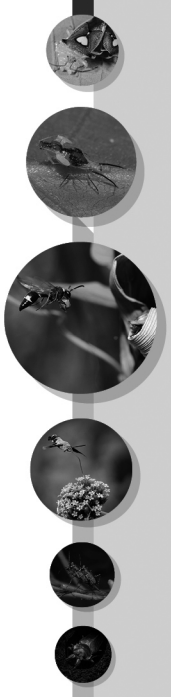
Poster Presentation Competition



P1

Casmara's non-desctructive identification method

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The genus *Casmara* was first described by Walker in 1863, and to date, 21 species have been reported worldwide. Among these, the only species reported in the Korean Peninsula is *C. agronoma* Meyrick, which was reclassified from the family Oecophoridae to Stathmopodidae based on molecular phylogenetic studies in 2016. However, no further research has been conducted since its reclassification, and thus, information on this species remains insufficient. In this study, we utilize Micro-CT (Computed Tomography) to non-destructively investigate the genitalia structure of *C. agronoma*, providing a new 3D description. Additionally, Micro-CT data from other congeneric species with a similar morphology will be presented to compare and elucidate the 3D structural characteristics of the genitalia across the genus, thus contributing to a deeper understanding of their morphological diversity.

Key words: Stathmopodidae, *Casmara*, Micro-CT

P2

Taxonomic review of the Tribe Pterostichini Bonelli, 1810 (Coleoptera: Carabidae) in Korea

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The Tribe Pterostichini Bonelli, 1810 is one of the largest group in the family Carabidae. There are 4 subtribes, 168 genera, and 3,309 species distributed worldwide, and 6 genera, 22 subgenera, and 84 species are recorded in Korea. Most species have degenerated hind wings and depend on walking, so their movement is very limited, and they inhabit various environments, so their species diversity is high. This tribe was first recorded in Korea by Morawitz (1862), and the taxonomic review was first conducted by Park (1994). Although research has been insufficient since the announcement of the new species by Park (2013), research is being conducted again recently.

In this study, we aim to provide morphological characteristics of this group and photographs of the male genitalia.

Key words: taxonomy, ground beetle, male genitalia, endophallus, Korea

P3

Investigation of the diversity of soil-dwelling mites (Acari) from Dokdo islands of Korea

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As the easternmost island of the Korean Peninsula, Dokdo has a unique ecosystem. While much of the research on the island's species diversity has focused on terrestrial insects, the soil invertebrates, particularly soil mites, have not been studied. We collected soil samples from 8 sites on Dokdo over three times from 2023 to 2024 and extracted mite samples using Berlese-Tullgren method. Using both morphological and molecular diagnosis, we identified most mites from family to genus level. The total number of collected mites was 443 individuals. First, mites were identified into 14 family groups by morphological analysis, and between 1 to 5 individuals from each sample were selected for molecular diagnosis. We identified 5 genera, 6 families in the Order Mesostigmata; 6 genera, 8 families in the suborder Oribatida. Among them, four species (*Cosmochthonius reticulatus*, *Gamasiphis pulchellus*, *Punctoribates punctum*, *Tectocepheus velatus*) were identified at the species level. This study is the first to report biodiversity of soil-dwelling mites distributed on Dokdo islands.

Key words: Biodiversity, Dokdo, Geographic distribution, Mesostigmata, Oribatida

P4

A blood-feeding sand fly species (Diptera: Psychodidae) newly recorded from Korea

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Sergentomyia, a genus within the hematophagous subfamily Phlebotominae (Diptera: Psychodidae) commonly known as sand flies, was traditionally known to feed on cold-blooded vertebrates and transmit reptile leishmaniasis. However, recent studies have detected mammalian *Leishmania* and *Trypanosoma* in some members of this genus, and also showing that their blood-feeding preferences can extend to mammals, including humans. Recently, sand flies collected from a riverside in Chuncheon were identified and newly recorded as *Sergentomyia hivernus*, originally recorded from Vietnam. This finding is rather unusual since *Se. hivernus* are primarily recorded from subtropical region and many other congeners are mainly recorded from tropical or subtropical regions. This warranted more comprehensive research on ecological and veterinary aspects of this blood-feeding insect.

Key words: blood-feeding, hematophagous insects, leishmaniasis, sand flies, *Sergentomyia*

P5

New records of the genus *Conicera* (Diptera: Phoridae) from South Korea with description of a new species

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Three species of the necrophagous scuttle fly genus *Conicera* Meigen are newly recognized from South Korea. Among them, one species is described new to science which has a unique sac-like organ beneath the posteroapical surface of midfemur instead of an exposed sunken structure called sensory pit, which is a commonly shared character of *Conicera* species having structures on midfemur. The other two species, *viz*. *C. schnittmanni* and *C. tortuosa*, are newly recorded from South Korea. Photographs of diagnostic characters and a revised key to males of South Korean *Conicera* are provided.

Key words: *Conicera*, new species, scuttle fly, sensory organ, 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 (NIBR202402202).

P6

Remarkable but ignored: description of the poorly known *Pholcus pojeonensis* (Araneae: Pholcidae), with two new congeneric species from Korea

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Pholcus pojeonensis has extraordinary genital morphology among Korean members of *Pholcus phungiformes*-group (Araneae: Pholcidae), such as strongly elongated male palpal procursus and embedded epigynal knob of female. However, since measurements and photographs of the original description was considered insufficient, this species has been omitted from the Korean national species list. In this study, *P. pojeonensis* is redescribed and the female internal genitalia is illustrated for the first time. Moreover, two new *Pholcus* species are described which are similar to *P. pojeonensis* and *Pholcus joreongensis*, and a taxonomic note on the identity of *P. joreongensis* and *Pholcus worak* is provided.

Key words: cellar spider, new species, *Pholcus phungiformes*-group, redescription, 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 (NIBR202402201).

P7

Pictorial key of underwing moths (Lepidoptera: Erebidae: *Catocala*) from Korean Peninsula

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The genus *Catocala* Shrank, also known as 'Underwing moths', is one of the most well-marked and speciose taxa within the family Erebidae. While underwing moths are generally easy to identify by their distinctive characteristics, some species can be hard to identify due to similarities in their wing patterns. Furthermore, seven species have been reported only from North Korea on the Korean peninsula; *Catocala adultera* Ménétriès, *C. helena* Eversmann, *C. musmi* (Hampson), *C. proxeneta* Alphèraky, *C. danilovi* (Bang-Haas), *C. pirata* (Herz), and *C. bokhaica* (Kononenko). Consequently, information on these species is relatively scarce compared to those recorded in the South Korea. The 'pictorial key', as opposed to the verbal key, allows for more intuitive taxonomic diagnoses. This facilitates the use of our most valuable taxonomic tool, the 'human eye', and access for people with limited prior knowledge of taxonomic descriptions. Therefore, we provide a pictorial key for more precise identification of Korean *Catocala* species by compiling all of the underwing moths from the Korean peninsula onto a single poster, something has not been done before.

Key words: identification, morphological characters, Owlet moths, wing pattern

P8

Taxonomic revision and molecular phylogeny relationship of the subtribe Anisodactylina (Coleoptera: Carabidae) from Korea

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Previous studies have recorded a total of four species, two subgenera, and one genus of the subtribe Anisodactylina in Korea. In this study, we report two species, *Harpalomimetes fukiensis* and *Anisodactylus* (*Hexatrichus*) *mandschuricus*, as newly recorded species in Korea. Additionally, we inferred the molecular phylogenetic relationships based on mitochondrial *COI*.

We also provide photographs of adults, along with a taxonomic key and descriptions of their morphological characteristics.

Key words: Anisodactylina, Carabidae, Korea, New record, Taxonomy

P9

First record of *Ceratovacuna lanigera* (Hemiptera: Aphididae: Hormaphidinae) from South Korea

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The genus *Ceratovacuna* Zehntner, 1897 (Hemiptera: Aphididae: Hormaphidinae) is predominantly found in East and Southeast Asia. *Ceratovacuna* species exhibit an intricate life cycle, necessitating seasonal alternation between primary host plants, specifically *Styrax* spp., and secondary host plants, encompassing various species of the family Poaceae. The sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* Zehntner (Himeptera: Aphididae: Hormaphidinae) is one of the most serious pests of sugarcane. We report *Ceratovacuna lanigera* for the first time in South Korea. The results of this study additionally include as followings: 1) redescriptions of the apterous viviparous female, 2) DNA barcoding, 3) population genetic analyses.

Key words: Aphids, Cerataphidini, Diversity, SEM

P10

A new record of *Cerataphis* (Hemiptera: Aphididae: Hormaphidinae) from Myanmar

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The aphid genus *Cerataphis* Lichtensteinis, 1883 is a south–east Asian genus of the tribe Cerataphidini (Hemiptera: Hormaphidinae). *Cerataphis*species are linked to a wide range of host plants such as bamboo, grasses, orchids, palms, and trees from the genus *Styrax*L. In addition, they are also present on certain plant species of Musaceae, Strelitziaceae, and Zingiberaceae families. In this study, we report *Cerataphis orchidearum* for the first time in Myanmar. The results of this study additionally include as followings: 1) redescriptions of apterous and alate viviparous females, 2) DNA barcoding.

Key words: Aphids, Cerataphidini, Diversity, SEM

P11

First record of *Cinara pilicornis* (Hemiptera: Aphididae: Lachninae) from South Korea

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The genus *Cinara* Curtis, 1835 (Hemiptera: Aphididae: Lachninae) is a large aphid genus comprising 256 known species worldwide associated with coniferous trees (Cupressaceae and Pinaceae families) as host plants. In this study, we report *Cinara pilicornis* (Hartig, 1841) for the first time in South Korea. The results of this study additionally include as followings: 1) redescriptions of the apterous and alate viviparous females, 2) DNA barcoding, 3) population genetic analyses, 4) modeling of potential distributions.

Key words: Aphids, Lachninae, Pest, Distribution

P12

Taxonomic revision of the genus *Parena* (Coleoptera: Carabidae) from Korea

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The genus *Parena* Motschulsky, 1860 is primarily distributed in the Oriental region. Despite this wide distribution, genus *Parena* has been poorly studied in Korea, with only six species recorded compared to 46 species worldwide. This study provides a revised pictorial key for the Korean species and reports a newly recorded species in Korean Peninsula.

Key words: *Parena*, New record, Carabidae, Korea, Taxonomy

P13

Two halophilous ptiliid genera, *Actidium* Matthews and *Actinopteryx* Matthews (Coleoptera: Ptiliidae: Ptiliini) new to Korea

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The genera *Actidium* Matthews and *Actinopteryx* Matthews (Coleoptera: Ptiliidae: Ptiliini) are comprise 40 and seven species, respectively. Most species of these genera are known to inhabit in sand, dried mud, mosses, or plant debris near fresh or salt water. In Northeast Asia, a single *Actidium* species is reported from the Russian Far East, and a single *Actinopteryx* species is reported from Japan and the Russian Far East. In this study, we report two halophilous ptiliid, *Actidium* sp. and *Actinopteryx parallela* Britten from Korean Peninsula for the first time. Illustrations of habitus, diagnostic characters, and genital structures, and a distributional map are provided.

Key words: featherwing beetles, coastal, halophilous, taxonomy

P14

Taxonomic review of Korean *Rhynchites* Schneider (Coleoptera: Rhynchitidae) with a new record

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한국산 주둥이거위벌레과의 *Rhynchites*속은 복숭아거위벌레 [*Rhynchites* (*Epirhynchites*) *heros* Roelofs, 1874]와 어리복숭아거위벌레 (*Rhynchites foveipennis* Fairmaire, 1888)가 기록되어 있었으나, Legalov (2007)에 의하여 어리복숭아거위벌레가 복숭아거위벌레로 동종이명 처리되었고, Nagayama & Okamoto (1940)의 연구를 근거로 북방복숭아거위벌레[*Rhynchites* (*Rhynchites*) *bacchus* Linnaeus, 1758]의 국내 기록이 인용되어 왔다. 하지만, 북방복숭아거위벌레는 러시아 우랄산맥의 서쪽인 유라시아 지역에 주로 분포하는 종으로 국내 분포가 의심스러운 종이었다. 본 연구에서는 영국자연사박물관에 소장되어 있는 *Rhynchites* 속의 모식표본과 국내 표본들을 토대로 한국산 *Rhynchites*속의 분류학적 재검토를 수행하였다. 연구 결과, 국내 기존 기록되어 있었던 북방복숭아거위벌레는 오동정이며, 과거에 어리복숭아거위벌레로 동정되어 왔던 종은 국내 미기록종인 *Rhynchites* (*Rhynchites*) *fulgidus* Faldermann, 1835로 최종 확인하였다. 따라서, 본 발표에서는 국내 미기록종인 *R.* (*R.*) *fulgidus* Faldermann의 진단학적 형질, 국내 기록된 *Rhynchites* 종의 분류학적 검색표, 생태학적 정보 등의 자료를 제공한다.

검색어: 바구미상과, 진단학적 형질, 검색표, 생태

P15

Sitophilus linearis (Herbst) newly reported on tamarind seeds in Sri Lanka

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The tamarind weevil, *Sitophilus linearis* (Herbst, 1795) (Coleoptera: Curculionidae: Dryophthorinae) is an important pest of tamarind from subtropical and tropical countries. After tamarind pods is ripen, the infestation starts in the field, and the damage can be continued during storage. Specimens of this weevil were collected from a household dried tamarind sample in the Nuwara-Eliya district, marking its first recorded occurrence in Sri Lanka. With this addition, the number of known *Sitophilus* species in Sri Lanka increases to four species including *S. granarius* (L.), *S. oryzae* (L.) and *S. zeamais* (Motschulsky). Among the known regional congeneric species, *S. linearis* is easily distinguishable by its contiguous antennal scrobe with anterior margin of eye.

Key words: *Sitophilus linearis,* Tamarind, New record, Sri Lanka

P16

Genetic structure of a lumpy skin disease vector, *Stomoxys calcitrans* (Diptera, Muscidae) in South Korea using mitochondrial Cytochrome c oxidase subunit I

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럼피스킨 매개충인 침집파리(*Stomoxys Calcitrans*)의 국내 지역별 유전형 분석을 미토콘드리아 Cytochrome c oxidase I (COI) 유전자를 기반으로 분석하였다. 2024년 5월부터 8월까지 럼피스킨 매개충 예찰을 통해 총 20개 지역에서 채집된 199개체의 COI 전반부 염기서열 658bp를 판독하여 확보하였다. COI 유전자염기서열의 Pairwise comparison 결과, 한국 서부해안을 중심으로 채집된 침집파리는 1.7%에서 2.7%의 서열 차이를 보이면서 크게 2개의 그룹으로 분지되었다. Haplotype 분석 결과, 침집파리는 총 34개의 Haplotype이 확인되었고, 이 중 H1(18개체)과 H2(136개체)가 우점하는 것으로 나타났다. MJ network 분석에서는 앞선 2가지 분석 결과를 반영하면서 크게 2개의 주요 Haplotype (H1, H2)을 중심으로 network를 형성하였으며, 이 두 Haplotype 간의 mutation point는 최소 15번 이상으로 나타났다. 이와 같은 결과로 볼 때, COI 유전자 상에서 우리나라에 분포하는 침집파리는 크게 2개의 주요 유전자형이 존재하는 것으로 나타났으며, 두 유전자형의 유전적 형질 차이는 큰 것으로 확인되었다. 이는 국외로부터 개체의 유입이나 이동이 있었을 것으로 추론되는 결과이다. 따라서, 추후의 국외 개체군을 분석에 추가하여 국내 침집파리 개체군의 개체군 동태(population dynamics) 분석을 진행할 것이다.

검색어: 침집파리, 집파리과, 파리목, 럼피스킨, 매개충, 한국

P17

Review of the subfamily Scydmaeninae Leach (Coleoptera: Staphylinidae) in Korea

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The subfamily Scydmaeninae Leach (Coleoptera: Staphylinidae) includes approximately 160 genera and 5,800 species in worldwide. In Japan, 13 genera and 130 species have been recorded. However, until 2021, only three genera and seven species have been recorded in Korea. From 2021 to the present, seven additional species within four genera, including two previously unrecorded genera (*Stenichnus* Thomson and *Nogunius* Jałoszyński), have been newly recorded in Korea. Nevertheless, many scydmaenid species in Korea remain unrecorded, and it is expected that more species will be discovered. In this study, we provide a species list and habitus images of Korean Scydmaeninae species collected from 2017 to the present in our laboratory. Additionally, we provide a taxonomic key for the genera of Korean Scydmaeninae.

Key words: ant-like stone beetles, Korea check list, taxonomy, unrecorded.

P18

Distinct morphological characteristics of the Korean population of *Pryeria sinica* Moore (Lepidoptera: Zygaenidae): A regional study

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This study examined the morphological characteristics of different developmental stages of the *Euonymus* defoliator moth, *Pryeria sinica* Moore. While the morphological traits of this species have been previously studied in populations from China, Japan, and Taiwan, no research has yet focused on the Korean population. According to Yen and Horie (1997), the morphological traits of *P. sinica* exhibit continuous variation across the regions. Thus, this study aimed to examine the morphological characteristics of the Korean population and compare them with those reported in China, Japan, and Taiwan. Both quantitative and qualitative traits were analyzed across all developmental stages (egg, larva, pupa, and adult). The results indicate that the Korean population exhibited distinct quantitative differences compared to other regional populations. Egg size showed minimal variation among the populations studied, but larvae from the Korean population had the smallest overall head capsule width. Contrary to the findings of Matsuzawa (1962) and Tamura and Ouchi (1977), which reported significant head capsule growth during the second molt, the Korean population displayed the least growth (1.3 growth ratio) during the second molt and the most growth (1.6 growth ratio) in the final molt. In the pupal stage, the Korean population was smaller than their Taiwanese counterparts. Among adults, Korean males were smaller than their Taiwanese counterparts, while the females were similar in size. Qualitative comparisons of adults with other regions also revealed notable differences. For instance, the Taiwanese population had 40-42 flagellomeres, while the Korean population had 35-36. Additionally, differences in wing venation, particularly in hindwings, were observed. These findings underscore the unique developmental patterns of the Korean population and emphasize the need for further comparative research across regions.

Key words: *Euonymus* defoliator moth, *Pryeria sinica* Moore, morphological characteristics, regional variation, comparative analysis, sexual dimorphism

P19

Two new species of the genus *Argyresthia* (Lepidoptera: Yponomeutiodea: Argyresthiidae) in Korea

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The genus *Argyresthia* Hübner, [1825] of the family Argyresthiidae Meyrick, 1932 is known to comprise over 200 species worldwide. Among them, more than 100 species are recognized in the Palaearctic region. The Korean fauna of the genus *Argyresthia* includes 11 described species to date. In this study, we describe two species of the genus *Argyresthia*: *Argyresthia* sp. nov. 1 and *A.* sp. nov. 2, as new to science. All available information, images of adults and genitalia for the species are provided.

Key words: Lepidoptera, Yponomeutoidea, Argyresthiidae, *Argyresthia*, new species, Korea

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P20

Identification of two newly recorded Crambidae (Lepidoptera, Pyraloidea) in Korea, using DNA barcode sequences and morphological characters

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The family Crambidae is a large and diverse taxonomic group with over 10,000 species reported worldwide. This paper reports on two species of Crambidae that are new to the Korean insect fauna: *Pagyda recticlavata* Qi & Li, 2020, and *Schoenobius gigantella* (Denis & Schiffermüller, 1775). The identification of these two species was fully supported by both DNA barcode sequences and detailed morphological characteristics. In addition, comprehensive descriptions and photographs of the adults and genitalia, as well as extensive DNA sequence information, are provided to facilitate further research.

Key words: Crambidae, Pyraustinae, Schoenobiinae, new record, DNA barcode, Korea

This study was supported by the Korea National Arboretum (project no. KNA1-1-20, 16-1).

P21

Taxonomic review of the genus *Anthrenus* (Dermestidae, Megatominae, Anthrenini) in Korea

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This study was conducted to review of the genus *Anthrenus* Geoffroy, 1762 belonging to the subfamily Megatominae of the family Dermestidae. A total of four subgenera eight species have been recorded in Korea. In this study, we review the taxonomy of the Korean *Anthrenus* based on the re-examination of the old literature records and specimens. A key to Korean species of *Anthrenus*, diagnosis, and photographs of the adult for the species are provided.

