류군의 형질을 기준으로 상위분류체계에 많은 변동사항이 있었다. 본 상과에 속한 여러 아과 중 일부 족 수준으로 강등되어 본 아과에 포함되는 등 분류학적 위치에 많은 혼란이 있었다. 따라서, 본 연구에서 꼬마짤름나방아과 및 근연분류군의 계통분류학적 연구를 통해 검토하고자 한다.

Key words: Lepidoptera: Erebidae, Hypenodinae, Boletobiinae, Taxonomy

SG7

Introduction of Bucculatricidae (Lepidoptera, Gracillarioidea) in Korea

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선굴나방과는 전 세계적으로 3속 300여 종이 알려져 있다. 이 중, 2 속은 호주의 고유속이므로 현재 *Bucculatrix* 속만이 활발하게 연구가 이루어지고 있다. 인근 국가 중 일본에는 1속 24종이 기록되어져 있으나, 그에 반해 한국산 선굴나방과는 1속 2종만이 알려져 있다. 이는 크기가 작은 미소나방중에서도 매우 작은 극소형미소나방에 속하며 잎에 잠엽하는 특징을 가지고 있고, 병해충도감에 의해서는 해충으로 알려져 있지만 분류학적 연구는 미비한 상황이다. 따라서 본 연구를 통해 한국산 선굴나방과는 1속 10종으로 정리하였으며, 이 중 5 신종 후보종과 3 미기록종 후보종을 확인하였다. 향후, 선굴나방과의 형태학적 및 계통학적 연구를 수행할 예정이다.

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

SG8

Introduction of family Micropterigidae (Lepidoptera): Habitat and ecology

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Micropterigidae는 날개 편 길이가 약 6~10mm 정도의 매우 작은 미소나방으로, 현존하는 나비목 중 가장 오래전에 분화된 것으로 알려진 그룹이다. 이들은 다른 나비목과 달리 큰턱을 가지고 있으며, 이를 이용해 꽃가루를 섭식하는 것으로 잘 알려져 있다. Micropterigidae는 전 세계적으로 약 160종이 알려져 있으며, 이들 중 명명되지 않은 종들을 포함하면 약 260종이 분포하는 것으로 알려져 있다. 국내에서는 아직 공식적인 기록이 존재하지 않지만, 일본과 중국 등 인접 국가의 현황을 볼 때 국내 역시 동등하거나 그 이상의 잠재적인 종이 분포할 것으로 예상된다. 따라서 본 연구를 통해 인접 국가의 Micropterigidae의 서식 환경과 생태를 소개하고 추후 연구의 기틀을 마련하고자 한다.

검색어: Micropterigidae, 서식환경, 생태, 나비목

SG9

Introduction of family Glyphipterigidae (Lepidoptera) in Korea

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그림날개나방과는 날개편 길이 10~12mm 정도의 작은 나방으로 파좀나방아과와 그림날개나방아과로 구성된다. 파좀나방아과는 앞날개 외연 중앙에 삼각형의 흰색 점이 있다는 형태적 특징이 있지만 종간 특징이 매우 유사하다. 그림날개나방아과는 앞날개에 반짝이는 금속성 무늬가 있으며 주행성이라는 특징이 있다. 그림날개나방과는 세계적으로 약 500여종이 기록되어있으며 중국은 57종, 일본은 41종이 기록되었지만 한국은 11종만이 알려져 있어 추가적인 연구 가능성이 충분한 분류군이다. 따라서 본 연구는 최신화 된 한국산 그림날개나방과의 정리를 목표로 한다.

검색어: 나비목, 그림날개나방과, 분류

SG10

Introduction of familiy Eriocraniidae (Lepidoptera, Eriocranioidea) from Korea

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좀날개나방과(Eriocraniidae)는 나비목 중 4번째로 분화한 분류군으로 잘 알려져 있으며, 현재 5속 29종으로 이루어져 있다. 성충의 머리에는 큰턱의 흔적기관이 남아있으며, 흡관이 관찰되어 흡관아목에 속한다. 출현시기는 3~4월의 초봄에 나타나며, 주로 아침에 활동하는 것으로 알려져 있다. 국내에는 *Eriocarnia* 속에 속하는 자작나무좀굴나방(*Eriocrania sparrmannella*) 한 종만이 알려져 있으며, 인근 국가의 분포 현황을 보았을 때 잠재적인 종이 분포할 것으로 예상된다. 본 연구에서는 Eriocraniidae의 서식환경 및 생태를 소개하여 추후 연구의 기틀을 마련하고자 한다.