Key words: Anthrenus, Anthrenini, Megatominae, Dermestidae, Korea

P22

Analysis of GC-EAD and GC-EPD responses to volatile extracts from oviposition host plants for developing female attractants in pumpkin fruit fly (*Bactrocera depressa)*

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The pumpkin fruit fly, *Bactrocera depressa* (Diptera: Tephritidae), causes damage to fruiting vegetables, leading to significant economic losses. It is also considered a major quarantine pest in many countries. The pumpkin fruit fly can lead to a ban on exporting crops to other countries. However, there are currently no effective methods for monitoring and controlling the pumpkin fruit flies. In the field, female pumpkin fruit flies damage to fruiting vegetables through oviposition. People use attractants made from protein baits or rice wine to monitor and control the pumpkin fruit flies. However, they have several serious issues, such as attracting non-target insects, spoiling easily, and difficulties in ensuring a consistent formulation. To develop attractants for effective monitoring and controlling female pumpkin fruit flies, we analyzed gas chromatography-electroantennographic detection (GC-EAD) and gas chromatography-electropalpographic detection (GC-EPD) responses to volatile extracts from oviposition host plants, including squash, sweet pumpkin, and pumpkin. Analysis of GC-EAD and GC-EPD recordings showed that antennae and palpi responded to six and three volatiles from each oviposition host plant, respectively. This study could lead to the development of attractants that specifically and effectively target female pumpkin fruit flies, potentially replacing the currently used attractants.

Key words: pumpkin fruit fly, GC-EAD, GC-EPD, oviposition host plants

P23

Metabolomics of the honey bee brain exposed to imidacloprid

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The honey bee as a pollinator has been important in most ecosystems and threatened various agrochemicals such as neonicotinoids which result in population reduction. It is known that neonicotinoids can damage the memoey and learning ability of honey bees, affecting decline in their foraging and homing abilities. To understand metabolite changes depending on dose or time of imidachloprid exposure, honey bees were exposed to various doses, LD_{10}, LD_{25}, and LD_{50} for 12 h and metabolites of their brains were analyzed using liquid chromatography tandem mass spectrometry (LC-Ms/Ms). Totally, 341 metabolites were found in LC-Ms/Ms and principle component analysis revealed that metabolites from imidachloprid exposure were completely separated from those from the control, indicating widespread metabolic disruption. KEGG pathway analysis showed that imidachloprid activated various metabolic pathways, including pantothenate and CoA biosynthesis, amino acid metabolism, nucleic acid metabolism and fructose/mannose metabolism and reduced TCA cycle, sphingolipid metabolism, pyruvate metabolism, glutathione metabolism and pentose phosphate pathway (PPP). Pyruvate metabolism, TCA cycle, and the PPP emerged as key metabolic pathways contributing to the bees' vulnerability to imidacloprid exposure. The reduction in these core pathways likely underpins the bees' decreased energy production, leading to impaired cognitive functions, reduced foraging ability, and overall survival challenges.

Key word: Metabolomics, Imidachloprid, the honey bee, Principle component analysis, KEGG pathway

P24

Comparative metabolomics of the honey bee brain exposed to fipronil

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To understand the colony collapse disorder (CCD) in honey bees, many studies have mainly focused on analyzing differentially expressed genes (DEGs) after exposure to agrochemicals. However, it is still unclear whether differential expression of some genes leads to behavioral changes in honey bees. In this study, physiological alteration in honey bees exposed to fipronil, phenylpyrazole insecticide, for 1, 4, 12, and 24 hours were investigated based on the activity of metabolic pathways in the brain. Total metabolites were extracted and identified using Liquid chromatography-quadrupole time-of-flight tandem mass spectrometry (LC-QTOF/MS), and modulated 32, 75, 56, and 118 metabolites were filtered for each time point. Comparative analysis of KEGG metabolic pathways showed that fipronil induced time-dependent changes in the metabolites of honey bees, which led to the regulation of various metabolic pathways. Initially, fipronil exposure only affected lipid biosynthesis in honey bees, but over time, it expanded to include metabolic pathways related to nucleic acids, amino acids, and saccharides. These results suggest that the metabolic activity of honeybees is altered by fipronil, which may help understand cognitive impairment and survival challenges.

Key word: Metabolomics, fipronil, honey bee, KEGG pathway, LC-QTOF/MS

P25

Classification and characterization of the immune hemocyte in the *Scolopendra subspinipes multilans*

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국내에 흔하게 분포하는 왕지네인 *Scolopendra subspinipes multilans* 의 혈구세포 분류 및 특성화를 진행하였다. 왕지네의 혈액을 추출한 뒤 광학현미경을 통해 혈구세포의 형태에 따른 분류를 진행하였다. 또한 Latex bead를 살아있는 왕지네에 접종한 뒤 시간 경과에 따른 혈구세포의 형태 변화와 면역반응을 관찰하였다. 육안 동정을 통해 왕지네의 혈구세포가 Granulocyte, Prohemocyte, Plasmatocyte 및 밝혀지지 않은 세포 한 종류가 있다는 것을 알 수 있었으며 Latex bead를 접종하였을 때 대식세포로서 활동하는 세포는 Granulocyte와 Plasmatocyte라는 것을 확인할 수 있었다. 향후 곤충 병원성 및 비병원성 세균의 접종, 그람양성 세균 및 그람음성 세균의 접종을 통해 곤충 및 다지류의 면역에 대한 연구를 지속할 계획이다.

검색어: 혈구 세포, 면역, 특성화

P26

Effects of back door forming residues on the functional and structural properties of *Apis mellifera* acetylcholinesterase 1

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Acetylcholinesterase (AChE) is a key enzyme that terminates impulse transmission by rapidly hydrolyzing the neurotransmitter acetylcholine at cholinergic synapses. Previous studies have identified a transiently opening channel, referred to as the 'back door', in *Torpedo californica* AChE. To investigate the role of the back-door-forming residue Phe391 in *Apis mellifera* AChE1 (AmAChE1), we substituted Phe391 with Ser, Trp, Thr, Ile, Asn, and Tyr, and analyzed the kinetic properties and molecular dynamics of the AChE variants. The Vmax values from the kinetic assays indicated that all substitutions resulted in higher values than the original Phe, with Tyr showing the highest increase (about 77-fold) and Ser the lowest increase (about 2-fold). Results from the molecular dynamics simulations revealed a positive correlation between the back door opening ratio and the root mean square fluctuation of residues near the back door with the Vmax values. This suggests that Phe391 substitutions impair back door formation, leading to a significant reduction in the catalytic activity of AmAChE1, and that this back-door-forming residue serves as a driving force for the functional transition from AmAChE1 to AmAChE2.

Key words: acetylcholinesterase, back door, *Apis mellifera*, kinetic assay, molecular dynamics

P27

Structural protein CPAP1-H functions in organization of cuticular extracellular matrix in a beetle

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The two different structural biopolymer, cuticular proteins (CPs) and chitin, are major components of insect cuticle, which plays critical roles in protecting them from several environmental stresses and pathogens. Insect *cuticular protein analogous to peritrophins* (*CPAPs*) genes comprise one of the major *CP* gene families, and its products have been classified into two subfamilies, CPAP1 and CPAP3, with respectively one or three copies of a CBM14 chitin-binding domain. In this work we investigated the physiological functions of TcCPAP1-H, belonging to the CPAP1 subfamily in *Tribolium castaneum*. RNAi of *TcCPAP1-H* at young instar larval stages resulted in lethal developmental arrest where the larvae exhibited a rough and crumpled cuticle. Injection of dsRNA for *TcCPAP1-H* (ds*TcCPAP1-H*) into last instar larvae had no effect on the subsequent larval-pupal molt. However, the resulting pupae failed abdominal contraction, wing expansion or tightening of head and appendages. Those pupae eventually died entrapped their pupal exuviae during adult eclosion. TEM analysis revealed that TcCPAP1-H is required for proper organization of chitinous horizontal laminae and vertical pore canal in the cuticle of adult *T. castaneum*.

Key words: exoskeleton/cuticle, chitin, cuticular protein (CP), cuticular protein analogous to peritrophin (CPAP), *Tribolium castaneum*, RNA interference (RNAi)

P28

Distribution and ultrastructure of the antennal sensilla of the fig weevil, *Aclees taiwanensis* Kono (Coleoptera: Curculionidae)

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Aclees taiwanensis, commonly known as the fig weevil, is a species native to Taiwan that was accidentally introduced to Korea. This species primarily feeds on plants of the *Ficus* genus and poses a significant threat to fig farms, particularly those cultivating *Ficus carica*. In this study, the morphology and distribution of the antennae and antennal sensilla of *A. taiwanensis* were examined using scanning electron microscopy. The antennae consist of a scape, pedicel, funicle, and club, with a total of 10 antennomeres. Three types of sensilla, including seven subtypes, were identified on the antennae: chaetica, basiconica, and dome-shaped sensilla. No significant sexual dimorphism was detected. This information is crucial for understanding the electrophysiological and behavioral aspects of chemical communication in *A. taiwanensis*.

Key words: *Aclees taiwanenesis*, antennal sensilla, ultrastructure, scanning electron microscopy

P29

The combined treatment effect of phosphine and methyl benzoate on *Tribolium castaneum*

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Phosphine is used as an alternative fumigant to methyl bromide for the quarantine and disinfestation of stored grain pest insects, but phosphine-resistant populations have recently emerged in imported agricultural products. Therefore, there is an urgent need to develop new alternatives and methods to efficiently disinfect phosphine-resistant insect pests. Here, we utilized methyl benzoate (MBe), a plant-derived natural volatile organic compound with insecticidal activity, and analyzed its effectiveness in combination with phosphine. We determined the LC_{90} of phosphine and MBe against *Tribolium castaneum* as 0.0063 mg/L and 10.2154 mg/L, respectively. Based on this, the combined treatment of phosphine LC_{30} concentration (0.004 mg/L) and MBe LC_{30} concentration (6.0 mg/L) resulted in a 99.2% mortlaity of *T. castaneum*. Namely, the combination of MBe in the phosphine treatment resulted in a high mortality of *T. castaneum* while reducing the phosphine content. This study is expected to be useful for efficient disinfection and control of phosphine-resistant stored grain insect pests.

Key words: quarantine, resistance, fumigation , synergistic effect

P30

Acaricide resistance ratios of *Tetranychus urticae* in strawberry cultivars in Korea

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Tetranychus urticae (TSSM) is a major pest in greenhouse agriculture worldwide. Its short life cycle and high reproductive rate frequently lead to the development of acaricide resistance. To evaluate resistance ratios (RR) of eight acaricides with different modes of action, we collected TSSM from 15 strawberry cultivars from five provinces between 2022 and 2024. Acaricides treated to eggs and nymphs using leaf dipping and adults using direct spray methods. The results showed high lethality (>80%) and low RR (<5) for two acaricides [acequinocyl (20b) and cyflumetofen (25a)], while the other six acaricides [fenpropathrin (3a), abamectin (6), etoxazole (10b), chlorfenapyr (13), flufenoxuron (15), pyridaben (21a)] exhibited mostly low lethality (<80%) and high RR (>5). These results provide important indicators for assessing pesticide resistance in the two-spotted spider mite.

Key words: two-spotted spider mite, chemical acaricide, resistance monitoring, pesticide resistance

P31

Mass rearing of a predatory mite, *Neoseiulus californicus*, using a sterilized pouch

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The two-spotted spider mite (TSSM), one of the most problematic pests in greenhouses worldwide, has developed significant resistance due to prolonged pesticide use. Additionally, as consumer awareness of pesticides changes and regulations tighten domestically, farmers are increasingly pressured by pesticide use, leading to growing interest in the use of natural predators. Amidst these changes, we developed a method for mass rearing *Neoseiulus californicus*, a natural enemy of TSSM using a sterilized pouch including a small amount of *N. californicus*, a large amount of prey mites, *Glycyphagus destructor*, and media (wheat bran, vermiculite, yeast), sealed, and kept at room temperature condition for 3 weeks. Then, the predator density was measured to determine the growth rate. This method is simple and highly efficient to get a high multiplication rate, and can be practically applicable for the control of TSSM.

Key words: two-spotted spider mite, chemical pesticide, resistance monitoring, pesticide resistance

P32

Evaluation of resistance to 8 insecticides to *Bemisia tabaci* (Hemiptera: Aleyrodidae) collected from cucumber greenhouse in Korea

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In this study, eight insecticides with high registered usage and different mode of action were selected and tested for insecticidal activity and resistance against *Bemisia tabaci* collected from cucumber greenhouse in 15 regions. The resistance evaluation method used the resistance index (RI), and an RI value was less than 1 was set as a safe stage, 1 or more or less than 10 as a concern stage, and 10 or more as a serious stage. Flonicamid was shown to be at a serious stage of 10 or higher in all 15 regions including the LAB strain, and the GR strain showed the highest value of 189.0. The other 5 insecticides (Fluxametamide, Spinetoram, Cyantraniliprole, Pyridaben, and Milbemectin) were showed as safe-concern stage, while Dinotefuran included safe, concern, and serious stage, with regional difference being observed. Pyriproxyfen showed lower values than the LAB strain(4.9) in two strain: CW(4.4) and AS(3.7). This study aims to help control *Bemisia tabaci* in Korea by understanding the development pattern of resistance and providing basic data for resistance management.

Key words: sweetpotato-whitefly, pesticide, pest control, resistance index, susceptibility

P33

Evaluation of the efficacy of sulfuryl fluoride (SF) fumigant against *Rhyzopertha dominica* and *Monochamus alternatus*

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Rhyzopertha dominica and *Monochamus alternatus* are distributed worldwide and serves as both a wood pest. The insects are often found in forest environments, highlighting the need for attention in wood quarantine. However, the primary fumigant currently used in wood quarantine, methyl bromide, is an ozone-depleting substance that presents safety concerns for workers. To address this issue, it is essential to find alternatives to MB. Sulfuryl fluoride is widely used internationally but not currently employed in Korea. This study evaluated the efficacy of the sulfuryl fluoride in controlling *Rhyzopertha dominica* and *Monochamus alternatus*. Controlling the larvae, pupae, and adults of *R. dominica* and *Monochamus alternatus* using SF was not difficult. However, a higher dosage was required to control the egg stage of *Monochamus alternatus*. Future research should include an assessment on the efficacy of controlling the eggs of *R. dominica,* and the improving effectiveness on egg stages *Monochamus alternatus.* Based on these tests, we can be conducted to establish new phytosanitary treatment guidelines using MB alternative.

Key words: *Rhyzopertha dominica*, Sulfuryl fluoride, methyl bromide alternative, wood pests

P34

Exploration of effective natural enemy insects on *Tuta absoluta* management

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토마토뿔나방(*Tuta absoluta*)은 최근 국내 침입한 외래해충으로서 토마토, 가지, 감자 등 가지과 작물의 주요 해충으로 특히 토마토 농가에 큰 피해를 끼치고 있다. 방제에 있어 관행 농가는 화학적 방제가 가능하나 친환경 농가에서는 방제에 어려움을 겪고 있기 때문에 생물적 방제에 대한 전략적인 개발이 시급하다. 본 연구는 포식성 천적곤충을 대상으로 토마토뿔나방 알의 포식력을 확인하고, 토마토 재배지에 현장적용 가능성을 비교했다. 토마토뿔나방 알이 포함된 사육통에서 24h 포식력을 비교해 본 결과 어리줄풀잠자리, 담배장님노린재가 각각 257개, 67개로 어리줄풀잠자리가 약 4배 높았으나 토마토 식물 케이지에서 알 포식력을 비교해 본 결과 어리줄풀잠자리보다 담배장님노린재가 약 3배 높았다. 즉 어리줄풀잠자리의 경우 토마토 식물체 표면의 털(trichome)로 인해 이동이 제한되어 포식 활동이 활발하지 못했으나 담배장님노린재는 이동에 전혀 문제가 없었다. 그러나, 담배장님노린재의 경우 먹이가 부족할 때 토마토 신초나 줄기에 괴사환(necrotic ring)을 형성하여 식물을 가해하는 특징이 나타났으나 어리줄품잘자리는 전혀 식물을 가해하지 않았다. 따라서 토마토뿔나방의 기주 식물 특성에 따라 담배장님노린재와 어리줄풀잠자리를 선별하여 활용할 만한 가치가 있다고 판단한다.

검색어: 외래해충, 생물적 방제, 천적, 담배장님노린재, 어리줄풀잠자리

P35

Sequencing and curing of dsRNA virus in *Marquandomyces marquandii* isolated from Korea

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Mycoviruses generally infect fungi asymptomatically, but some cause variable pathogenicity in their hosts, attracting attention for new biological control strategies. In this study, double-stranded RNA virus was sequenced from a strain of *Marquandomyces marquandii* isolated from Korea and eliminated through single-spore isolation. dsRNA 1 and 3 showed 63.47% and 47.88% similarity to the RdRp and hypothetical protein of Metarhiziuim brunneum polymycovirus 1, while dsRNA 2 and 5 exhibited 51.11% and 55.30% similarity to the putative serine protease and PAS-rich protein of Phaeoacremonium minimum tetramycovirus 1. A virus-free isogenic strain was obtained through single-spore isolation, and comparisons of phenotypes between strains with and without viral infection are planned. Additionally, the virus will be trasferred to and entomopathogenic fungal strain to study the effect on pathogenicity.

Key words: dsRNA, *Marquandomyces marquandii,* mycovirus, polymycovirus

P36

Evaluation of efficacy of 3 fumigants on *Sitophilus zeamais* adults

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Wood pellets are biofuels made by compressing wood fibers, and global demand is increasing to replacing fossil fuels. Wood pellets are intercepted by stored grain pests in the process of importing into Korea. According to the current phytosanitary disinfection standards, wood pellets are fumigated by using methyl bromide(MB) and phosphine together. However, MB is an ozone-depleting substance and poses a significant threat to worker safety due to its high toxicity. In addition, phosphine has a resistance issue with stored grain pests and generally requires a long fumigation time, so new disinfection treatment regulations are needed to replace it. Therefore, this study evaluated the efficacy of Ethane dinitrile, Ethyl formate, and Sulfuryl fluoride on adult *Sitophilus zeamais*. Based on this study, we are looking forward to establishing new plant phytosanitary disinfection standards for wood pellets by conducting a follow-up test in the future.

Key words: Ethane dinitrile, Ethyl formate, Sulfuryl fluoride, Maize weevil

P37

Investigation of host preference for ten leguminous plants and selection of a trap plant for control of *Tetranychus urticae* (Acari: Tetranychidae)

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The two-spotted spider mite, *Tetranychus urticae* Koch, is a major pest of greenhouse strawberry. *T. urticae* rapidly develops resistance to acaricides due to its short life cycle and continuous exposure to these chemicals. Therefore, new pest management strategies, such as trap plants, are needed for sustainable control of *T. urticae*. In this study, we evaluated the host acceptance and preference of *T. urticae* for ten leguminous plant species to select trap plants in the laboratory. We also assessed preference for selected plants under dark conditions, compared them with strawberry, and examined the effect of plant height (150 ㎜ and 300 ㎜) on preference. As a result, nine leguminous plant species as peanut, sword bean, black soybean, brown soybean, kidney bean, pea, fava bean, adzuki bean, and mung bean, except chickpea, were highly accepted by *T. urticae* (71.3-93.2%) compared to the control (plastic board) in two-choice tests. Among the nine plant species, kidney bean (29.4%), black soybean (24.9%), and adzuki bean (18.0%) showed higher preference by *T. urticae* than the other plant species in multiple-choice tests. These three selected plants also showed preference under dark conditions, and particularly kidney bean was 2 times more effective in attracting *T. urticae* and inducing oviposition than strawberry. Additionally, 300 ㎜ kidney bean seedlings showed a higher preference of *T. urticae* than 150 ㎜ seedlings. In conclusion, 300 ㎜ kidney bean seedlings have potential as trap plants for *T. urticae*. Further studies are needed to investigate the installation interval and replacement timing of trap plants in strawberry greenhouse environments.

Key words: two-spotted spider mite, attract, oviposition, kidney bean

P38

Insecticide resistance status in different populations of *Bemisia tabaci* (Homoptera: Aleyrodidae) in Korea

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Since World War II, chemical control using insecticides has been the main method of pest control in the world. As a result, most pests have developed resistance to the major insecticides. As a major horticultural crop pest, *Bemisia tabaci* has been treated with a variety of insecticides. However, the level of insecticide resistance in this pest has not been investigated. Here, we investigated the resistance ratio (RR) of *B. tabaci* collected in tomato cultivars from 15 regions of the country to eight insecticides [Acetamiprid (4a), flupyradifurone (4d), spinetoram (5), emamectin benzoate (6), pyrifluquinazon (9b), pyridaben (21a), spiromesifen (23), cyantranniliprole (28)] with different mode of action using a leaf-dipping method. Our results showed that RR_{50} levels of spiromesifen (56 to 140-fold), pyridaben (32 to 103-fold), were high to very high resistance, pyrifluquinazon (14 to 49-fold) and flupyradifurone (12 to 51-fold) moderate to a high level of resistance, cyantraniliprole, spinetoram, emamectin benzoate, was relatively low to moderate resistance (4 to 20-fold), and acetamiprid relatively susceptible to low resistance (1 to 13-fold) RR_{50} value in most samples. However, the RR level varied from region to region, and even different cultivars within the same region. The results provide important information to create a national-level RR map and contribute to reducing insecticide resistance of *B. tabaci* in the future.

Key words: Resistance ratio, tomato, whitefly, pesticides, mode of action

P39

Profiling of destruxins, the toxin from entomopathogenic fungus *Metarhizium pinghaense* 15R against *Aphis gossypii*

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대표적인 곤충병원성 진균 중 하나인 *Metarhizium*속은 종에 따라 폭 넓은 곤충에 병원성을 일으키며, 이들이 생산하는 것으로 알려진 destruxin이라는 2차대사산물은 살충력과 더불어 항바이러스, 항증식, 항암 등의 효능이 연구되며 해당 물질에 대한 관심이 집중되고 있다. 살충 물질로써의 destruxin은 여러 곤충에 대하여 병원성을 나타내는 것이 확인되었으나, 전 세계적으로 심각한 경제적 피해를 끼치는 해충인 목화진딧물에 대해서는 아직 destruxin의 역할이 연구되지 않고 있다. 본 연구는 목화진딧물에 대하여 곤충병원성 진균 *Metarhizium pinghaense* 15R의 병원성 발현에 미치는 destruxin의 역할을 간접적으로 확인하고자, 생물검정을 활용하여 목화진딧물 내 destruxin 합성효소의 발현 및 destruxin의 생성·분해 시간, 종류 등을 확인하였다.

검색어: Metarhizium, Destruxin, Aphis gossypii, qPCR, HPLC

P40

Analysis of meteorological factors affecting mosquito population in Sangju-si

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Since mosquito outbreaks are an important factor in public health, identifying meteorological factors affecting mosquito population is essential for developing mosquito control strategies. In this study, we operated digital mosquito monitoring systems (DMSs) in Sangju-si, Gyeongsangbuk-do, South Korea, and collected mosquitoes twice a week (Tuesday and Wednesday) to monitor the seasonal dynamics of mosquito populations from May to November from 2021 to 2023. Meteorological conditions (temperatures and precipitations) covering mosquito collection periods were downloaded from the Korea Meteorological Administration. Subsequently, we analyzed the statistical correlation between meteorological conditions and the mosquito population. The analysis revealed that when precipitation is below 10.61871 mm, maximum temperature has a positive effect on increase in the mosquito population, but there is no correlation between maximum temperature and the number of collected mosquitoes when precipitation exceeded the threshold.

Key words: Digital mosquito monitoring system, Meteorological conditions, Poisson regression model

P41

Analysis of catalysis genes in insecticidal *Beauveria bassiana* ERL836 against *Frankliniella occidentalis*

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Western flower thrips (*Frankliniella occidentalis*) is a major pest in greenhouse crops, and characterized as high reproduction and rapid development of resistance, thus making it difficult to control. The entomopathogenic fungus *Beauveria bassiana* ERL836 as an alternative showed high insecticidal activity against thrips. In this study, we investigated the function of fungal catalase genes which showed significantly enriched gene expression pattern from the RNA sequencing analysis of ERL836-infected adult. The catalysis gene expression was investigated using RT-PCR, focusing on genes which are primarily secreted outside the fungal hyphae, and phylogenetic relationships with other isolates. Of the analyzed genes, the expression of chitinase gene was validated, and hereafter it is planned to conduct knock-out of chitinase gene using a ribonucleotide complex (RNP) to analyze its impact on the virulence. This study will provide understanding of the insecticidal mechanisms of ERL836 and the functional roles of chitinase.

Key words: western flower thrips, *Beauveria bassiana*, RNA sequencing, catalase, chitinase

P42

Transporter genes in *Beauveria Bassiana* ERL836 with insecticidal activity against western flower thrips, *Frankliniella occidentalis*

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Western flower thrips (*Frankliniella occidentalis*) is a polyphagous pest that damages crops, and the pest management is not always successful due to rapid reproduction and insecticide resistance. Alternatively *Beauveria bassiana* ERL836 has high insecticidal activity against the thrips. Research on ERL836 has primarily focused on industrialization, which has left its mechanisms of action rarely explored. In this study, we conducted an in-depth analysis of transporter genes identified through previous RNA-seq analysis. We specifically examined the expression levels of metabolite-localizing transporter genes, which were significantly enriched in the RNA sequencing of the infecting ERL836. Transporter genes were categorized by sub-family and localization, and substances which are transported across the plasma membrane. Gene expression analysis was conducted through RNA extraction and RT-PCR. Hereafter, we plan to conduct a phylogenetic analysis with other transporter genes from different species based on RT-PCR and analyze the functions of transporter genes through a knock-out approach. This study will provide a comprehensive understanding of the functions of the transporter gene clusters in *Bb* ERL836 isolate.

Key words: *Frankliniella occidentalis, Beauveria bassiana*, ERL836, transporter, metabolites

P43

Assessment of insecticide-free pest control tactics: indoor light traps, repellent lamps, and freeze aerosols

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Many people tend to have a vague aversion to synthetic chemical pest control agents, possibly due to concerns about their unknown toxicity and side effects. Several insecticide-free pest management methods are available, including indoor light traps, repellent lamps, and freeze aerosols. These products emphasize their insecticide-free nature and claim high efficacy. From a sustainability standpoint, it is recommended to prioritize physical and non-chemical pest control and prevention strategies before considering chemical agents. Nonetheless, neither official test guidelines for these methods nor legal standards have been established for non-chemical agents. In the present study, we designed test methods for these products and evaluated their efficacy. Ten commercially available insect light traps were assessed for their mosquito-attraction activity. Tests were conducted under laboratory, semi-field, and field conditions. The highest capture rates were 93.0% and 93.3% in laboratory and semi-field tests, respectively. Mosquito-repellent lamps were tested in outdoor conditions, but no significant mosquito reduction was observed. For the freeze spray, a long exposure time was required to achieve acceptable knock-down and insecticidal activity against mosquitoes, houseflies, and cockroaches. In conclusion, these agents appear promising, except for the repellent lamp, but specific conditions are required, and caution is necessary as not all methods are equally effective. More research attention is welcome to evaluate sustainable pest management methods.

Key words: Sustainable pest management, insecticide-free, mosquito attraction, freeze aerosol

P44

Prediction of sRNA from *Metarhizium anisopliae* JEF197 for knock-down of *Monochamus alternatus* serine protease

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Japanese pine sawyer beetle (JPSB), *Monochamus alternatus* Hope, damages pine trees and acts as a vector for pine wilt disease. Chemical control is commonly used, but the environmental toxicity issue makes it difficult to be widely used. Alternatively, entomopathogenic fungus JEF-197, *Metarhizium anisopliae*, identified as having high insecticidal activity against JPSB, could be used for control. Of the mode of actions, fungal small RNA could be involved in the insecticidal activity. Small RNA fragment possibly targeting trypsin-like serine protease (JPSB-1249SP) was detected from the analytical mapping of fungal sequenced reads to JPSB coding genes and structural stem-loop structure analysis. From the mapping, dozens of fungal reads were aligned to the full-body coding transcripts of JPSB, and stem-loop structures were identified. Consequently, four potential candidates were determined, and JPSB-1249SP was finally selected for its structural potential. JPSB-1249SP, blasted to *Anoplophora glabripennis*, could be involved in the protective response of JPSB against fungal pathogens. The possible small RNA was experimentally sequenced from the fat body of JPSB, and now more deep characterization is underway to figure out how it works. A knock-down study would be followed by this small RNA characterization.

Key words: Japanese pine sawyer beetle, JEF-197, small RNA, 1249SP, knock-down

P45

Evaluation of the insecticidal activity of *Bacillus thuringiensis* to lepidopteran larvae, *Plutella xylostella* by cold treatment

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곤충병원성 비티를 *Bacillus thuringiensis* subsp. *aizawai* (BtA)와 *Bacillus thuringiensis* subsp. *kurstaki* (BtK)의 두 아종 균주로 분리하여 저온처리에 따른 포자형성과 섭식처리 시 살충효과를 조사하였다. 분리한 두 아종 균주는 28℃에서 48시간 동안 회전진탕배양(120rpm) 후 5℃에서 시간대별(0, 24, 48, 72, 및 96시간)로 저온처리하였다. 본 연구에서 배추좀나방(*Plutella xylostella*) 2령 유충을 대상으로 살충력 생물검정을 수행하였다. BtA는 48시간, BtK는 72시간 저온처리 시 무처리구와 비교하여 각각 17%와 27% 살충효과가 증가하였으며, *P. xylostella* 유충에 대하여 100%의 살충효과를 보였다. 또한, BtA는 BtK 보다 처리 후 48시간에서 최대 43% 이상 살충효과가 높아 *P. xylostella* 유충에 더 감수성임을 확인할 수 있었다.

검색어: 비티, 저온처리, 포자형성, 살충효과, 배추좀나방

P46

Efficacy of registered insecticides against fall webworm (*Hyphantria cunea*) on non-registered residential area trees

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The *Hyphantria cunea*, a polyphagous pest, causes damage to trees in residential areas. This study was conducted to determine the insecticidal activity of previously registered insecticides for moth control on non-registered host plants. The four insecticides (abamectin benzoate, fenitrothion, metaflumizone, deltamethrin) were applied against the target pest in tree branches of *Lagerstroemia indica*, *Elaeagnus umbellata* and *Hibiscus syriacus* and mortality rates were recorded after 3 and 7 days after treatment. All the tested insecticides showed excellent efficacy against the pest on the 3rd days, and a 100% insecticidal rate was recorded after 7 days.

Key words: efficacy, host plant, ornamental tree, phytotoxicity

P47

Combined application of *Steinernema carpocapsae* and *Beauveria bassiana* to control *Spodoptera litura*

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Spodoptera litura is an important agricultural pest that causes serious damage to various crops. While chemical insecticides have traditionally been employed to control *S. litura*, but the emergence of resistance has necessitated the development of new control methods. In this study, we evaluated the efficacy of the entomopathogenic nematode *Steinernema carpocapsae* against *S. litura*, and investigated whether *S. carpocapsae* was affected by the entomopathogenic fungus *Beauveria bassiana*. Three days after treatment, the *S. carpocapsae* single treatment group showed 50% mortality. The combined application of *S. carpocapsae with B. bassiana* at three different concentrations showed comparable insecticidal activity to *S. carpocapsae* single treatment. Our results suggest that *S. carpocapsae* could be used to control *S. litura*, and could be applied in combination with *B. bassiana*.

Key words: *Spodoptera litura*, *Steinernema carpocapsae* , *Beauveria bassiana*

P48

Assessing degree-day prediction models for *Matsucoccus matsumurae* (Coccomorpha: Matsucoccidae) developed with two different temperature data

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Matsucoccus matsumurae (Kuwana, 1905) is a significant forest pest that attacks *Pinus* species in Korea. This study developed a degree-day model to predict the 25% cumulative flight period using the flight periods of *M. matsumurae* and AWS temperature data from the nearest station. Combinations of 9 calculation methods, 10 starting dates, lower (-20 to 15°C), and upper (20 to 37°C) developmental thresholds were used in calculating degree-day, and these were assessed with Root Mean Squared Error (RMSE). Optimum calculating scenarios were used in comparing the prediction accuracy of model developed with two temperature data sources (Data logger, AWS). The optimum model based on AWS data was identified as a double triangle method with vertical cutoff, biofix date of June 1st and developmental thresholds of –12.22°C and 32.22°C. In addition, the accuracy was deemed inadequate due to deviations between predicted and observed date of each region. This study evaluates the applicability of logger temperature data, and the proposed degree-day calculation method could be used in predicting the annual flight phenology of *M. matsumurae*.

Key words: *Matsucoccus matsumurae*, Degree-day model, Prediction model

P49

The effect of high temperature environment on the oviposition and development of seedcorn maggot, Delia platura (Meigen) (Diptera: Anthomyiidae)

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씨고자리꽃파리(*Delia platura*)는 온대지역에서 발생하며, 백합과, 콩과, 십자화과 작물을 포함한 다양한 농작물을 가해하는 해충이다. 이들은 국내 포장에서 여름철 이후에 발생이 감소하거나 사라지는 경향을 보였다. 이에 본 연구에서는 여름철 고온환경에서 씨고자리꽃파리의 생존 가능성과 암컷 성충의 산란 가능 여부를 알아보기 위하여 실험을 진행하였다. 22℃에서 산란 받은 알을 이용하여 37℃에서의 알과 부화 유충의 발육을 확인하였으며, 추가적으로 산란 받은 알을 각각의 온도(22℃, 30℃)에서 사육한 뒤, 번데기 단계에서 22℃는 30℃로, 30℃는 22℃의 항온기로 옮겨 암컷 성충의 산란 가능성을 확인하였다. 37℃에서 사육한 개체군의 경우, 알의 부화율은 4%로 매우 낮았으며, 부화한 유충은 모두 24시간 이내에 사망하였다. 22℃에서 부화시켜 37℃에서 사육한 유충 또한 24시간 이내에 모두 사망하였다. 22℃로 옮긴 개체군의 산란율은 58.82%이며, 30℃로 옮긴 개체군은 4.55%의 산란율을 보였다. 따라서 고온환경에서 씨고자리꽃파리의 산란 및 발육은 어려울 것으로 추정된다.

검색어: 씨고자리꽃파리, 작물해충, 온도발육, 산란

P50

Study on the immigration and dispersal characteristics of *Spodoptera frugiperda*

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열대거세미나방, *Spodoptera frugiperda* (J.E. Smith(Lepidoptera: Noctuidae)는 이동 능력이 뛰어나기 때문에 수백 킬로미터를 날아서 이동할 수 있으며, 편서풍 기류를 타고 국내에 침입하여 옥수수에 큰 피해를 주는 해충이다. 해마다 중국과 같은 주변국으로부터 제주로 비래하여 지속적으로 페로몬 트랩에 포획되어 왔으며, 제주도뿐만 아니라 국내의 다른 지역에서도 꾸준히 포획되고 있는 상황이다. 그러나 국내에서의 이들 생태는 불분명한 점이 많으며, 특히 제주에서 성충 포획량에 의한 유입 경로 예측이 어려운 상태이다. 이에 비래한 개체군들이 한 곳에 오래 머물러 있는 것이 아닌 장기간에 걸친 대륙횡단의 가능성과 동선을 파악하고자 각 지역에서의 유충과 성충 포획 기록을 토대로 발육단계 추적모형을 이용하여 유충 발육단계와 성충발생을 추정하고 결합하여 열대거세미나방의 비래, 분산의 이동 특성을 알아보고자 하였다.

검색어: 열대거세미나방, 비래 해충, 발육단계 추적모형, 페로몬트랩

P51

Occurrence pattern of *Specodoptera sheni* (Lepidoptera: Cossidae) on pin oak trees, *Quercus palustris* in urban areas

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Sphecodoptera sheni is a recently recorded as non-native wood-boring pest that infests the phloem areas and cambium layer including some part of outer xylem areas under barks. Infested trees are weaken over time and may eventually die when infestation levels increase. The host species, pin oak, Quercus palustris is partly planted along roadsides across the country, but the number of them is rapidly increasing in recent. Since S. sheni is newly recorded in South Korea, little is known about its biology and ecology. This study aimed to investigate their adult occurrence pattern following with monthly infestation rates. The research was conducted along roadsides in Wonju, containing 98 pin oak trees. The number of new exuviae on tree trunk and larval frass on ground were counted for all trees weekly in 2024. Results showed that S. sheni adults first emerged in early July, with numbers increasing steadily until mid-August. After this peak, the number of new exuviae sharply declined, while newly produced larval frass showed a rapid increase.

Key words: clearwing moth, exuviae, larval frass, non-native species

P52

Monitoring reports about *Bactrocera dorsalis* of South Korea in 2024

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최근 기후 변화, 국제 교역량, 여행객 및 외국 이주민 증가 등으로 고위험 식물 병해충의 유입이 증가하고 있으며, 고위험 해충에 대한 국내 유입 여부를 상시 조사하여 외래 식물 해충을 발견하고 발생 시 조기 대응하는 전문 지식과 경력을 갖춘 민간 전문가를 활용한 예찰 시스템 구축의 필요성이 요구되고 있다. 침입 우려 고위험 해충인 오리엔탈과실파리(*Bactrocera dorsalis*)는 광식성 해충으로 파프리카, 망고, 바나나, 감귤류 등 약 80종의 과실 농작물에 피해를 입히고 있으며, 해당 종의 국내 정착 시 큰 경제적 피해를 입을 것으로 예상된다. 2024년 조기 방제 및 선제적 대응과 국내 확산 정착을 방지하기 위해 4개 도(강원, 전북, 전남, 경남) 18개 시군 90개소에 유인트랩(스테이너) 및 끈끈이 트랩을 설치하여 설치 장소별 월 1회 정밀 조사를 실시하였다. 트랩에 포획된 해충을 수거 후, 동정한 결과 오리엔탈과실파리는 발견되지 않았다.

검색어: 오리엔탈과실파리, 고위험해충, 기후변화, 예찰 방제, 모니터링 조사

P53

Effect of winter temperatures on the hatching rate of *Ramulus mikado* eggs and the changes in population density over 3 years

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대벌레(*Ramulus mikado*)는 돌발적으로 대발생하는 산림해충으로 알려져 있다. 대벌레의 대발생 원인 중 하나로 겨울철 이상고온 등 기후변화가 대벌레의 생존율을 높이거나 발육속도에 영향을 줘 대발생하였을 것으로 추정되고 있다. 본 연구에서는 겨울철 온도가 월동 알의 부화율에 미치는 영향을 조사하고, 3년 동안 대발생 지역 내 대벌레의 밀도 변화를 조사하였다. 먼저 온도에 따른 알 사망률 조사를 위해 대벌레 알을 3개 지역(청계산, 대룡산, 구절산)을 대상으로 각 지역별 5개 고도를 선정하여 야외 배치를 하고, 동시에 온습도 데이터를 수집하였다. 대벌레의 밀도 변동 조사는 의왕시 청계산 내 9개 지점(20m×20m)을 고정조사구로 선정하여 신갈나무, 아까시나무, 잔털벚나무를 대상으로 털어잡기천을 이용하여 각 지점별, 먹이식물별 3번의 털어잡기를 실시하고 채집된 대벌레의 개체수를 조사하였다.

검색어: 대벌레, 돌발 해충, 곤충 대발생, 산림해충, 이상고온

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Changes in the infection rate and mortality of walking sticks, *Ramulus mikado* with *Metarhizium phasmatodea* carriage during summer season

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대벌레(*Ramulus mikado*)는 식엽성 곤충으로 최근 수도권 지역에서 돌발적으로 대발생하여 산림에 피해를 주고 있다. 대벌레는 고온 다습한 환경인 장마 기간에 곤충병원성 곰팡이인 녹강균(*Metarhizium phasmatodeae*)의 감염에 매우 취약하여 장마 시작 후 치사율이 급격히 높아지는 것으로 보고된 바 있다. 본 연구에서는 대벌레의 녹강균 보균율 변화가 감염률에 영향을 줄 것으로 가정하고 이들간의 상관관계를 확인하고자 조사 시기별 대벌레의 녹강균 보균율, 감염률, 치사율의 변화를 조사하였다. 이를 위해 2024년 장마철 전후로 경기도 남양주시 일대 산림에서 대벌레를 30~45개체씩 채집하였으며, 각 조사 시기마다 녹강균 보균율을 확인하였다. 또한 채집된 개체를 2주 동안 사육하며 녹강균 감염 후 치사에 이르기까지 걸리는 기간을 조사하여 최종 치사율을 확인하였고 치사한 개체에 대한 감염 여부를 조사하였다.

검색어: 곤충병원성 곰팡이, 곤충 대발생, 산림 해충,

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Interactions between thanatosis and biological factors in *Aclees taiwanensis* (Coleoptera: Curculionidae: Molytinae)

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Anti-predatory defenses, such as thanatosis (death-feigning), are pivotal in insect behavioral ecology, but remain underexplored in the family Curculionidae. This study presents the first comprehensive analysis of thanatosis in the fig weevil (*Aclees taiwanensis*), assessing the effects of sex, body weight (males: 0.21-0.26 g, 0.26-0.28 g, 0.28-0.32 g; females: 0.24-0.28 g, 0.28-0.32 g, 0.32-0.38 g), feeding status (fed vs. starved), and feeding duration (24 h vs. 48 h) under controlled laboratory conditions. Results indicate that sex and feeding status significantly affect thanatosis duration with females displaying prolonged responses, and starved individuals, particularly males, exhibiting reduced durations. Conversely, body weight and feeding duration did not significantly influence thanatosis. These findings enhance understanding of the adaptive mechanisms employed by *A. taiwanensis* for anti-predatory defense.

Key words: *Aclees taiwanensis*, Thanatosis, Feeding status, Sex, Weight

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Development of system dynamics model for exploring relationships between *Bursaphelenchus xylophilus* and various factors using causal-loop diagram

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Bursaphelenchus xylophilus kills pine trees, a vital resource in the forests of the Korean Peninsula, causing significant damage to forestry income, the local economy, and tourism. Moreover, it negatively impacts forest ecosystems by reducing biodiversity through the destruction of habitats for plants and animals that live on pine trees. Since *B. xylophilus* are immobile and can only move to new hosts through vectors, *Monochamus alternatus*, the occurrence and spread of pine wilt disease are closely related to both environmental and artificial factors that affect the nematodes and their vectors. Therefore, analyzing the causality among these various factors is essential for understanding the occurrence and impact of pine wilt disease. This study aims to develop a model that represents the interactions of *M. alternatus* and *B. xylophilus* with biological, environmental, and artificial factors within the forest system using a causal-loop diagram (CLD), which is part of the system dynamics model. Key factors considered in the CLD include the environmental factors that affect the growth and development of pine trees, *B. xylophilus*, and their vector, *M. alternatus* (temperature, precipitation, drought, and soil), as well as artificial factors that influence the occurrence and spread of *M. alternatus* (roads and city development, pesticides).