검색어: 좀날개나방과, 미소나방, 분포, 자작나무좀굴나방

SG11

Introduction and characterization of Incurvariidae (Lepidoptera) from Korea

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곡나방과는 날개 편 길이 10~20mm 정도의 미소나방으로, 전 세계적으로 11속 100여종이 알려진 작은 분류군이다. 이들은 단풍나무, 자작나무 등의 잎을 가해하며, 1령 유충은 잠엽성 생태를 보이고 그 이후에는 기주식물의 잎을 둥글게 잘라 은신처를 만들고 그 안에서 생활하는 독특한 생태를 보인다. 국내에는 현재 3종이 알려져 있으며, 인접 국가의 현황을 보면 잠재적인 종이 좀 더 분포할 것으로 예상된다. 본 연구를 통해 국내 곡나방과를 소개하고 추후 연구의 기틀을 마련하고자 한다.

검색어: 곡나방과, 미소나방, 잠엽성, 미기록종, 분류군

SG12

Korean noctuoidea, the past and the future

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The superfamily Noctuoidea Latreille, 1809 is the largest group within the order Lepidoptera. This big superfamily have been studied for a long time by numerous authors and literatures. However, these huge number of information make hard to study this important group.
In this discussion, we hope to talk a simplified overview of significant literature on Korean noctuid moths, recent trends, and forecast for approaching them more easily.

Key words: Fauna, bibliography, taxonomic history, Oriental region, Palaearctic region

SG13

Introduction of subfamily Acronictinae with characteristics and insight

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The subfamily Acronictinae is established by Harris in 1841 based on the type species, Acronicta leporina.. In the Korean penisula, the acronictine moth Acronicta cuspis was initially reported by leech in 1889, and a total 45 species have been recorded to date. This brief overview cover adult and larval morphology, as well as ecological data, for more profound comprehension of the Acronictinae. Additionally, further research direction could involve conducting a phylogenetic analysis and clarifying the evolutionary relationships within the subfamily.

Key words: Research history, morphology, ecology, phylogeny, evolution

SG14

Characteristics of the family Pterophoridae (Lepidoptera) in Korea

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The family of Pterophoridae, also called ‘Plume moth’, is distributed all around the world. More than 1,100 species have been studied and reported in the most recent world catalogue, and it has been discovered 34 species from Korea. The reason why they are called Plume moth is that they have a distinct shape of wings, which makes them easily distinguished. This group have a 6 − 40mm wingspan, mostly have two-pronged forewings and three-pronged hindwings. Interestingly, their resting posture is T-shaped with the narrow forewings held perpendicular to the body, while the hindwings tucked under or folded within the forewings. They have slender bodies with long, fragile legs, and also have three types of color : plain white, mottled gray or brown. Pterophoridae has unique morphological characteristics, and it is an interesting group for us to look over them in general.

Key words: plume moth, palearctic region, entomology, morphology

SG15

An overview of the family Stathmopodidae

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One of the taxa of the superfamily Gelechioidea, Stathmopodidae, is widely distributed around the world, with 39 genera and 390 species reported as of 2015. This family shares the common characteristic of carrying their long hind tibia, but depending on the species, they have a variety of wing patterns and colors. Additionally, while there are species classified as pests for causing damage to grains and fruits, there are also species that feed on moss, spore of ferns and aphids. Consequently, they exhibit a diverse range of morphological and ecological characteristics. However, due to the lack of research and similarities between species, there is still much confusion in identification and phylogenetic analysis to date. In this current situation, further research intends to resolve the confusion in the phylogenetic sutdy of Stathmopodidae not only through morphological and molecular analysis but also by incorporation the latest technologies.