Key words: system dynamics model, causal loop diagram, pine tree, *Monochamus alternatus*, *Bursaphelenchus xylophilus*

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Field survey of *Grapholita* Species in Korean Orchards with *G. molesta* Pheromone Traps in 2024

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The *Grapholita* genus comprises several notorious pests that show significant risks to fruit production, especially apples and hawthorn. While *Grapholita* species have been reported in neighboring countries such as China, Russia, and Japan, their distribution in Korea remains unclear. This study was conducted to monitor the *Grapholita* species using *G. molesta* pheromone in Korea, with extensive surveys in the Asan region, one of the apple farms, and other regions. Pheromone traps were utilized, and regular sampling was conducted to identify *Grapholita* species. The results from Asan and other surveyed regions provide important insights into the possible distribution of these pests and will aid in enhancing pest monitoring and management strategies within Korea's fruit agriculture area.

Key words: *Grapholita*, pheromone trap, Lepidoptera, pest, Korea

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P58

Secretion of target protein by promoter strength in Baculovirus Expression System

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배큘로바이러스 발현계(Baculovirus Expression System, BES)는 번역 후 수정 과정을 제공하여 높은 품질의 단백질을 생산할 수 있는 발현계이다. 그러나 이를 이용한 분비 단백질 발현 선행 연구에서는 강력한 발현을 유도하는 프로모터의 사용은 분비 경로에서 과부하를 야기하여 오히려 분비 효율에 문제를 발생시키는 것으로 추측하였다. 이 연구에서는 프로모터 강도에 따른 단백질의 분비에 미치는 영향을 조사하기 위하여 동일한 프로모터들을 이용하는 두 가지 형태의 녹색형광단백질(Enhanced Green Fluorescent Protein, EGFP) 발현 재조합 곤충 바이러스를 제작하였다. 세포 내부에서 발현되는 일반적인 형태와, 세포 외부로 분비되는 형태로 재조합 바이러스를 각각 제작하였다. 각각의 재조합 바이러스들을 곤충 세포주에 감염시켜 프로모터에 따른 형광단백질의 발현 및 분비 경향을 비교함으로써 프로모터의 강도가 단백질 분비 효율에 미치는 영향을 조사하였다. 또한, 다양한 프로모터들을 이용하여 분비 효율을 비교 평가함으로써 분비에 최적화된 프로모터 조합을 선발하고자 하였다.

검색어: 배큘로바이러스, 발현계 , 분비, 프로모터, 목적 단백질

P59

Body size and mating competition in bumblebees under climate change

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기후변화는 농업 및 생태계에 중요한 화분 매개자인 뒤영벌의 개체수 및 다양성 감소뿐만 아니라 충체 크기에 영향을 미친다. 기후변화로 인한 발육온도의 상승은 뒤영벌의 충체 크기 감소를 유발하는데, 일벌의 충체 크기 감소는 방화 활동의 저하를 초래한다고 알려졌다. 그러나 뒤영벌의 생활사 중 차세대 개체수 유지에 중요한 발육 단계인 신여왕벌과 수벌의 교미에서 충체 크기와 교미 경쟁에 대한 기후변화의 영향은 알려지지 않았다. 본 연구에서는 실험적인 기후변화 조건인 고온(32°C)의 발육온도에서 출현한 뒤영벌(*Bombus terrestris*)의 신여왕벌과 수벌의 충체 크기를 구분하여 교미 적온인 23°C와 고온인 32°C에서 교미경쟁 여부를 조사하였다. 일정한 크기의 여왕벌과 수벌의 크기(LM 및 SM, large- 및 small-sized males)에 따른 교미 실험 결과, 23°C에서는 LM(74.41%)이 SM(25.59%)에 비해 현저히 높은 교미율을 보였다. 반면 32°C에서는 SM(37.52%)의 교미율이 LM(62.48%)에 비해 현저히 낮았지만 23°C에서의 SM에 비해 높은 교미율을 보였다. 교미는 32°C에 비해 23°C에서 그리고 SM에 비해 LM이 먼저 시작하는 경향을 보였다. 교미시간은 23°C와 32°C에서 LM에 비해 SM이 다소 길었지만 LM의 저정낭 내 많은 정자수에 기인하여 교미 여왕벌의 수정낭 내 많은 정자를 전달하였다. 일정한 크기의 수벌과 여왕벌의 크기(LQ 및 SQ, large- 및 small-sized queens)에 따른 교미 실험 결과는 23°C에서는 LQ(53.36%)와 SQ(46.63%)의 교미율이 큰 차이를 보이지 않았지만 32°C에서는 LQ (84.17%)가 SQ(15.83%)에 비해 현저히 높은 교미율을 보였다. 교미는 32°C의 LQ가 먼저 시작하였고 23 °C의 LQ와 SQ가 뒤따랐다. 교미시간은 23°C와 32°C에서 LQ와 SQ 간에 차이를 보이지 않았다. 이상의 결과는 기후변화 조건에서 신여왕벌과 수벌의 충체 크기와 교미 경쟁 관계를 보여준다.

검색어: 뒤영벌 (*Bombus terrestris*), 충체 크기, 교미 경쟁, 기후 변화

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Negative relationships between elevated developmental temperatures and morphological traits of different castes of bumblebees (*Bombus terrestris*)

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Climate change can negatively impact the morphology and behavior of bumblebees. In particular, it can decrease the body size of workers, thereby reducing foraging activity. However, the morphological impacts of higher developmental temperatures on different castes of bumblebees remain insufficiently understood. In this study, we investigated the effects of elevated developmental temperatures on the morphological traits of different castes of bumblebees (*Bombus terrestris*). We reared queens that emerged from hibernation at different developmental temperatures: optimal (constant temperature of 27°C), moderately high (constant temperature of 32°C), and high (35°C; by transferring the colony from 32°C to 35°C after the emergence of 10 workers). The body weight, head capsule width, body width, body length, and wing length of different castes of bumblebees significantly differed at elevated developmental temperatures. The highest impact was noted on the body width and body weight of workers, body width and wing length of queens, and body length, head capsule width, and wing length of males. Among the different castes of bumblebees, workers were most impacted by elevated developmental temperatures, followed by queens and then males. In contrast, the relative ratio of wing length to body length suggested the allometry of wing length in bumblebee castes at elevated developmental temperatures. These findings indicate that elevated developmental temperatures resulting from climate change may negatively affect the morphological traits of different castes of bumblebees.

Key words: *Bombus terrestris*, Bumblebee, Body size, Developmental temperature, Thermal stress

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Antifungal performance of Ch-1 isolated from Chinese tiger beetle against for anthracnose leaf Spot by *Colletotrichum truncatum* on Korean red pepper

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우리는 길앞잡이의 장에서 분리한 공생 미생물 중 식물병원성 곰팡이의 균사 성장을 억제하는 세균을 동정하였고 이를 Ch-1이라 명명하였다. 우리는 Ch-1균주가 고추탄저병을 일으키는 *Colletotrichum trunratum*의 성장 억제를 통한 생물학적 방제제의 역할을 지녔음을 확인하기 위하여 동일한 종의 다른 strain인 Ch-2, Ch-3균주와 비교하여 병원균과의 대치배양 및 청양고추를 이용한 접종실험을 진행하였다. 우리가 분리한 Ch-1균주는 동종의 두 균주보다 더 높은 길항력을 보였으며 병원균과 함께 고추에 접종 할 경우 Ch-1을 접종한 고추의 병징이 다른 두 균주에 비해 완화되는 것을 확인했다. 이러한 연구 결과를 바탕으로 Ch-1균주를 이용하여 국내 고추농가들의 피해 완화 효과를 기대해 볼 수 있을 것으로 보인다.

검색어: 길앞잡이, 장내 미생물, 길항작용, 탄저병, 고추, 생물학적 방제

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Availability of microorganism 'WB-1' isolated from Chinese red-headed centipede (*Scolopendra subspinipes multilans*) as an eco-friendly microorganism for controling *Beauveria bassiana*

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본 연구는 왕지네(*Scolopendra subspinipes multilans*)의 장에서 분리한 공생 미생물 중 곤충 병원성 곰팡이 *Beauveria bassiana*(백강균)에 대한 균사 성장 억제력을 확인한 결과이다. 우리는 왕지네의 장에서 다양한 공생 미생물들을 분리하였다. 그중 곰팡이의 성장을 억제하는 미생물을 동정하였고 'WB-1'이라 명명하였다. 우리는 WB-1 균주를 사용하여 식용 곤충 농가에 피해를 주는 곤충 병원성 곰팡이인 *B. bassiana*(백강병) 균사 생장 억제력을 확인하였다. 또한 8종의 항생제 (Ampicillin, Ceftriaxone, Chloramphenicol, Kanamycin, Levofloxacin, Metronidazole, Streptomycin, Tetracycline)에 대한 저항성 검사를 진행하여 친환경 미생물제제로서의 가능성을 확인하였다. WB-1 균주는 특허 등록 및 친환경 미생물제제로 등록하였고 향후 곤충 농가에서 생물학적 방제제로 활용될 수 있을 것으로 기대된다.

검색어: 왕지네, 곤충 병원성 곰팡이, 장내미생물

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RNA interference efficacy against *Vairimorpha* (*Nosema*) *ceranae* in the honeybees using dsRNA-Chitosan nanocomplexes

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꿀벌은 중요한 농업 작물의 수분 매개자로서 생태계 유지에 필수적인 역할을 한다. 그러나 꿀벌은 여러 질병에 의해 위협을 받고 있으며, 그 중 *Vairimorpha* (*Nosema*) *ceranae*에 의한 Nosemosis는 가장 흔한 질병 중 하나로 보고되었다. *V. ceranae*는 꿀벌 군체 붕괴(Colony Collapase Disorder, CCD)와도 관련이 있는 병원체로 알려져 있다. 최근 RNA 간섭(RNAi) 기술을 이용한 유전자 침묵이 *V. ceranae*의 생존과 증식을 억제하는 는 데 효과가 있음을 확인하였다. 본 연구에서는 생화학적 과정에서 전자전달을 담당하는 효소로 밝혀진 Ferredoxin NADPH Reductase 2 (FNR2) 유전자를 표적으로 삼는 RNAi 기술을 활용하여 *V. cearnae*의 증식을 억제하고자 하였다. 이를 위해 dsRNA와 키토산을 이용한 나노복합체를 형성하여 꿀벌에게 처리한 후, RNAi의 전달 효율성을 높이고자 하였다. 실험 결과, dsRNA-chitosan 나노복합체는 *V. ceranae* 포자 형성을 감소시켰으며, 꿀벌의 생존율을 증가시키는 효과를 보였음을 확인하였다. 이로써 dsRNA-키토- 나노복합체가 RNAi의 효과를 증진시키는 효과를 가져올 수 있음을 확인하였다.

검색어: RNA 간섭, dsRNA, 키토산 나노복합체, *V. ceranae*, 꿀벌, 질병 억제

P64

First report of the genus *Cephalispa* Malloch (Diptera: Muscidae) from Korea

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The genus *Cephalispa* Malloch (Diptera: Muscidae) is a predatory muscid fly, comprising 32 species worldwide, but it has not been recorded on the Korean Peninsula. In this study, we discovered this genus in Korea for the first time, along with one unrecorded species, *C. acerca* (Xue, Wang & Ni, 1990), in a herbaceous area of the forest ecosystem. External photographs and taxonomic information are presented herein.

Key words: Muscidae, Coenosiinae, *Cephalispa*, new record

P65

Taxonomic note of the genus *Bellardia* Robineau-Desvoidy (Diptera: Calliphoridae) from the Korean peninsula with the one unrecorded species

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The genus *Bellardia* Robineau-Desvoidy, 1863 is widely distributed in the Palaearctic region. This taxon is viviparous, and its larvae are apparently parasites or predators of earthworms. In our study of Calliphoridae in Korea, *B. menechmoides* Chen, 1979 was discovered for the first time. External photographs and a diagnosis of this species, as well as taxonomic information on the Korean *Bellardia* species, are provided herein.

Key words: Calliphoridae, *Bellardia*, new record, checklist

P66

One species new to science and two species new to Korea of Phycitinae (Lepidoptera: Pyralidae)

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The subfamily Phycitinae Zeller, 1839 is the biggest subfamily in Pyralidae, accounting for more than 60%. In this study, one new species, *Sciota albata* Yu & Paek, sp. nov., and two unrecorded species new to Korea, *Acrobasis ferruginella* Wileman, 1911 and *Acrobasis curvella* (Ragonot, 1893), are presented. In Phycitinae, the two genera, *Sciota* Hulst, 1888 and *Acrobasis* Zeller, 1839, have been argued over continuously due to difficult identification. We provide diagnoses, descriptions, images of the adults and genitalia, and mtDNA COI information of the three species.

Key words: snout moth, DNA barcode, misidentification, fauna of Korea

P67

A new species of *Wockia* Heinemann, 1870 (Lepidoptera: Urodidae) from Korea

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Urodidae is a less known family of Urodoidea. It includes seven genera with nearly 80 species. In Korea, only the genus *Wockia* Heinemann, 1870 is known, which contains two species *W. koreana* Sohn, 2008, and *W. magna* Sohn, 2014. Here we introduce a new species of the genus, *Wockia fascispina* sp. nov., described from Korea. The diagnosis, description, photograph of the adult and genitalia are provided here.

Key words: Lepidoptera, False burne moth, Korean Peninsula, Palearctic Region

P68

Taxonomical history and ecological characteristics of *Meganola major* (Hampson, 1891), a recent outbreak in Korea

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

Key words: Palearctic region, Lepidoptera, Nolidae, Hostplant, History

P69

Review of *Zanchius* Distant, 1904 (Miridae: Orthotylinae) and allied genera from Oriental region, with discussion on three new species

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Orthotylinae is one of the highly diverse subfamily among family Miridae, containing around 2,100 species worldwide. In this work, the genus *Zanchius* and allied genera are reviewed from Oriental region with three new species and one new distributional record, *Zanchius marmoratus* Zou, 1987. The habitus illustrations, male and female genitalic structures, and diagnostic characters of newly described species are documented. Additionally, a list of taxa belonging to the *Zanchius* complex, comprising four genera and 24 species, was compiled.

Key words: Miridae, Phylogeny, Mitochondrial genome

P70

Redescription and Phylogenetic analysis of *Philhelius coreanus* (Shiraki, 1930) (Diptera: Syrphidae) in Korea with its complete mitochondrial genome

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Philhelius coreanus (Shiraki, 1930) was originally described based on only Korean males. Subsequently, Russian females were described, but they did not accurately represent the intraspecific variation of this species. According to our morphological examination, we noted that the variability of the yellow spots on the pleuron is significant. This variation is particularly high in females. We here provide a diagnosis and redescription of *P. coreanus*, including genitalic characters of both males and females, with color photographs showing its intraspecific variation. In addition, we analyzed the complete mitochondrial genome of *P. coreanus* for the first time, and provided fundamental genetic data with discussion of the phylogenetic relationship. Based on the protein-coding genes (PCGs), we tried to elucidate the relationships with other genera of the tribe Syrphini. As a result, a sister group relationship between *Philhelius* and *Doros* Meigen, 1822, was strongly supported. This clade is also grouped with the *Chrysotoxum* + *Dideopsis* clade at a somewhat weak support value.

Key words: intraspecific variation, mitochondrial genome, *Phihelius*, Phylogenetic analysis, Redescription, Syrphini

P71

Invasive potential of the exotic wasp *Vespula pensylvanica* (Saussure, 1857) (Hymenoptera: Vespidae) detected at Busan newport: Risks and quarantine implications

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농림축산검역본부는 외래 병해충 유입 차단을 위해 공·항만 지역을 대상으로 예찰 조사를 수행하며, 본 연구는 부산신항에 설치된 예찰 트랩에 포획된 외래종 땅벌인 *Vespula pensylvanica* 1개체가 유입된 첫 연구 사례이다. *V. pensylvanica*는 북미 서부 지역과 캐나다 등에 서식하며, 이전해 교미에 성공한 여왕벌 1마리가 월동 후 4~5월에 땅속에 둥지를 만들어 군체를 형성한다. 형태적 특징을 활용하여 *V. pensylvanica*로 동정 되었으며, 샘플의 다리에서 DNA를 추출하여 *COI* 바코딩 영역을 증폭한 결과, *V. pensylvanica*로 최종 동정되었다. 유입 원산지 규명을 위해 하플로타입 분석 결과 미국 Arizona와 캐나다 Alberta 지역 개체와 유전적으로 가장 가까운 것으로 확인되었다. 이 결과를 통해 북미 서부 해안에서 하와이로 유입된 사례와 같이 국제 교역 과정에서 화물에 편승하여 유입되었을 것으로 추정되며, 생태계 교란 및 인명 피해를 예방하기 위해 항만 지역에서의 외래종 유입 조사의 중요성을 보여준다.

Key words: *Vespula pensylvanica*, wasp, epidemiological investigation, genetic markers

P72

Molecular epidemiological investigation of the invasive pest subterranean termite (*Coptotermes formosanus*, *C. gestroi*) in South Korea, 2024

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2024년 3월 경기도 화성시, 4월 서울시 금천구 소재 업체가 수입한 물품의 포장재에서 외래흰개미 2종이 발견되어 역학조사를 실시하였다. 화성시에서 발견된 흰개미는 *Coptotermes formosanus*, 금천구에서 발견된 흰개미는 *C. gestroi*로 종동정 되었으며, 두 종 모두 미국, 중국, 동남아시아 등에 분포하는 지중흰개미(Subterranean termite)이다. 특히 *C. formosanus*는 세계의 흰개미 중 건축물과 수목에 가장 큰 피해를 주는 지중흰개미(Subterranean termite)의 대표종이다. 경기도 화성시에서 발견된 *C. formosanus*의 *COII* 염기서열은 비교 레퍼런스 부족으로 원산지 분석을 수행하지 못하였다. *Coptotermes gestroi* 8개체를 포함한 38개체의 *COI* 서열을 이용하여 비교한 결과 독립적인 단계통을 형성하였으며, 유전적 거리가 가장 가까운 개체는 distence 0.0068를 보이는 말레이시아 개체로 나타나 Distance Estimation analysis도 동일한 결과를 보였다.

Key words: subterranean termite, *Coptotermes formosanus*, *C. gestroi*, epidemiological investigation, *COI*, *COII*

P73

Molecular epidemiology and invasion pathways of the red imported fire ant (*Solenopsis invicta*) in South Korea: Insights from mitochondrial DNA and microsatellite markers

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중앙아메리카와 남아메리카의 열대기후 지역이 원산지인 붉은불개미(*Solenopsis invicta* Buren, 1972)는 국제 선박 무역의 증가로 세계 각지로 유입되어, 농업, 보건, 생태계 전반에 걸쳐 심각한 문제를 야기하고 있다. 1996년 검역해충으로 지정·관리 중인 붉은불개미는 2017년 부산에서 첫 침입이 확인된 후 국경검역에서 지속적으로 검출되고 있다. 본 연구는 붉은불개미의 침입 경로와 원산지를 밝히기 위해 미토콘드리아 DNA 바코딩을 통한 하플로타입 네트워크 분석과 66개 초위성체 마커를 이용한 집단유전학적 분석을 수행하였다. 국제공동연구를 통해 중국, 대만, 미국 등 4개국에서 확보한 65개 집단, 총 1,074개체의 붉은불개미 유전형을 비교한 결과, 하플로타입 네트워크와 주성분 분석(PCoA)에서 세 가지 유형의 유전적 집단이 관찰되었으며, 특히 한국에서 발견된 17개 집단은 중국 집단과 높은 유전적 연관성을 보였다.

Key words: red imported fire ant, *Solenopsis invicta*, Mitochondrial DNA, microsatellite markers

P74

Field Investigation of insect pests on *Citrullus lanatus* in Korea

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전북특별자치도 수박(*Citrullus lanatus* (Thumb.) Matsum. et Nakai) 재배면적은 2,235ha로 우리나라 총 재배면적의 20.6%를 차지하고 있다. 그중 익산, 정읍, 고창은 도내 수박 재배면적의 71%를 차지하는 주요 재배 지역이다. 수박은 수분 함량이 많고 당도가 높아 여름 제철 과일로 선호도가 높으며, 시설재배를 통한 연중 재배가 이루어지고 씨 없는 수박 등 다양한 품종의 재배가 확대되고 있는 작물이다. 그러나 수박에서 발생하는 해충에 대한 최근 연구는 미흡한 편이다. 본 연구에서는 최근 20년간의 문헌자료를 수집하여 수박에서 발생하는 주요 해충의 종 목록을 확인하고, 올해 5~6월 3개 시설재배 포장을 선정하여 3회에 걸친 현장조사를 실시하였다. 그 결과 꽃노랑총채벌레(*Frankliniella occidentalis* Pergande), 점박이응애(*Tetranychus urticae* Koch), 목화진딧물(*Aphis gossypii* Glover)이 우점종으로 확인되었고, 문헌조사 결과에서는 확인되지 않았던 다수의 미소해충이 확인되었다. 앞으로 추가 조사와 미소해충군에 대한 분자생물학적 종 동정을 실시하여 수박 포장에서 발생하는 해충군에 대한 유의미한 연구를 지속하고자 한다.

검색어: 수박, 해충, 현장조사, 분류

P75

First record of genus *Atemelia* Herrich-Schäffer (Lepidoptera: Yponomeutoidea: Praydidae) in Korea, with a newly recorded species

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The genus *Atemelia* Herrich-Schäffer, 1853 is a group belonging to Praydidae, which is a relatively young family. At present, it comprises about five described species worldwide. Of these eight species, only two are distributed in the Palearctic region, while the others occur Nearctic or Neotropical region. However, there are no records of this genus in Korea and Japan. Among them, the larvae of two species in the Palearctic region are common leaf miner pests of family Ulmaceae.

In this study, we report the newly recorded genus *Atemelia* from Korea, with a description of *A. fusca* Liu, 2017. All available information including a brief description and illustrations of adult and genitalia, host plants, and DNA barcode is provided.

Key words: Lepidoptera, Yponomeutoidea, Praydidae, *Atemelia*, newly reocord, taxonomy, DNA barcode

P76

Taxonomic review of the genus *Stephostethus* Leconte, 1878 (Coleoptera: Coccinelloidea: Latridiidae) in Korea

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The family Latridiidae Erichson, 1842 (Coleoptera: Coccinelloidea) includes 31 genera and 839 species within two subfamilies worldwide. Adults of Latridiidae primarily inhabit leaf litter, trees, and shrubs, where they feed on the conidia and hyphae of various fungi. Larval habits are largely unknown, but since they feed on the same food as adults, it is presumed that they mostly inhabit the same environments as the adults. The genus *Stephostethus* LeConte (Latridiidae: Latridiinae) includes 44 species worldwide with most species are distributed in the Palearctic and Nearctic regions. In Asia, they have been found in China, Taiwan, Japan, and mountainous areas of India. Only a single species, *S. chinensis* (Reitter), has been recorded in Korea. In this study, *S. setosus* Rücker is recorded for the first time in Korea, and *S. chinensis* (Reitter) is redescribed. An illustration of habitus, diagnostic characters, a distribution map, and an identification key are provided.

Key words: biodiversity, minute brown scavenger beetles, morphology, new record, taxonomy

P77

Detection trands and taxonomic key of stored grain pests in quarantines

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Currently, there have been 37,072 domestic inspections related to grain storage. While exporting countries prioritize grain storage management and scientifically control pest identification and mitigation processes, domestic protocols for classifying and identifying approximately 100 species of stored grain pests still rely on outdated data from before 2017. This study aims to develop a new pictorial key for stored grain pests, covering families such as Dermestidae, Silvanidae, and Tenebrionidae. In addition, genetic barcode data for 200 species, including both pest species and morphologically similar species, will be included. The study also incorporates pest management techniques utilized internationally for each target species. This new manual for stored grain pests will enhance pest identification capabilities at quarantine sites and improve overall inspection effectiveness.

Key words: stored grain pests, identification, quarantine

P78

Review of the family Corylophidae LeConte (Coleoptera: Coccinelloidea) in Korea with two new records

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The family Corylophidae LeConte comprises small beetles (generally 0.5–3.0 mm) and includes 11 genera worldwide. These beetels are known for feed on fungus and found in dead wood, mushroom, soil and leaf litter. In this study, we describe eight species including two newly recorded species: *Arthrolips lewisii* Matthews, 1899, *Arthrolips oblonga* Matthews, *Clypastraea polita* (Reitter), *Clypastraea yuasai* Nakan, *Gloeosoma japonicus* Mattews, *Gloeosoma sibericum* Reitter, *Sericoderus lateralis* (Gyllenhal) (new record), and *Sericoderus brevicornis* Matthews, (new record). Illustrations of habitus and genitalia, diagnostic characters, a key to Korean species of Corylophidae, and a distribution map are also provided.

Key words: minute hooded beetles, minute fungus beetles, new records, Korea, taxonomys

P79

DNA barcoding reveals taxonomic insights into pest species of leafhoppers (Hemiptera: Cicadellidae) on fruit trees in South Korea

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Severe leafhopper pests infesting fruit trees (apricot, grape, peach, persimmon and plum) in South Korea were investigated. DNA barcoding using mitochondrial cytochrome c oxidase (COI) sequences identified four Typhlocybinae species: *Arboridia kakogawana* (Matsumura, 1932) and *A. maculifrons* (Vilbaste, 1968) on grape, *Singapora shinshana* (Matsumura, 1932) on *Prunus* trees, and *Zorka* sp. on persimmon, spanning both nymphal and adult life stages. Notably, DNA barcoding revealed phylogenetically-relevant color variation among adult specimens of the grape pest, *A. kakogawana*. This study presents, for the first time, live nymphal and adult photographs alongside neighbor-joining trees, host plant associations, and updated DNA barcode sequences for these Korean leafhoppers, which have not been included previously in global datasets.

Key words: DNA barcoding, east Asia, fruit pests, leafhoppers

P80

Five new species and one new record of the genus *Phaenocarpa* Foerster (Hymenoptera, Braconidae, Alysiinae) from South Korea

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We described and illustrated five new species of the genus *Phaenocarpa* Foester, 1863 (Braconidae: Alysiinae), *P. acutidentata* sp. nov., *P. tacitoides* sp. nov., *P. setosa* sp. nov., *P. tanycauda* sp. nov., and *P. angusticeps* sp. nov. Additionally, *P. tacita* Stelfox, 1941 is recorded for the first time from South Korea. We also analyzed the barcode region of mitochondrial cytochrome c oxidase I (COI) for the seven congeneric species including one reference. In addition, we provided an identification key for the *Phaenocarpa* species recorded in Korea.

Key words: Hymenoptera; Alysiini; phylogeny; new species; parasitoid wasp; taxonomy

P81

Two unrecorded species of the genus Trioxys (Hymenoptera: Braconidae: Aphidiinae) parasitic on bamboo aphids from South Korea

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The genus *Trioxys* Haliday, 1833 is consists of more than 80 species worldwide and three species recorded in South Korea. In this study, two unrecorded species, *T. liui* Chou & Chou, 1993 from *Takecallis arundinariae* (Essig, 1917) on *Phyllostachys bambusoides* Siebold & Zucc., 1843 and *T. remaudierei* Starý & Rakhshani, 2017 from *T. taiwana* (Takahashi, 1926) on *Sasa borealis* (Hack.) Makino & Shibata, 1901, are described and reported with photographs of the diagnostic morphological characters and mitochondrial *cytrochrome c oxidase subunit I* (*COI*) data and Bayesian tree of the phylogenetic analysis amongst the colsely-related taxa and provided.

Key words: DNA barcoding, natural enemy, parasitioid wasps, systematics, taxonomy

P82

Phylogeny and evolution of Laelapidae (Acari: Mesostigmata) focusing *Varroa* mites

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The *Varroa* mite is a crucial acarine taxon that can affect honeybee population decline. The mites feed on the honeybee's fat body and can serve as vectors for several bee viruses. Initially, *Varroa* mite was treated as Laelapidae when they were discovered in 1904. However, the genus was reclassified as an independent family, Varroidae in 1974 due to unique morphology and behavior that highly adapted to their hosts. Recently, various molecular studies have inferred a close relationship between Varroidae and Laelapidae among groups of parasitic mites. In this study, we aim to relegate the taxonomic position of *Varroa* mite from Varroidae to Varroinae subfam. nov. with reconstructing two different phylogenetic trees based on four molecular markers (total 3,158 bp), 13 mitochondrial protein-coding genes (total 9,257 bp), and also we will discuss host trait changes of Laelapid mites focused on the highly adapted bee-parasitic behavior of *Varroa* mite.

Key words: Acari, Mesostigmata, Laelapidae, Varroidae, taxonomic position

P83

Induction of antimicrobial peptides in honeybee, *Apis mellifera*, exposed to ethanol and acetic acid

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Antimicrobial peptides (AMPs) play an important role for the immune response in insects against bacteria, fungi and parasites. Referring to our previous studies showing a correlation between AMP expression and chemical exposure in *Drosophila melanogaster*, here we also investigated the induction of AMP transcription in honeybee following ethanol and acetic acid treatment. In this study, we determined the expression levels of five AMPs (*Abaecin, Apidaecin 1, Defensin 1, Defensin 2,* and *Hymenopatecin*) in two tissues (head and abdomen) of nurse bees treated with 2 concentrations (10% and 30%) of ethanol and acetic acid. In general, all AMPs were up-regulated by chemical exposure although induction ratio of AMPs varied depending on the conditions. In particular, expression level of hymenoptaecin in head of bee exposed 30% of acetic acid was 1201-fold higher than that of control sample. This result suggests a applicable method for enhancing the immunity of honeybee.

Key words: honeybee, ethanol, acetic acid, antimicrobial peptide, immunity

P84

Identification of novel odorant-binding proteins with binding affinity to sex pheromones in *Maruca vitrata*

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Insects induce various physiological behaviors, such as mating, feeding, and laying eggs, by detecting volatile compounds using their chemosensory system. To understand sex pheromone recognition in *Maruca vitrata*, we performed antennal transcriptome analyses of male adults. Approximately, 11.1 Gb of data were obtained, and 37 odorant-binding proteins (OBPs) were identified. Among these genes, five OBPs (MviOBP12, MviOBP19, MviOBP23, MviOBP24, and MviOBP26) were highly expressed in male antennae compared to female antennae. These five MviOBPs were expressed in all developmental stages and tissues. Three MviOBPs (MviOBP12, MviOBP19, and MviOBP26) were expressed using *Escherichia coli* and purified with His-Tag. Cold binding assay with purified MviOBPs and sex pheromone components of *M. vitrata* revealed that three MviOBPs bound to the sex pheromone components with different binding affinities.

Key word: sex pheromone, odorant-binding protein, cold binding assay, *Maruca vitrata*

P85

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 꿀벌산업에 적색경고등이 켜졌다. 지구온난화로 인한 급격한 기후변화로 양봉농가들에게 대응할 시간마저 예고하지 않은 채 꿀벌 군집붕괴현상(Colony collapse disorder, CCD)이라는 자연생태계 붕괴위기를 예고하였다. 이에 본 연구는 복합적인 가설 원인들로부터 약해진 꿀벌의 면역력과 봉군 세력을 향상시키기 위해 농업부산물 홍삼박을 활용한 인공먹이 화분떡을 제조하여 분봉한 꿀벌의 먹이 급이를 통한 봉군 세력에 어떠한 영향을 미치는지를 알아보고자 수행하였다. 건조한 가공부산물 홍삼박을 130 mesh 이상 초미립자로 분쇄하였으며, 조사포닌 분석결과 725 mg 100^{-1}을 함유하였다. 그리고 화분떡 총중량의 0.5, 1.0, 2.5, 5.0, 10.0%로 홍삼박 분말을 혼합한 후 자동배합기에서 30분간 배합하여 꿀벌 인공먹이 화분떡을 제조하였다. 실험 봉군은 5월 20일 분봉한 후 2일 뒤인 5월 22일 신여왕벌을 투입하였으며, 약 21일간 신여왕벌이 안정하게 정착된 것을 1주일 간격으로 3회 확인한 후 6월 13일부터 8월 31일까지 인공먹이 화분떡 급이실험을 수행하였다. 약 3개월 동안 10~15일 간격으로 시판용 대조구 화분떡과 제조한 홍삼박 화분떡 5처리구를 급이해가며 봉군의 세력을 조사하였다. 봉군 세력 조사결과, 초기 분봉벌의 봉군은 1매 1가리로 시작하여 약 50일 후에 대조구와 홍삼박 0.5~1.0% 처리구에서는 6매 봉판으로 증소가 우수하였고, 홍삼박 2.5% 이상 처리구에서는 5매로 다소 증소가 늦어지는 경향을 보였다. 이 시기에 봉개율 산정 결과, 대조구 53%(100) 대비 홍삼박 0.5~1.0% 처리구는 59~72%(111~126)로 우수하였으나 홍삼박 2.5% 이상 첨가된 처리구에서는 약 6~13% 감소하는 양상을 보였다. 그리고 화분떡 먹이 소모량을 조사한 결과, 대조구 평균 소모율 87.6%(100) 대비 홍삼박 0.5% 처리구는 89.0%로 가장 많았으나 홍삼박 2.5% 이상 처리구에서는 점점 감소하는 경향을 보였다. 추후 9월부터 월동 전까지 화분떡 급이실험과 월동 후 봄벌 깨우기까지 봉군 세력을 면밀히 조사하여 홍삼박 화분떡을 활용한 꿀벌 강군 형성과의 상관성을 평가하고자 한다.

검색어 : 꿀벌, 분봉벌, 봉군세력, 홍삼박, 화분떡

P86

Indoor small-scale codling moth (*Cydia pomonella*) pheromone effect verification experiment

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코드린나방은 나비목(Lepidoptera) 잎말이나방과(Tortricidae)에 속하는 해충으로 배, 사과, 복숭아, 호두 등의 다양한 과실류를 가해하며, 대한민국 식물방역법상 금지 해충으로 지정되어 있다. 본 해충은 우리나라에 침입이 가장 우려되는 해충 중 한종으로써, 향후 국내 침입에 대비하여 효과적인 예찰 트랩 개발의 기초자료로 활용하기 위해 본 연구를 수행하게 되었다. 가장 효과적인 코드린나방 유인제 선발을 위해 3개국가 5종류의 상업용 유인제를 대상으로 실내에서 소규모 선호도 조사를 실시하였다. 미국의 Scentry biologicals, ISCA, Alpha Scents 등 3종류와 네덜란드의 Pherobank, 중국의 Henan Jiyuan Baiyun Industry 제품을 사용하였다. 1미터 길이의 실리콘 튜브의 양쪽 끝에 각각 1종류의 유인제를 두고 가운데를 뚫어 수컷코드린나방 성충을 투입하였다. 총 10개 테스트 조합을 대상으로 암조건에서 코드린나방수컷이 선호하는 루어를 조사하여 통계분석을 통해 유의성을 검정했다. 본 연구를 통해 코드린나방 예찰에 효과적인 유인제 선발에 기여할 것으로 사료된다.

검색어: 유인제, 코드린나방, 초이스테스트

P87

Effect of sorghum-cowpea intercropping patterns and pesticide application on legume pod borer (*Maruca vitrata*) infestation, yield, and profitability of cowpea

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In West Africa, M. *vitrata* has been identified as a destructive insect pest that causes devastating damage to cowpea. Therefore, the development of potential sustainable pest management strategies including intercropping systems and use of beneficial botanical pesticides is paramount for its management. This study was conducted to evaluate the interaction effects of sorghum-cowpea intercropping pattern and plant-based pesticide application on *Maruca vitrata*. The experiment involved four sorghum-cowpea row-intercropping patterns, two pesticides application in a randomized complete block design. There was a significant ($P < 0.01$) sorghum×cowpea intercropping effect on aphids' population, thrips population, legume pod borer abundance, and number of pod sucking bugs. Pest populations were higher on the sole cowpea plots, compared to intercrop plots. The interaction effect of intercropping and insecticide sprays significantly reduced insect pest populations while increasing grain yields. Among the intercropping patterns, 1×4 had the highest aphid, thrips, legume pod borer and pod sucking bugs with or without pesticides, whereas the lowest occurred on 1×1 cropping pattern. Conversely, the 1×4 intercropping pattern had the highest aphid, thrips, legume pod borer and number of pod sucking bugs with or without pesticides, while the 1×1 cropping pattern had the lowest. The 1×4 intercropping pattern produced the highest cowpea grain yield and marginal returns, whereas the lowest occurred on 1×1 cropping pattern. We therefor speculate that minimizing plant density between host intercropping plants could reduce competition for resources while increasing yield and profitability.

Key words: Intercropping pattern, marginal returns, botanical pesticides, legume pod borer, pest management

P88

The effectiveness of the biopesticide based *Ricinus communis* essential oil against five agricultural pest species

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Plant essential oils are used to manage various agricultural pests. In this study, we tested the effectiveness of a biopesticide based on essential oil from Ricinus communis against five agricultural pests. At a 1/1000 dilution, the biopesticide showed high efficacy against Tetranychus urticae, Aphis gossypii, and Riptortus pedestris in the larboratory experiments, with control values of 78.2%, 83.3%, and 83.3%, respectively. The biopesticide also had a high effect on Scotinophara lurida (92.8%) at 1/500 dilution, but it was ineffective against Plutella xylostella (0%). We conducted field experiments with T. urticae on strawberries and A. gossypii on cucumbers, confirming high effectiveness again with control values of 85.2% and 81.9%, respectively. Therefore, the biopesticide based on essential oil from R. communis shows promise for controlling various agricultural pests.

Key words: *Ricinus communis,* essential oil, Biopesticide

P89

Notification service for the timing of pesticide application by monitoring hatching nymphs of white peach scale

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핵과류에서 뽕나무깍지벌레(*Pseudaulacaspis pentagona* Targioni Tozzetti) 방제를 위해 년간 1~3회 정도 약제를 살포하고 있음에도 불구하고 발생과원율 65.6%, 발생주율 23.9%로 여전히 문제 해충인 것으로 나타나(2024년) 방제효율을 높일 수 있는 대책 마련이 시급한 상황이다. 따라서 부화 약충 모니터링에 의한 방제적기를 산정하고 그 결과를 주산지 농업기술센터를 통해 농가에 알려주는 '방제적기 알림 서비스'를 추진하였다. 금년도 4월 20일부터 순천, 전주, 예산, 원주의 뽕나무깍지벌레 암컷 성충이 발생한 복숭아나무를 대상으로 부화약충 모니터링을 실시하였고 최초 발생시점(4월 25일~27일)을 기준으로 방제시기를 산정(1차살포: 5월 16일, 2차살포: 5월 30일)하여 핵과류 주산지의 36개 농업기술센터를 통해 농가에 방제시기를 공지하였다. 방제시기는 2017년 발생생태 연구결과를 적용하여 1차살포 시기는 애벌레 최초 발생 후 3주째(월동 성충에서 부화 애벌레가 거의 다 나온 시기), 2차살포 시기는 1차 살포 후 2주째(부화한 애벌레가 성충이 되기 전)으로 산정하였다. 2세대 때에도 같은 방법으로 모니터링하여 7월 9일~11일에 부화 약충 발생을 확인하고 7월 24일~26일을 방제시기로 공지하였다. 본 방제적기 알림서비스가 아직은 시작단계이지만 농업기술센터와의 정보 전달 체계가 자리잡히면 방제 효율은 높이면서 약제 사용량은 줄여 농업인 부담을 줄이는 데 기여할 것으로 기대한다.

검색어: 핵과류, 뽕나무깍지벌레, 부화, 예찰, 방제적기

P90

Basic ecological research on borers insect pest *Anoplophora malasiaca=A.chinensis* and natural enemy *Sclerodermus sichuanensis* (*S. harmandi=S. guani*)

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천공성 해충인 하늘소류는 재선충을 매개하는 종부터 각종 과수의 생목을 가해히여 고사하게 만들어 농가에 많은 피해를 입혀왔다. 특히 최근 3년간 알락하늘소(*Anoplophora malasiaca=A.chinensis*)는 2020년 제주 감귤 농장을 시작으로 2023년에는 블루베리 농장에서 대량으로 발생하였고 같은해에 서울에는 벚나무사향하늘소, 제주에서는 팽나무, 종가시나무 등을 가해하는 외래 노랑하늘소까지 발생하여 피해가 더욱 확산되는 실정이다. 특히 유충은 나무 속에서 활동하기 때문에 약으로 방제하기가 쉽지않다. 이에 하늘소류에 체외 기생하는 천적 개미침벌의 대량 사육 기술을 개발하여 생물학적 방제로 농작물 피해를 최소화 하고자 한다. 본 연구의 공시충 알락하늘소는 충남 천안시의 무가온 블루베리 시설 하우스내에서 채집하였고 시설 내 알락하늘소 성충 발생시기는 6월상순에서 6월중순으로 갈수록 출현개체가 줄어들었고 성별은 암컷보다 수컷이 많았으며 6월중순에 수컷 밀도는 급격히 감소하였다. 알락하늘소 성충의 실내산란 선호성은 블루베리 가지 2cm 굵기에서 다른처리보다 높았다. 개미침벌은 연구소 내 뽕나무 포장에서 기주산란목을 이용한 트랩으로 채집하였는데 형태적 분류는 기존에 *Sclerodermus harmandi* (=*S. guani*)와 차이가 없었다. Mitochondrial cytochrome c oxidase subunit I gene을 이용한 phylogenetic분석 에서는 *S. sichuanensis* 로와 같은 그룹을 형성하였다.