Key words: Stathmopodidae, phylogenetic, morphology, molecule

SG16

A study of the Reduction of Diamide Resistance of *Spodoptera exigua* in Jindo according to the Breeding of the generation

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대파(*Allium fistulosum* L.)는 동양에서 옛날부터 중요한 식재료로 재배되어온 중국 원산지의 향신 채소이다. 적어도 통일신라시대부터 재배되어 온 기록이 있으며 현재에도 식재료로 수요가 많아 전국적으로 재배면적이 넓어지고 있고, 종자의 유통량 또한 많다. 대파에는 파굴파리(*Liriomyza chinensis*), 파좀나방(*Acrolepiopsis sapporensis*), 파밤나방(*Spodoptera exigua*) 등이 주요 해충으로 알려져 있다. 전남 진도군은 국내 대파 주산단지로 파밤나방의 발생이 많고 다이아마이드 계통 농약의 저항성이 발현되고 있어 계대사육에 따른 저항성 감소를 실험하고자 한다. 실험은 진도군의 대파밭에서 파밤나방 개체를 채집하여 실내에서 약제처리를 통해 살충률과 섭식률을 검정, 몇세대에 걸쳐 저항성이 감소되는지 알고자 한다.

검색어: 파밤나방, 진도군, 다이아마이드 계통, 저항성, 계대사육

SG17

Introduction to subfamily Erebinae (Lepidoptera: Erebidae) in Korea

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Erebinae, a subfamily within the family Erebidae, represents one of the largest classification groups in Lepidoptera. This taxonomic group exhibits remarkable ecological diversity and astonishing predator defense adaptations. Erebinae possesses what is presumed to be the most sensitive tympana (hearing organs) among Lepidoptera, allowing them to evade predators such as bats. Furthermore, they have distinctive hindwings, in contrast to their inconspicuous forewings, which they can suddenly expose as a strategy to escape danger from predators. The classification of the subfamily Erebinae is based on molecular studies conducted by Zahiri et al. (2012). However, despite these efforts, there is no single external feature that can reliably identify all Erebinae, and the boundaries of this group remain somewhat unclear. Many specimens have yet to be thoroughly studied, and numerous genera are still awaiting placement within the phylogenetic framework.

Key words: classification, Erebinae, review, taxonomy

SG18

Family Blastobasidae (Lepidoptera) of Korea: Introduction and characteristics

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The Blastobasidae is microlepidopteran, narrow-winged moth and account of more 500 species among 23genera worldwide. This family is defined by the following characteristics: i) presence of antennal pecten in head; ii) Rs and M_1 separate in the hindwing; iii) valva with well-developed digitate saccular processus in male genitalia; iv) aedeagus with a band-like internal sclerite.

Key words: Blastobasidae, Characteristic , Taxonomy

SG19

Exploring Pseudoscorpiones: Diversity and insights from Korea

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Pseudoscorpiones De Geer, 1778, an order of arachnids, exhibits a global distribution spanning all continents, with the notable exception of Antarctica. This taxon is characterized by a wide array of unique behaviors, including phoresy and matriphagy, setting it apart from other arachnid groups. Moreover, their morphological features distinguish them notably from other animal taxa. Surprisingly, in the context of Korean research, pseudoscorpions remain a relatively unexplored field. Up until the year 2023, only 8 families, 13 genera, and 26 species have been documented in Korea. This number stands in stark contrast to neighboring countries like Japan, boasting 13 families, 35 genera, and an impressive 100 species, and China, which has documented 12 families, 39 genera, and an extensive 168 species of pseudoscorpions.

Key words: Pseudoscorpiones, false scorpion, Introduction

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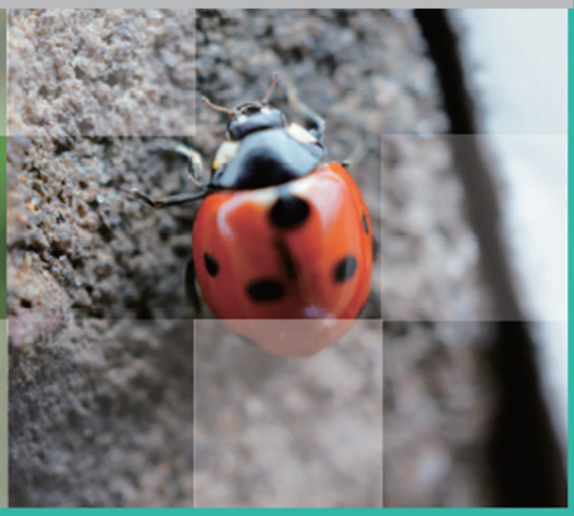

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