검색어 : 알락하늘소, 하늘소, 개미침벌, 천적, 방제

P91

Transcriptome-based biomarkers for phosphine-resistance in *Tribolium castaneum* using RNAi

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Phosphine (PH_3) is a primary fumigant used to control stored grain pests, with increasing reports of PH_3-resistant pests due to its widespread and continuous use. A transcriptomic analysis using a PH_3-susceptible strain (*Aus10*) and a PH_3-resistant strain (*Aus07*) of *Tribolium castaneum* exhibited differently expressed genes, including up-regulation of structural maintenance of chromosomes protein 3-like (*smc3*) and angiopoietin-4 (*angpt4*) in *Aus10*. Using RT-qPCR analysis, mRNA levels of *Aus10* and *Aus07* were compared to validate the transcriptomic results. Gene knockdown in *Aus10* was achieved by injecting dsRNA into adults, and at 48 h after injection, the insects were exposed to a PH_3 concentration of 0.01 g/m^3 for 20 h. The increased expression of *smc3* and *angpt4* in *Aus10* was validated, and knockdown of *angpt4* confirmed the enhancement of PH_3 resistance, highlighting the potential of transcriptome-based biomarker for assessing PH_3 resistance.

Key words: Phosphine resistance, *Tribolium castaneum*, RNAi, RT-qPCR

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Alternation of symbionts and gene expressions in *Akanthomyces attenuatus* JEF-147-infected two-spotted spider mites

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Two-spotted spider mite (*Tetranychus urticae* Koch; TSSM) is an agriculturally serious pest tat has acquired strong resistance against acaricide. Alternatively, mite-pathogenic fungi could be used to control the mites. The spider mite has symbiotic microorganisms which could be involved in the physiological and ecological adaption to biotic stress. In this study, mite-pathogenic fungi were used to control female adults, and the change of microbiome in the fungus-infected mites was analyzed. The acaricidal activity of fungal isolates was tested, and *Akanthomyces attenuatus* JEF-147 with the highest acaricidal activity was determined. Microbiome in the female adults which was infected by *A. attenuatus* JEF-147 was analyzed, and composition of microorganism was changed by fungal treatment. In bacteria abundance, the arthropod defense-related *Rickettsia* increased, but reproduction-associated *Wolbachia* decreased. Additionally RNA-sequencing of infected mites was analyzed changes in genes related to defense and reproduction. This work describes that a possible trade-off in arthropods against fungal pathogens could be predicted by the microbiome analysis.

Key words: Arthropod-pathogenic fungi, microbiome, *Tetranychus urticae*, *Rickettsia*, *Wolbachia*

P93

Development of comprehensive control caused by *Scirtothrips dorsalis* hood of persimmon in Gyeongsangbuk-do province

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2023년~2024년 경상북도 청도군 각북면 떫은감 과수원에서 청도반시 품종을 대상으로 볼록총채벌레 방제법 연구를 실시하였다. 청도반시 품종은 연시용으로 과실 표피에 볼록총채벌레로 인하여 과피 괴사 현상이 생겨 상품성을 저하시키고 있다. 떫은감에 발생하는 볼록총채벌레 피해는 개화기에 집중되어 발생이 심하여 잦은 농약사용에 의한 내성증가로 방제에 어려움이 많다. 즉, 청도반시에 발생하는 볼록총채벌레를 방제하기 위해서는 지상부의 약제 방제만으로는 어렵다. 따라서 백강균제(3~6월,1개월 간격 4회, 토양처리살포), 생육기 약제 살포, 과원잡초관리(제초제+방제약제 혼용)를 이용한 볼록총채벌레 종합방제 기술을 개발하였다. 떫은감 청도반시 재배 농업인과 현장지도원의 볼록총채벌레에 대한 피해진단 및 피해경감을 위한 종합방제 기술 보급으로 청도지역 청도반시의 안정생산에 기여할 수 있다고 생각한다.

검색어 : 해충, 피해증상, 볼록총채벌레, 감, 경북지역

P94

Unique gallery structures and defense strategies against pathogens of stem-boring beetle, *Agapanthia amurensis*

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Insects have multiple strategies such as immune and behavioral responses to protect themselves against predators and pathogens. Some stem-boring beetles such as *Agapanthia amurensis,* have developed unique defense strategies to overcome its limited food and space. Interestingly, *A. amurensis* larva build unique structures within its host plant stalk, consisting of ceiling, wall, and gallery. Among 248 overwintering larva in the field, 6 larva were found daed by entomopathogenic fungus. This observation suggests that *A. amurensis* larvae may be protected by symbionts. We found antibacterial and antifungal activity of crude extract of larval gallery structures. Accordingly, we have isolated 116 bacterial strains of 19 genus and 484 fungal strains from habitat structures. We have isolated and identified 8 strains of 2 entomopathogenic fungal species, *Beauveria bassiana* and *Metarhizium marquandii.* Larval surface symbionts were found to protect the larva from the entomopathogenic fungus.

Key words: Insect-microbe symbiosis, entomopathogenic fungus, *Agapanthia amurensis*, *Erigeron annuus*

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First record of the queen of *Bombus terrestris* hibernating in the wild, Korea

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2024년 4월 27일 부산 가덕도 신항만 근처 영산홍에서 흡밀중인 여왕으로 보이는 서양뒤영벌을 발견해서 채집하였다. 주변에는 서양뒤영벌을 이용하는 농가가 없었으며, 이 개체외에 다른 서양뒤영벌 일벌들의 활동도 관찰되지 않았다. 채집 후 꿀물과 화분을 주며 관찰 중 6월 24일 배를 바닥에 길게 늘어 붙이는 행동을 하며 작은 덩이 2개를 만들어 품고 있는 것을 관찰하였다. 6월 27일 청소를 위해서 덩이를 꺼냈다가 산란을 확인하고, 도로 넣어주니 서양뒤영벌이 알들을 먹어 치웠다. 6월 29일 다시 꽃가루로 덩이를 만들고 품는 행동을 시작하였고 산란을 계속하였다. 7월 26일 첫 일벌이 나와서 저자들이 채집한 개체가 월동한 여왕벌임을 확인할 수 있었다. 첫 수벌이 9월 11일 나왔으며 공주벌은 9월 15일 우화하여 9월 20일 첫 짝짓기를 하였다. 이번 채집과 사육을 통해서 서양뒤영벌 여왕이 야생에서 동면하고 정상적으로 일벌을 생산한 국내 첫 사례로 기록한다. 이에 서양뒤영벌의 국내 자연서식에 대한 면밀한 조사가 필요하다고 제시하는 바이다.

검색어: 서양뒤영벌, 여왕, 자연동면, 일벌생산, 정착

P96

Prediction of potential habitats for *Linepithema humile* (Hymenoptera: Formicidae) in Korea using species distribution modeling based on the Americas

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The Argentine ant (*Linepithema humile*) is one of '100 of the World's Worst Invasive Alien Species'. This ant was first discovered in Korea near Busan Station in October 2019. It was confirmed to be overwintering and establishing a population through monitoring, and it is estimated to have been established for at least 2-3 years prior. This study aims to model the potential habitats of Argentine ants in the Americas and project them onto the Korean Peninsula to identify areas with the same or higher probability of occurrence as the Busan Station area. Modeling was performed using the biomod2 R package for GBM, ANN, MARS, RF and MAXENT models, and an ensemble model combining these was derived. The localities with a higher probability of presence than Busan Station area were identified as Geoje, Yeosu, Ulsan, Pohang, Jindo, Mokpo and parts of Daegu.

Key words: species distribution model, invasive species, habitat estimation

P97

Effect of glucosinolate profiles in different Kimchi cabbage genotypes on diamondback moth (*Plutella xylostella*) resistance assessed by the clip-cage

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The diamondback moth (*Plutella xylostella*) is a significant pest of Kimchi cabbage (*Brassica rapa* L.). In this study, we assessed the resistance of 28 Kimchi cabbage cultivars to DBM using both acrylic cage and clip-cage assays under laboratory and field conditions. DBM larval weight varied notably among cultivars, with CR-matzzang consistently identified as resistant, while 19-FQ-49-1 were grouped as susceptible. Glucosinolate (GSL) profiles, analyzed through liquid chromatography-mass spectrometry (LC-MS), indicated that indolic GSLs, particularly neoglucobrassicin, were the most abundant in resistant cultivars. Correlation analysis revealed a significant negative relationship between neoglucobrassicin content and DBM larval weight. These findings suggest that specific GSLs, especially neoglucobrassicin, may play a key role in conferring DBM resistance in Kimchi cabbage and present a potential target for breeding programs aimed at enhancing pest resistance in Brassica crops.

Key words: diamondback moth, kimchi cabbage, glucosinolates, resistance, clip-cage test

P98

Building safe havens: Aquatic herbivore, *Elophila turbata* using the host plant *Lemna minor*: Predator defence through growth inhibition

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Ecosystems are composed of complex interactions among plants, herbivores, and predators. Herbivorous insects, particularly those in aquatic environments, not only require immobile plants for feeding but also develop strategies to protect themselves from predators. In this study, we investigated the house-building behavior of the aquatic herbivore *Elophila turbata* and its use of the free-floating plant *Lemna minor* as both a food source and a defense mechanism against predators. We found that the stability of these houses is critical for the survival of *E. turbata* caterpillars. When we artificially destabilized these structures and exposed the caterpillars to predators, predation rates increased significantly compared to those in stable, control houses. Moreover, our findings indicate that the fronds of *L. minor* used in house construction exhibited stunted growth compared to normal fronds. We also observed an elevation in key metabolites, particularly gamma-aminobutyric acid (GABA), within the fronds utilized by the caterpillars. Interestingly, treating *L. minor* fronds with oral secretions from the caterpillars inhibited both the growth of the plant and GABA production, suggesting a caterpillar-induced response essential for maintaining the protective structure. This study highlights how *E. turbata* caterpillars manipulate their host plants to construct stable, protective homes, thereby enhancing their survival in aquatic ecosystems.

Key words: aquatic herbivore, duckweed, shelter building, predation, growth inhibition

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Degree-day based model for forecasting adult emergence of *Synanthedon bicingulata* (Lepidoptera: Sesiidae)

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복숭아유리나방(*Synanthedon bicingulata*)은 유충이 나무 줄기 속으로 파고 들어가 형성층을 섭식하는 생태적 특징으로 인해 방제가 어려운 해충이다. 현재에는 성충의 발생시기를 지속적인 모니터링을 통해 화학 방제에 의존하고 있다. 따라서, 성충 발생 시기를 예측할 수 있다면 표본조사와 방제 효율을 극대화할 것으로 기대된다. 본 연구에서는 국내에서 발표된 발생 소장 연구의 발생 데이터와 해당 지역의 기온 데이터를 활용, Weibull function을 이용하여 복숭아유리나방의 성충 발생 최성기를 예측하는 모델을 개발하였다. 또한 개발된 모델과 SSP 미래 기후변화 시나리오를 이용해 미래 기후변화 상황에서 복숭아유리나방의 전국적 발생 양상이 어떻게 변화할지 예측해보았다. 복숭아유리나방의 성충 발생은 온일도일에 따라 예측이 가능하였고 연 중 2회의 성충 최성기가 발생하는 것으로 예측되었다. 이번 연구에서 개발된 모델은 첫 번째와 두 번째 성충 최성기(50% 발생시기)를 국내 전역에서 평균 6.3일, 4.0일 이내로 예측해 예측 정확도가 매우 높았다. 이번 연구 결과는 난방제 해충인 복숭아유리나방의 방제 효율을 급격히 높혀줄 뿐만아니라, 기후변화에 따른 복숭아유리나방의 발생 변화 예측에도 기여할 수 있을 것으로 기대된다.

검색어: 복숭아유리나방, 누적온일도, 발생최성기, 발생예측모형

P100

Characteristics of queen hornets captured different with the attractive trap color in spring

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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. 최근 우리나라 양봉산업은 이들 말벌류 중에서 특히, 생태계교란종인 등검은말벌과 토종 장수말벌로 인해 심각한 피해를 받고 있다. 이에 본 연구는 이들 말벌류로부터 양봉농가의 현장애로를 해결하고자 기존의 시판품인 말벌 유인트랩의 효율성을 개선하고자 유인트랩 색상을 달리하여 여왕말벌류들의 포획 반응에 대한 선호도를 2024년 4월 1일부터 6월 20일까지 연구소 내 양봉장 주변 3지점에서 6종의 색상으로 조사하였다. 포획된 여왕말벌류 선호도 조사결과, 등검은말벌은 흰색 > 노란색 > 파란색 > 빨간색 > 검정색 > 녹색(대조구, 시판품) 순이었으며, 대조구 대비 흰색 3.7배, 노란색은 3.3배 더 많이 포획되었다. 장수말벌은 흰색 > 파란색·검정색 > 노란색 순이었고, 대조구 대비 흰색 2.5배였으며, 꼬마장수말벌은 파란색에서 가장 많이 포획되었고 2.5배 높게 나타났다. 그리고 포획되어진 여왕말벌류 총개체수 170여 마리중 등검은말벌 61.6%, 장수말벌 13.9%, 꼬마장수말벌 4.9%, 말벌 8.5%, 좀말벌 11.1%로 분포 비율을 차지하였다. 추후 말벌 유인트랩 색상별 선호도에 대한 포획 개체수 조사는 말벌류가 월동에 들어가는 11월말까지 진행하여 이에 대한 상관성을 평가하고자 한다.

검색어 : 말벌류, 여왕말벌, 꿀벌, 유인트랩, 색상

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Survey of the pest population on nursery trees in domestic tree nursery greenhouses by period

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1990년대부터 양묘사업의 시설 및 용기재배가 본격화되면서부터 득묘율의 수치가 비약적으로 상승하였으나 그에 따른 병해충의 발생 양상과 발생량도 변화하였다. 본 연구는 양묘장에서 재배되는 주요 수종별 발생 해충의 최대 발생 시기와 밀도를 조사하여 양묘장 발생 해충의 효율적인 방제를 위한 기초자료로 제공될 목적으로 수행되었다. 2023년 2월부터 11월까지 2주 간격으로 시설 용기묘 재배 양묘장을 방문하였다. 각 수종이 식재된 다혈 양묘용기 10pot를 3반복으로 해충의 발생량을 조사하여 일자별로 정리하였다. 낙엽송에서 발생한 파밤나방은 7월 중순에서 최초 발생하여 7월 하순에서 최다 발생하였다. 자작나무의 경우 차응애가 6월 하순에서 최초 발생하여 8월 하순에서 최다 발생하였다.

검색어: 시설양묘, 해충, 응애류, 나방류, 밀도조사

P102

Development of LAMP assay for the detection of *Gryllus bimaculatus* densovirus

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Gryllus bimaculatus densovirus(GbDV) is a significant pathogen affecting two-spotted cricket (*Gryllus bimaculatus*), leading to high mortality rates. Timely and accurate detection of this virus is essential for managing outbreaks in both research and commercial environments. However, there is currently no reliable field-deployable diagnostic method for detecting GbDV. In this study, we developed a loop-mediated isothermal amplification (LAMP) assay to detect GbDV. Five sets of LAMP primers were designed based on the complete coat protein gene sequence of the densovirus. Primer testing showed that Set-1 and Set-4 produced the most reliable amplification. Set-1 was optimized for 40 minutes and Set-4 for 60 minutes. Additionally, we designed a TaqMan probe to increase the specificity of the assay. Our results demonstrate that the developed LAMP assay, particularly with the use of the TaqMan probe, is both sensitive and specific, providing a potential field diagnostic tool for GbDV.

Key words: *Gryllus bimaculatus*, densovirus, LAMP assay, TaqMan probe, molecular diagnostics

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The effects of insect-based healing agriculture programs: for elementary school students

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초등학생 대상 인성교육프로그램으로 교육부로부터 2023년 11월 인증받은 '누에와 함께 놀자' 프로그램을 농촌지역의 초등학교 학생을 대상으로 현장에 적용하였다. 참여자는 경북 성주군 지역의 초등학생으로 전학년 35명 모두를 대상으로 하였다. 총 10회차로 구성된 프로그램은 2024년 6월-7월에 학교의 정규 수업 시간을 이용하여 활동이 이루어졌으며, 프로그램 운영은 인근 지역에 위치한 누에 농가의 대표가 진행하였다. 효과를 측정하기 위한 사전-사후 검사에 대한 분석 결과, 프로그램 참여 후 학생들의 삶의 만족도가 증가(7.42점→8.73점)하였고, 곤충에 대한 선호도가 긍정적으로 증가(3.31점→3.81점)하였다($p<0.05$). 또한 스트레스 지수가 사전 29.5KIU/L에서 사후에 24.0KIU/L으로 낮아진 것으로 나타났다($p<0.05$). 향후 다양한 형태의 곤충을 이용한 치유농업프로그램이 개발되어 초등교육 현장에 적극 활용될 수 있기를 기대한다.

검색어: 누에, 치유농업, 인성교육프로그램, 초등학생

P104

Development of artificial diets for optimal *Zophobas atratus* larvae growth

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This study aimed to evaluate the effects of various artificial diets on the development of *Zophobas atratus* larvae. Larvae on artificial diets had slightly longer development periods but significantly higher weight compared to those on the wheat bran control. To reduce mortality during the early stages of larvae development, artificial diets with varying concentrations of agar were investigated. In conclusion, the wheat bran + fish meal + agar 2% (WFA2) artificial diet was more suitable for *Z. atratus* larvae development than wheat bran, leading to greater weight gain, shorter development periods and higher adult emergence rates. Additionally, WFA2 showed potential in reducing dust issues and labor demands linked to wheat bran usage. These finding suggest that WFA2 can be effectively used for the artificial rearing of *Z. atratus*.

Key words: Artificial diet, development characteristics, food efficiency, *Zophobas atratus*

P105

Report on the occurrence of *Pyrausta panopealis* on sweet basil *Ocimum basilicum* in Chungcheongnam-do

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Basil (*Ocimum basilicum*) is a member of the Lamiaceae family with green perilla, and is renowned for its aromatic, medicinal, and insecticidal properties. It is one of the most popular herbs globally. In Korea, the enhancement of economic trade and economic growth, coupled with the infiltration of Western cultural elements into dietary practices, has led to the diversification of food culture, thereby contributing to an increase in consumption. In accordance with this trend, there has been a notable increase in the prevalence of agricultural endeavors, extending from modest home gardens to large-scale farms dedicated exclusively to the cultivation of basil. The perilla leaf moth, *Pyrausta panopealis* Walker, belonging to an insect family Crambidae in Lepidoptera demonstrates a highly restricted host range, with incidences of damage predominantly occurring in perilla within Korea. The larval stage of *Pyrausta panopealis* primarily inflicts damage by targeting the young shoots and leaves of crops. The morphology of the larvae is characterized by a light green coloration in the early instars, which progressively darkens and becomes more pronounced with the development of black spots in the mature larvae. The mature larvae, just prior to pupation, exhibit a purplish hue. The adult moths are yellowish-brown, with distinct dark brown markings on the hind wings. Oviposition occurs sporadically, with females depositing several eggs in overlapping clusters or singly. The aims of this study were to record the occurence of *Pyrausta panopealis* attacking sweet basil (*O. basilicum*) plants, it was newly reported host plant, grown in Chungcheongnam-do, as well as to provide information on the stage of development and morphological characteristics in *Pyrausta panopealis.*

Key words: occurrence, *Pyrausta panopealis,* sweet basil

P106

Detection Trends and DNA Barcoding of Diptera on imported Plants in Korea During 2011-2020

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Over the past 10 years(2011-2020), 4,022 cases of Diptera have been detected in imported plants during the quarantine. The number of detections of Diptera has shown a continuous upward trend, inceasing more than sixfold from 121 cases in 2011 to 739 cases in 2019. The most frequently detected Diptera were found in lettuce (437 cases), followed by Happy Tree Seeding (*Heteropanax fragrans*) (213 cases) and broccoli (180 cases). By country, China accounted for the highest number of detections, with 1,824 cases across 115 plant items, representing 45.4% of all detections. The detection of Diptera on quarantine plants is often challenging due to their small size and frequent discovery of laval or pupal stages, making accurate species identification and monitoring of occurrence difficult. The DNA sequences of the detected Diptera were analyzed, and phylogenetic trees were constructed. This study aims to collect and database the genetic information of various pests detected in quarantine settings to systematically manage genetic resources.

Key words: plant quarantine, DNA barcod, Diptera, Phylogenetic tree

P107

The impact of feed sources using agricultural processing by-products on the growth of *Hermetia illucens*

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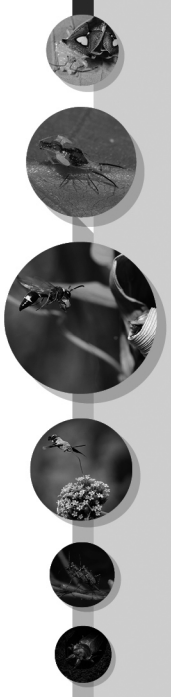
아메리카동애등에(*Hermetia illucens*)는 국내에서 남은음식물습식사료로 대부분 사육되고 있는 실정이나 시기에 따른 먹이원의 불균일한 양분조성, 이물질 혼입 및 다량 염분 함유 등으로 성상이 균일하고 위생적인 동애등에 생산이 어려울 뿐만 아니라 수확 후 분변토 내 염분 집적으로 퇴비원료로써의 사용 제한으로 2차 폐기물 처리비용이 발생된다. 이에 아메리카동애등에 사육 시 균일한 품질 및 생산성을 유지하고, 남은 음식물 습식사료로부터 발생되는 악취를 저감하기 위한 농업가공부산물 활용한 먹이 대체원을 개발하고자 본 연구를 수행하였다. 농업가공부산물인 소사료, 빵 부산물과 적정 비율(1-5%)로 선발된 인공화분사료 급여 후 유충의 생육은 소사료 부산물이 가장 우수하였으며 발육일수도 관행구 대비 0.7일 단축되었다. 챔버 내에서 사육하며 암모니아와 산소 농도를 측정시 남은음식물+톱밥(관행) 처리구는 산소 농도가 낮아지며, 암모니아 농도가 11mg kg^{-1} 으로 가장 높게 나타났으며 다른 처리구에서는 암모니아가 측정되지않았다. 결론적으로 농업가공부산물 중에서는 소사료부산물에 인공화분사료 5% 첨가 시 유충생육이 가장 우수하였으며 암모니아 발생은 적고 산소 농도는 높게 나타나 환경조건이 양호하였다.

검색어 : 아메리카동애등에, 농업가공부산물, 먹이원, 악취저감

Poster Presentation
Non-Competition



P108

First report of genus *Aceria massalongoi* (Canestrini, 1890) (Acari: Eriophyidae) on Roundleaf chastetree (*Vitex rotundifolia*. L.f.) in Korea

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At late September 2024, a species of gall mite in the genus *Aceria* (Eriophyidae, Eriophyinae) was found on the Roundleaf chastetree (*Diospyros kaki* Thunb.) in the Aewol handam Park of jeju island, Korea. The gall mite was subsequently identified as Roundleaf chastetree gall mite, *Aceria massalongoi* (Canestrini, 1890). This is the first reported in Korea, and also It was collected from globoid leaf galls on severely injured chaste trees, Vitex agnus-castus L. (Lamiaceae), in Bari and Bernalda (southern Italy), and on the Ionian island Leukade (Greece).

Key words: Roundleaf chastetree, gall mite, *Aceria massalongoi,* Eriophyidae, Korea

P109

First record of *Chrysoperla suzukii* (Neuroptera: Chrysopidae: Chrysopinae) from Korea

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The *Chrysoperla* species are the most important group as commercially available natural predators such as *Chrysoperla carnea*. Some species are morphologically cryptic species complex but separated based on the vibration courtship song or morphological character of the larval stage. We first report *Chrysoperla suzukii* from Korea. We provide brief descriptions and photos of larva, adults and adult genitalia.

Key words: Neuroptera, Chrysopidae, green lacewing, *Crysoperla*, *Chrysoperla suzukii*

P110

Updated checklist of Korean Acentropinae Stephens, 1836 (Crambidae, Lepidoptera) based on a survey of the literature

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The first record of Korean Acentropinae by Leech (1889), the reports about new species of Deltoid and Pyralid moths from Korea, North China, and Japan. Up until the mid-20th century, research on Acentropines was predominantly conducted by Japanese researchers. Since then, research on this group in Korea has been relatively insufficient, with only three species explicitly reported as unrecorded by Korean researchers. According to the National Institute of Biological Resources (2023), 17 species of Acentropines are recorded in Korea. However, issues have been identified, such as discrepancies in species status and historical literature records. This study aims to resolve such confusion by reviewing relevant literature to update the checklist of Korean Acentropines.

Key words: species list, first record, Nymphulinae, Hydrocampinae, *separatalis*

P111

A Report on a newly recognized species, *Caloptilia cecidophora* Kumata, 1966 (Lepidoptera: Gracillariidae) and its parasitoid wasp, *Bracon* sp. (Hymenoptera, Braconidae) from South Korea

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A Korean endemic plant species *Glochidion chodoense* in Euphobiaceae was first discovered in Jodo-myeon, Jindo-gun, Jeollanam-do, Republic of Korea. It is known to be native exclusively to Jindo of the Korean Peninsula. To date, there have been no reports on insect pest damage or related ecological interactions associated with this plant in the country. In this study, we report a gall-inducing micromoth, *Caloptilia cecidophora,* new to Korea, on *G. chodoense* and its parasitoid wasp *Bracon* sp. (Hymenoptera: Braconidae), which parasitizes the larvae of *C. cecidophora*, was also first discovered as part of this newly observed tri-trophic interaction. Also, the presentation includes detailed image of key morphological traits of both *C. cecidophora* and *Bracon* sp., along with biological notes on parasitism rates and types. These findings will contribute to understanding ecological interactions among these three organisms as well as studies on biodiversity and trophic dynamics within ecosystems in Korea.

Key words: Taxonomy, Gracillariidae, Braconidae, Ectoparasitism, new record

P112

First record of genus *Pseudorobitis* Redtenbacher of Nanophyinae (Coleoptera: Brentidae) in Korea

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The subfamily Nanophyinae Gistel contains 60 species under 11 genera in the Palaearctic region (Alonso-Zarazaga, 2017). Only 5 species belonging to 2 genera (*Alonsiellus* Zherikhin and *Nanophyes* Schoenherr) under the tribe Nanophyini recorded in the Korean fauna until now (Han *et al.*, 2013). The genera of tribe Nanophyini with 6 desmomeres in antennal funicle were include 7 genera, *Ctenomerus* Schoenherr (12 spp.), *Hexatmetus* Marshall (3 spp.), *Kantohia* Alonso-Zarazaga & Perrin (1 sp.), *Lyalia* Alonso-Zarazaga & Perrin (3 spp.), *Oxycorax* Alonso-Zarazaga (1 sp.), *Pseudorobitis* Redtenbacher (3 spp.), and *Shiva* Pajni & Bhateja (6 spp.) (Alonso-Zarazaga, 2014). The genus *Pseudorobitis* Redtenbacher, 1868 is firstly reported in South Korea with *P. gibbus* Redtenbacher, 1868, which collected on the leaves of crape myrtle (*Lagerstroemia indica* L.) belonging to the family Lythraceae.

Key words: *Pseudorobitis gibbus*, Nanophyinae, *Lagerstroemia indica,* New record, Korea

P113

Taxonomic revision and molecular phylogeny of two subgenera of genus *Copris* (Coleoptera: Scarabaeidae) from Cambodia

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The genus *Copris*, first described in 1762, belongs to the tribe Coprini within the family Scarabaeidae of the order Coleoptera. The identification of *Copris* species remains challenging due to considerable morphological variation within the genus. This study provides a detailed morphological description of three *Copris* species, belonging to two subgenera, based on both literature review and direct specimen examination. Additionally, we employed molecular techniques, analyzing mitochondrial DNA sequences using likelihood and Bayesian inference methods to investigate phylogenetic relationships among the species. This research aims to contribute valuable baseline data for future taxonomic research and underscores the ecological importance of *Copris* in maintaining environmental balance through its ecosystem services.

Key words: *Copris*, Cambodia, Taxonomy, Molecular phylogeny, Morphology

P114

On the moving metro train: one moth fly species (Diptera: Psychodidae) newly recorded from Korea

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Genus *Trichopsychoda* is known to include 23 recorded species worldwide, some of which possess filiform tenacula with complex apical expansions. In the Korean Peninsula, only *T. coreanica* has been recorded in North Korea, but no records of *Trichopsychoda* existed in South Korea—until now. Single male moth fly was collected on a moving Line 1 metro train, and upon identification, it was determined to be *Trichopsychoda arnaudi*. Brief descriptions, along with a photograph and illustrations of this species are provided.

Key words: Psychodidae, Moth flies, Korea, New record, Taxonomy

P115

Insect Survey and Collection in Cleopatra's Needle Critical Habitat, Palawan, Philippines

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The Philippines is one of the world's 18 most biologically rich countries ranking fifth in flora diversity and maintains 5% of the world's flora. It is also a biodiversity hotspot with at least 700 threatened species, thus making it one of the top global conservation areas (CI, 2013; DENR, 2015). Many more species remain to be discovered and identified, and level of endemism is generally poorly known. Palawan, the survey area, is known as the Philippine's "last ecological frontier" endowed with rich natural resources and highly diverse flora and fauna.

In this study, we have reviewed the insect fauna based on the expeditions in the Philippines from 2022 to 2024, with a focus on Lepidoptera fauna. Results of the survey identified approximately 320 species of 120 genera in 58 families belonging to eight orders are identified, including some new and newly recorded species. Of these, 200 species from 82 genera of 24 families were lepidopterans. However, many specimens need further examination to verify their species identity.

Key words: Oriental region, tropical ecosystem, Lepidoptera, species diversity

P116

Larval redescription of *Necrophila* (*Eusilpha*) *jakowlewi jakowlewi* (Semenov, 1891) (Coleoptera: Staphylinidae: Silphinae)

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A necrophagous beetle, *Necrophila* (*Eusilpha*) *Jakowlewi Jakowlewi* (Semenov, 1891) feeds on vertebrate carcasses, such as human and pig, and is recognized as a potential bioindicator in forensic entomology. The developmental stages of necrophagous insects in corpses can be used as crucial indicators in estimating the postmortem interval (PMI). However, detailed descriptions of each larval stages of *N. Jakowlewi* have never been made so far. The aim of this study is to provide reliable morphological characters, with quantitative and qualitative morphological information, for identifying each immature stage of the species. We hereby provide the redescription, larval images and an identification key to larval instars of the species.

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

P117

Taxonomic notes on the Pyralini (Lepidoptera: Pyralidae: Pyralinae) from Korea

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[2]Bio-Resource and Environmental Center, Incheon National University

The tribe Pyralini was established by Latreille in 1809, with type genus *Pyralis* Linnaeus, 1758. Pyralini belongs to the subfamily Pyralinae within the family Pyralidae. This tribe includes mostly medium-sized moths, and approximately 30 genera have been described worldwide (Nuss *et al*., 2024). Each genus has unique ecological traits and plant associations, with some closely linked to specific plant groups, such as landscape trees, crops, oak trees etc. In this study, a total of 19 species of Korean Pyralini are listed to date. Illustrations of adults are provided.

Key words: Pyraloidea, Pyralidae, Pyralinae, Korea, Taxonomy

P118

Checklist of Olethreutes group (Lepidoptera: Tortricidae: Olethreutinae) from Korea

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According to Diakonoff (1973), the subtribe Olethreutina is classified into a total of 27 genera and three genera groups: *Olethreutes* group, *Hedya* group, *Apotomis* group. Up to date, 39 species from 5 genera within the *Olethreute* group have been reported in Korea. In this study, we provide a checklist of *Oletreutes* group along with illustrations of adult and genitalia.

Key words: Tortricoidea, Olethreutini, Palearctic Region

P119

Preliminary checklist of Tiger beetles (Coleoptera: Carabidae) in Korea

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[2]DASARI research Institute of BioResources

Tiger beetles are fast-moving predators that prey on small insects and other arthropods. They are generally found in sand dunes of lake and sea shores, clay banks and in the mud of salt fields. The subfamily Cicindelinae Latreille, 1802, includes more than 2,600 species worldwide. In Korea, 21 species are recorded. Some species, such as *Cicindela sylvatica sylvatica*, *Cicindela japana japana*, *Callytron nivicincta*, and *Callytron yuasai yuasai*, have uncertain distributions in Korea. *Cicindela coerulea nitida*, is estimated to be extinct in Korea. In this study, we provide a checklist and discussions the habitats and distributions of tiger beetles in Korea.

Key words: Cicindelinae, Checklist, Coleoptera, Tiger beetles

P120

Insects fauna in Korean islands (2023)

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Islands often have relatively well-preserved ecosystem and an abundance of bioresources with a high conservation value, with unrecorded species continuing to be reported (Hong, 2011). The Honam National Institute of Biological Resources (HNIBR) has been conducting research on the biodiversity of Korean islands since 2021, and plans to conduct a 10-year survey targeting 200 islands selected through various criteria. Twenty islands were selected as the subject of the 2023 research, and the islands are known to 1,046 species of insects. In this study, 67 field survey were conducted on the 20 islands from May to September 2023, and 5,369 specimens of 1,320 species were collected. Of these, 767 species were previously unknown in 20 islands.

Key words: Korean islands, insect fauna

P121

Two new species of the genus *Gonioctena* Chevrolat, 1836 (Coleoptera: Chrysomelidae) from China

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Gonioctena Chevrolat, 1836 is one of the most diverse genera of the subfamily Chrysomelinae, with approximately 120 species occurring in Holarctic and Oriental Regions (Cho 2023). According to the recent catalogue of Palaearctic Coleoptera (Bezděk and Sekerka 2024), China has exceptionally high species richness of the genus. There are 51 species of *Gonioctena* in China, accounting for about 40% of world's total, 60% of which are species endemic to China. Amongst them, 12 species have been newly described from China in the past decade. During the examination of materials in the old collections, I found two new species of the genus *Gonioctena* from Sichuan and Fujian Provinces, which are described below.

Key words: leaf beetle, Chrysomelinae, taxonomy, new species, Fujian, Sichuan

P122

The first record of the subgenus *Sarcophaga* (*Leucomyia*) (Diptera: Sarcophagidae) from Korea

Jongwon Kim[1,2], Young-Kun Kim[3], Sangjin Han[4] and Sang Jae Suh[3]
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[2]School of Applied Biosciences, Kyungpook National University, Daegu, Republic of Korea
[3]Department of Plant Medicine, Kyungpook National University, Daegu, Republic of Korea
[4]School of Biological Sciences and Institute of Biodiversity, Seoul National University, Seoul, Republic of Korea

The subgenus *Leucomyia,* within the genus *Sarcophaga*, is a monotypic group distributed across the Palaearctic and Oriental regions. Unlike other subgenera of *Sarcophaga*, *Leucomyia* exhibits distinctive features, such as the presence of two katepisternal setae (as opposed to three in other subgenera) and a densely silver-gray dusted body. This species is typically found in sand dunes near beaches. In this study, *Sarcophaga* (*Leucomyia*) *alba* is reported for the first time in Korea. The diagnosis, ecological information, habitus, and genitalia photographs are presented herein.

Key words: Taxonomy, Diptera, Sarcophagidae, *Sarcophaga* (*Leucomyia*) *alba*.

P123

Taxonomic revision of the subgenus *Bothynoptera* (Coleoptera: Carabidae) from Korea

Seungmin Shin, Eun Young Choi, Jong Bong Choi, Myeonghwan Kim, Taeyeong Kwon, Hee Soo Lee, Sodavy Gnim and Jong Kyun Park
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Subgenus *Bothynoptera* Schaum, 1863 of the genus *Parena* is mainly found in Oriental region. Despite this widespread distribution, species of the subgenus *Bothynoptera* are poorly known in Korea. While a total of 14 species have been recorded worldwide, only 3 species have been recorded in Korea. In this study, as a revisional work of Korean known species, a pictorial key and photographs of habitus and male genitalia for each species are provided, with a newly recorded species in Korea.

Key words: *Parena*, Carabidae, Taxonomy, Korea, New record

P124

A new record of the genus *Bioxys* (Braconidae: Aphidiinae) from South Korea

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The genus *Bioxys* Starý & Schlinger, 1967 belonging to the subfamily Aphidiinae is known to include only one species worldwide. This genus is a parasitic wasp on *Machilaphis machili*. Chang and Youn (1983) reported *Bioxys* in South Korea, but their description differs in several key aspects from other records. In this study, we provide detailed describtions of *Bioxys japonicus* with diagnosis, distribution and illustration.

Key words: hymenoptera, natural enemy, parasitoid, unrecorded species

P125

South Korean species of *Acrossus* Mulsant (Coleoptera: Scarabaeidae: Aphodiinae) with a new synonym

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A taxonomic study of the genus *Acrossus* Mulsant in South Korea is present. Two species [*Acrossus superatratus* (Nomura & Nakane) and *Acrossus atratus* (Waterhouse)] are recognized and a new synonym [*Paulianellus asahinai* (Nakane) = *A. koreanensis* (Kim), new synonym] is proposed. *Acrossus atratus* is reported for the first time in the Korean Peninsula. A key, redescriptions and illustrations of diagnostic characters of South Korean species are provided..

Key words: Coleoptera, Scarabaeidae, Aphodiinae, *Acrossus*, new synonym, Korea

P126

Population genetics divergence and relationships of *Matsucoccus matsumurae* (Hemiptera: Matsucoccidae), in South Korea using mitochondrial DNA sequence

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Matsucoccus matsumurae, first reported by Miller and Park (1987) across southern and parts of eastern and western coastal regions of South Korea. Since its initial identification in 1963, *M. matsumurae* (Black pine bast scale) has been a persistent forest pest in South Korea, causing widespread damage to *Pinus* species.

To date, we have investigated the genetic diversity and relationships of 23 *M. thunbergianae* populations in South Korea using ND5 and CYTB sequences. Haplotype analysis of the ND5 sequences in *M. thunbergianae* collected from 23 regions identified 54 haplotypes from 716 individuals. Similarly, haplotype analysis of the CYTB sequences identified 56 haplotypes from 706 individuals. Baps analysis based on the ND5 gene region identified five haplogroups, while analysis of the CYTB gene region revealed four haplogroups.

Key words: *Matsucoccus matsumurae,* Black pine bast scale, genetic divergence

P127

Complete mitochondrial genome of genus *Oiketicoides* species (Lepidoptera: Psychidae)

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We report the complete mitochondrial genome of *Oiketicoides* sp. nov, Roh & Lee 2024. The genome has a total length of 15,493bp, consisting of 13 protein coding genes, 22 tRNA, 2 rRNA genes, and A+T rich control region. The nucleotide composition was 37.7% T, 40.5% A, 14.1% C, and 7.6% G. This study is the first report of a complete mitochondrial genome of a psychid species, and the mitogenomic sequence can be used as a reference data for extensive phylogenetic studies of Tineoidea.

Key words: Psychidae, bagworms, new species

P128

The complete mitochondrial genome of *Hilara echinata* (Diptera: Empididae)

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This study encoded the complete mitochondrial genomic sequence of the *Hilara echinata*. The mitochondrial genome has a total length of 17,041 base pairs (bp), consisting of 13 protein-coding genes (PCGs), 22 transfer RNA (tRNA) genes, two ribosomal RNA (rRNA) genes, and a control region. The nucleotide composition was 40.4% thymine (T), 37.8% adenine (A), 8.5% cytosine (C), and 13.3% guanine (G). This study provides the basic information on the mitochondrial genome of *H. echinata* and supports the understanding of its mitogenomic data and its phylogenetic relationship within Empididae.

Key words: *Hilara echinata*, Mitochondrial genome, Empididae, Diptera

P129

Identification and Characterisation of CAPA peptides and CAPA-Rceptor in the Western Flower thirps, *Frankliniella occidentalis*

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The PRXamide family is the largest group in insect neuropeptide hormones, characterized with a common amino acid sequence, PRXamide(X, a variable amino acid), at the C-terminal end, which is conserved for diverse functions across Insecta. There are classified into three subfamilies: CAPA (capability peptide produced by capagene), pyrokinin(PK) including pheromone biosynthesis activating neuropeptides (PBAN) and diapause hormone (DH), and ecdysis-triggering hormone (ETH). Physiological major functions of CAPA are known to regulate diuresis, anti-diuresis, osmoregulation, and visceral muscle contraction. In this study, we used the PCR amplifications including 3' and 5' RACEs, and identified the full sequences of the CAPAand CAPAreceptor (CAPA-R) genes in the western flower thrips, *Frankliniella occidentalis*, and characterized the expressions of *capa* and *capa-r* genes in the developmental stages and the tissues (head, thorax, abdomen) in the western flower thrips. During the developmental stages, both ligand and receptor genes were more expressed in males than females. In the tissues, the *capa* and capa-r genes were expressed in all the tissues, more in the head and less in the abdomen.

Key words: CAPA, CAPA receptor, neuropeptide, western flower thrips, *Frankliniella occidentalis*

P130

RNA-seq reveals thermal stress-related genes in honey bee, *Apis mellifera* L.

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The honey bee, *Apis mellifera* L., a key pollinator, has seen population declines linked to colony collapse disorder (CCD), with climate change as a suspected factor. This study examined gene expression under thermal stress, comparing RNA-seq data from bees at 10°C, 25°C, and 38°C. We identified 3,445 differentially expressed genes (DEGs) at 10°C and 5,330 DEGs at 38°C. Heat shock proteins (*HSP70* and *HSP60*) genes were high expressed at high temperatures, while genes like *ApolD* and *HR38* were highly expressed at low temperatures. In both thermal condition, some genes including *ETH*, *TTLL4*, and *OR* were highly expressed. Our finding highlighting potential molecular responses to climate-related stress in CCD.

Key words: honey bee, thermal stress, colony collapse disorder, RNA-seq, gene

P131

Analysis of fatty acid contents in drone pupae(powder and oil) on *Apis mellifera* L.

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수벌번데기는 2020년 한시적 식품원료로 등록되어 2022년에 일반식품으로 전환된 식용곤충으로 3대 필수영양소인 탄수화물(15%), 지방(26%), 단백질(51%)이 고르게 분포하고 있다. 우리는 수벌번데기의 성분분석을 위해 동결건조 분말과 오일(지방)추출물에 대해 지방산을 조사하였다. 지방산 분석 결과 분말은 포화지방산(13종) 13.2 g/100 g, 불포화지방산(10종) 10.9 g/100 g 함유되었고, 불포화지방산에 oleic acid가 10.2 g/100 g으로 가장 많이 함유되었다. 오일 추출물은 포화지방산 56%, 불포화지방산 44% 나타났으며, 주요지방산으로 palmitic acid 42%, oleic acid가 41%로 확인되었다. 종합하면 수벌번데기 분말 또는 오일에는 국소용 연고제나 화장품, 비누 등에 이용되는 지방산을 다량 함유하고 있어 추후 연구를 통해 식의약품 소재 개발에 응용될 수 있을 것으로 판단된다.

검색어: 수벌번데기, 서양종꿀벌, 지방산

P132

Control effect of *Calvia muiri* on aphids based on initial aphids density and treatment area size

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This study was conducted to develop aphid control technology using the *Calvia muiri*. Before testing the control effect in a greenhouse, an experiment was performed to verify the optimal release density for control. The predation effect of *C. muiri* on aphids was compared according to the number of aphids and the volume of the test cage. First, for the two species of aphids(*Myzus persicae*, *Aphis gossypii*), the number of *C. muiri* required to control the density tended to increase as the number of aphids increased. It was also observed that the control efficiency decreased as the aphid density increased. When the volume of the test cage increased, more *C. muiri* were needed to control the same number of aphids. Based on these results, the initial density of aphids suitable for testing in a greenhouse was set at 100 individuals, and the number of *C. muiri* released was selected as 32 and 64 individuals. When 64 *C. muiri* were released, a higher control effect was observed on both aphid species in pepper and cucumber plants. In conclusion, when using *C. muiri* for aphid control, it appears reasonable to release lady beetles at low initial aphid densities and determine the required number of beetles based on the volume of the treated space.

Key words: *Calvia muiri, Myzus persicae, Aphis gossypii,* natural enemy

P133

A comparison of biological characteristics between *Metarhizium anisopliae* isolates

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Entomopathogenic fungi have been studied to control insect pests as an alternative to chemical insecticides. However, all fungi haven't a high virulence against pests. In this study, we compared the biological characteristics of *Metarhizium anisopliae* isolates. First, we selected 17 *M. anisopliae* isolates and compared the thermotolerance, conidial productivity, and virulence. For the thermotolerance test, conidial suspensions were exposed to 0, 30, 60, and 90 min at 45 °C. As a result, the conidial germination rate of all isolates was over 96% when exposed for 0 min, and as the heat treatment, a tendency to gradually decrease. To compare conidial productivity, 200g of millet were used and inoculated with a conidial suspension of 1 ml (1×10^7 conidia/ml). Conidial productivity was investigated after 14 days. As a result of conducting a virulence test against *Tenebrio molitor* using a spray method, differences in virulence between isolates were confirmed.

Key words: conidial productivity, *Metarhizium anisopliae*, themotolerance, virulence

P134

Physical control methods for Bulb mites (*Rhizoglyphus robini* Claparede) in *Allium wakegi* ARAKI

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뿌리응애(*Rhizoglyphus robini*)는 백합과 구근식물에 주로 피해를 주는 해충으로 땅 속에서 뿌리와 구근을 가해하여 방제가 잘 되지 않는 특징이 있다. 충청남도 예산과 아산 지역처럼 쪽파의 연작이 이루어지는 곳에선 꾸준히 발생하여 2023년에는 쪽파 관행 재배에서 14.9%, 무농약 재배에서 25.7%의 뿌리응애 피해율을 보이기도 했다. 또한 수확한 쪽파 구근의 인편 틈에 숨어있다가 파종 후 활동하는 특성으로 파종 전 쪽파 구근의 소독이 이루어지지 않으면 재배 초기에 큰 피해를 주기도 한다. 뿌리응애의 물리적 방제를 위해 온도처리 실험을 수행하였고, 35℃의 온도부터 뿌리응애가 사멸하기 시작하는 것을 확인하였다. 35℃에선 1일 이상의 시간이 필요하였고 40℃부터는 1.5시간 이상 필요하였으나 45℃부터는 30분 이내에서 모두 사멸하였다. 또한 건열처리 조건보다 습열처리 조건에서 뿌리응애가 더 빠르게 사멸하였다. 노지에서 뿌리응애가 주로 분포하는 곳은 토양에서 3.95cm±0.68cm 깊이였으며, 여름 휴경기에 토양 멀칭 태양열 소독으로 5cm 깊이에서 48.3℃까지 온도가 상승하여 뿌리응애를 물리적으로 방제하기에 충분하였다.

검색어: 뿌리응애, 쪽파, 방제, 친환경

P135

Host-Pathogen interaction: Transcriptomic profiling of insect responses to *Metarhizium anisopliae*

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Entomopathogenic fungi serve as eco-friendly alternatives to chemical pesticides. In this study, we investigate the interactions between insects and *Metarhizium anisopliae*, which showed high insecticidal activity against insects, by RNA-seq analysis. RNA from insects was extracted at the median lethal time to identify changes in gene expression. The results showed 580 genes were up-regulated, while 336 genes were down-regulated in fungal treated insects. Up-regulated genes were related to metabolic and cellular processes such as cytochrome P450, DNA replication, and apoptosis. Down-regulated genes were involved in metabolism pathways such as lysosome, starch and sucrose metabolism, and fatty acid biosynthesis. Within insects, 948 genes of fungi have been identified, with key genes related to energy and protein metabolism such as ribosome, oxidative phosphorylation, citrate cycle, glycolysis/gluconeogenesis. Additionally, genes influencing apoptosis and DNA repair and damage prevention pathways in response to stress factors have been identified. These results are crucial for elucidating the mechanisms of fungal invasion and interaction in insects, providing insights for future pest management strategies.

P136

Transcriptome profiling reveals calcium ion regulatory genes confer chlorantraniliprole resistance in *Spodoptera exigua*

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Transcriptomic resistance mechanisms of ryanodine receptors, detoxification enzymes, and calcium regulation were investigated due to the weak correlation between the resistance level and mutation reported previously. RNA-seq analysis was performed on diamide-resistant, susceptible strains and F1-hybrid of *S. exigua*. Based on the reference unigene set, 4,669 genes were differentially expressed, with 2,809 upregulated and 1,860 downregulated in the resistant strain compared to the susceptible strain. Enrichment and orthologous analyses demonstrated that genes involved in metabolic factors were overrepresented in the resistant strain. In particular, the resistant strain overexpressed endoplasmic reticulum (ER)-related calcium ion homeostasis- and cell stability-associated genes. The selected differentially expressed genes were validated then with qPCR. These genes were inferred to induce cell stability to overcome ER stress derived from calcium ion imbalance caused by chlorantraniliprole. These results provide advanced insights into the critical roles of calcium ion homeostasis- and cell stability-related genes in conferring diamide insecticide resistance.

Key words: *Spodoptera exigua*, chlorantraniliprole, calcium ion imbalance, endoplasmic reticulum stress

P137

Functional elucidation of CYP9A40 involved in diamide resistance in *Spodoptera exigua*

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RNA sequencing and differential gene expression analysis were performed to investigate other resistance mechanisms. Diamide-resistant and susceptible strains and F1 hybrids were compared by mapping RNA-seq reads to the *Spodoptera exigua* reference genome. *CYP9A40* was identified as a critical gene in diamide resistance due to its high expression in the resistant strains. Synergist bioassays with piperonyl butoxide supported the role of P450s in diamide metabolic resistance in *S. exigua*. A strong positive correlation between *CYP9A40* over-expression levels (up to 80-fold) and diamide LC_{50} values was obtained for field-collected populations uniformly showing a 100% frequency of the RyR I4790M target-site resistance allele. To validate the function of *CYP9A40* in diamide detoxification, we recombinantly expressed the gene and tested its ability to bind and degrade chlorantraniliprole as a substrate. The results confirmed its catalytic role in diamide metabolism. *CYP9A40* has been identified and validated to confer metabolic resistance in Korean *S. exigua* populations. It works alongside the RyR target-site I4790M mutation to enhance diamide resistance. These mechanisms offer insights for resistance monitoring and support insecticide resistance management programs to improve control strategies for *S. exigua*.

Key words: cytochrome P450, insecticide resistance, detoxification, evolution, xenobiotics

P138

Screening of organic agriculture materials for the control of exotic fig weevil, *Aclees taiwanensis* Kôno (Coleoptera: Curculionidae)

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Ficus carica is predominantly cultivated in the Jeollanam-do region, accounting for approximately 80% of the total fig cultivation area in South Korea, which spans 1,081 hectares. Since its first reported occurrence in the country in 2020, the fig weevil, *Aclees taiwanensis*, has become a significant insect. This nocturnal insect causes severe damage, with adults attacking young shoots, branches, and immature fruits during the night, while larvae burrow into the woody parts of the fig tree, potentially leading to tree mortality in severe cases. In this study, fig weevils were collected from fig orchards in the Jeollanam-do region, and the efficacy of various commercially available organic agricultural materials, including plant extracts and microbial cultures, was evaluated through laboratory assays. A total of 27 organic agricultural products were tested using both foliar spray and soil incorporation methods. The results indicated that two materials, garlic extract and derris extract, achieved over 70% control efficacy at a 1,000-fold dilution. Further pot experiments conducted with these two materials at a 500-fold dilution showed control efficacy exceeding 80%. These findings suggest that the tested organic materials can be effectively utilized for the eco-friendly management of fig weevils in fig orchards.

Key words: *Ficus carica*, Weevil, *Aclees taiwanensis*, Organic agricultural materials, Control efficacy

P139

Effect of symbiotic bacteria isolated from entomopathogenic nematodes on plant parasitic nematode control

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Symbiotic bacteria move into insects by entomopathogenic nematodes and kill them by secreting insecticidal substances. At this time, symbiotic bacteria secrete various metabolites including insecticidal substances and antibacterial substances. This study was conducted to identify symbiotic bacteria suitable for environmentally friendly control of plant parasitic nematodes(PPN) that attack crop roots by utilizing symbiotic bacteria that secrete various insecticidal substances. The control effect on PPN was confirmed using symbiotic bacteria of *Xenorhabdus* sp. and *Photorhabdus* sp. Among the symbiotic bacteria, *Photorhabdus luminescens* showed excellent control effect. In addition, it was confirmed that the control effect increased when plant extracts were added.

Key words: Nematicide, Eco-friendly agent, Plant parasitic nematodes, Symbiotic bacteria, Biological control

P140

Chemical control effect against *Hyphantria cunea* in *Ricinus communis*

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충북 청주와 괴산에서 미국흰불나방 3~4령 유충을 대상으로 피마자 잎에서 에마멕틴벤조에이트, 클로르페나피르, 블로플라닐라이드, 플루벤디아마이드, 루페뉴론 5종의 약제 약제 효과를 검정하였다. 그 결과, 에마멕틴벤조에이트, 브로플라닐라이드, 플루벤디아마이드는 약제 처리 후 3일차에 청주와 괴산지역 모두 방제가 100%를 보였으며, 루페뉴론의 경우 약제 처리 후 3일차에는 방제가가 31.7%(청주), 56.7%(괴산)로 다소 낮았으나, 5일차에는 청주, 괴산 모두 방제가 100%를 보였다. 클로르페나피르의 경우 약제 처리 후 3일차 17.3%(청주), 14.0%(괴산) , 5일차 38.3%(청주), 46.7%(괴산), 7일차 41.7%(청주), 51.7%(괴산)로 낮은 방제가를 보였다. 따라서 본 연구에서 사용한 약제 중 에마멘틴벤조에이트, 브로플라닐라이드, 플루벤디아마이드, 루페뉴론 약제의 경우 미국흰불나방을 방제하기 위해 사용하는 것이 적절하지만, 클로르페나피르는 방제 효과가 낮아 사용을 피해야 할 것으로 판단된다.

검색어: 미국흰불나방, 피마자, 방제효과, 약제살포

P141

Effective control of resistant two-spotted spider mite using environmental friendly organic material

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점박이응애(*Tetranychus urticae*)는 전 세계적으로 분포하고 있으며, 약 1,000여종의 작물을 가해하는 해충으로 알려져 있다. 점박이응애 방제는 주로 화학농약에 의존하고 있는 추세이나 짧은 생활사와 발생 세대수가 많은 특성으로 인해 저항성 발현 문제가 대두되고 있다. 이에 따라 본 연구는 팜오일을 주성분으로 하는 유기농업자재(이하 '시험약제')를 이용한 저항성 점박이응애의 효과적인 방제법을 제시하고자 수행되었다. 저항성 점박이응애가 문제 되는 딸기 포장 2곳을 대상으로 경엽처리를 통해 시험약제의 약효를 평가하였다. 포장1의 방제가는 14일차 95%이상의 우수한 약효가 확인되었으며, 포장2의 방제가는 약제처리 7, 14일 후 각각 90.6, 84.3%로 확인되었다. 추가로 화학살비제의 사용량 저감 가능성을 평가하고자 METI계, 지질생합성 저해에 작용하는 저항성 응애를 대상으로 시험약제와 주요 살비제와의 체계처리 시험을 수행하였다. 시험결과 7일간격 2회 단용처리시 저항성 응애에 대해 우수한 방제가가 확인되었으며, 지질생합성 저해 살비제 1종(23)은 화학약제-시험약제 체계처리시 높은 시너지효과가 확인되었다. 본 연구를 통해 시험약제는 단용처리만으로도 저항성이 발현된 응애에 대해 화학농약과 비등 또는 우수한 방제 효과를 나타냄을 확인하였으며, 화학살비제와 체계처리시 추가 상승효과를 확인할 수 있었다. 시험약제는 저항성 응애의 밀도를 효과적으로 관리하는 대안책이 될 수 있을 것으로 사료되어진다.

검색어: 유기농업자재, 저항성, 점박이응애, 체계처리, 팜오일

P142

Trap monitoring of soybean insect pests occurrence in paddy field

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최근 논콩 재배 면적이 크게 증가하고 있고 밭콩과 다른 해충 발생양상의 변화로 이어질 수 있으므로 생산단지를 중심으로 대규모 재배실정에 맞는 지속적인 예찰연구가 필요하다. 논콩 생산단지('23년 기준 100ha 이상)가 있는 경상북도 안동/상주, 전라북도 김제/부안, 전라남도 장성, 충청남도 논산을 중심으로 콩 주요 해충에 대한 페로몬 트랩조사 및 육안조사를 수행하였다. 트랩 조사결과 7월 상순은 중부내륙지역(상주, 안동, 논산)은 파밤나방(*Spodoptera exigua*)의 발생이 많았으며, 중부서해안 지역(김제, 부안, 장성)은 담배거세미나방(*Spodoptera litura*)의 발생이 많았다. 7월 중순은 조사지역 모두 파밤나방의 발생이 많았다. 8월 상순에는 경북 산간지(안동, 상주)에서 파밤나방의 발생이 크게 증가하였으며 8월 하순 이후에는 서해안 지역(김제, 부안)에서 파밤나방, 담배거세미나방의 발생이 증가하였는데 이는 재배 온도 및 위치에 따른 발생 차이로 보인다. 또한 대규모 생산단지의 해충 발생양상은 밭과 유사하나 파밤나방의 발생량은 평균 2배이상, 담배거세미나방은 평균 5배이상 많아 집중 예찰이 필요할 것으로 보인다.

검색어: 논콩, 발생조사, 모니터링, 해충 관리, 예찰

P143

Optimizing the releasing strategy of *Telenomus remus* (Hymenoptera, Scelionidae) for controlling lepidopteran insect pests in fields

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나방류 알 기생성 천적인 밤나방검정알벌의 효과적인 방사를 위한 몇가지 야외실험을 진행하였다. 밤나방검정알벌 방사지점으로부터 1, 3, 5, 10, 20m 거리별 담배거세미나방과 열대거세미나방 난괴 설치 후 기생률을 조사한 결과, 방사 후 48시간 이내 방사지점으로부터 20m까지 평균 10.8%의 기생률을 보였다. 방사지점으로부터의 거리에 따른 알벌의 나방류 알기생률은 유의미한 차이는 없었으나, 10m에서 평균 알기생률 60%로 가장 높게 나타났으며, 이에 따라 적정 방사간격은 최소 10m 간격으로 설정 가능할 것으로 판단된다. 작물에 따른 기생률 차이도 확인되었는데 콩보다는 옥수수에 설치한 난괴에 높은 기생률을 보였으며, 옥수수와 콩에 설치한 난괴의 평균 알기생률은 각각 52.9%와 21.8%였다. 밤나방검정알벌의 실내 기주선호성 조사 결과에서는 열대거세미나방보다는 담배거세미나방 알을 선호하는 것으로 확인되었으나, 야외조사에서는 각각의 알기생률이 42.7%와 36.8%로 두 기주곤충 간의 기생률은 통계적으로 유의미한 차이가 없었다.

검색어: 밤나방과, 방사거리, 기주선호성, 알기생률

P144

Effect of pesticides on an aphid parasitoid, *Binodoxys communis* for controlling aphids in cucumber greenhouses

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농업현장에서 이용가능한 진딧물 방제 천적의 다양성을 높이고 국내 환경에서의 적응력이 높은 토착천적으로 발굴한 쌍꼬리진디벌과 병해충 방제용 작물보호제와의 혼용 가능성을 검토하였다. 작물보호제 16종 의 쌍꼬리진디벌 머미 및 성충에 대한 직접 및 작물체 처리 후 잔류독성 실내검정을 통해 각 약제의 독성정도를 확인하였다. 충해방제용 작물보호제 7종 중 dinotefuran은 처리 후 1일차에 사충율 74.1%로 보통독성을 보였다. 오이 흰가루병 및 노균병 방제용 작물보호제 8종 중 carbendazim은 처리 후 1일차 작물체 잔류독성에서 54.4%의 사충율을 보였으며, 오레가노오일 성분의 친환경유기농자재와 chlorothalonil 살균제도 쌍꼬리진디벌에 약한독성을 나타내었다. 하지만 처리 후 3일차에서는 모든 처리에서 사충율 25%미만의 저독성으로 나타나 처리 3일 이후부터 쌍꼬리진디벌 방사가 가능할 것으로 보인다. 실내 검정을 통해 저독성으로 확인된 flonicamid와 충해방제용 데리스추출물의 친환경유기농자재 및 살균제 tebuconazole을 오이 재배 하우스에 살포한 후 3일차에 쌍꼬리진디벌을 방사하고 7, 14, 21일차 진딧물 방제효과 및 쌍꼬리진디벌에 의해 기생된 진딧물 머미수를 조사한 결과 천적처리구와 천적+저독성작물보호제 처리구간에 통계적으로 유의미한 차이가 없었다. 따라서 선발된 저독성 작물보호제와 쌍꼬리진디벌은 진딧물 방제를 위한 혼용이 가능할 것으로 판단된다.

검색어: 목화진딧물, 기생성 천적, 저독성작물보호제

P145

Control effect to *Scotinophara lurida* (Burmeister) (Hemiptera: Pentatomidae) in peddy field using eco-friendly materials

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The black rice bug(*Scotinophara lurida*) possesses the ability to detect human pest management activities and can readily detach from rice plants, submerging itself in water as a means of evasion. Consequently, standard pest control strategies are frequently inadequate for achieving a significant reduction in its population density. Accordingly, a pest management strategy was formulated to coincide with the overwintering activities of the black rice bug and the timing of water removal from the rice paddies. Furthermore, the effectiveness of environmentally sustainable organic agricultural materials applicable to eco-friendly rice cultivation was evaluated for the control of the black rice bug. In prior studies employing accumulated degree days (ADD) to assess the overwintering generation of the black rice bug, it was established that the peak activity period for the overwintering generation in 2024 coincided with May 1st in both coastal and inland regions. The control timing for overwintering habitats was scheduled for May 10th, and the control timing after draining water from paddy field was scheduled for July 5th. The pest control agents utilized in this study comprised the chemical pesticide broflanilide+etofenprox (3.5% + 20%), the organic agricultural material rotenone (0.58%), and a proprietary formulation currently under development, referred to as 240801P. The chemical pesticides exhibited control efficacy exceeding 90% in both overwintering habitats and the main rice fields. In contrast, rotenone demonstrated a markedly lower efficacy of approximately 50%. The proprietary formulation 240801P similarly showed a control efficacy of about 50% in overwintering habitats; however, it achieved a significantly higher efficacy of 78% in the main rice fields.

Key words: *Scotinophara lurida*, Paddy field, Control stratigy, Organic materials

P146

Effect of soil mulching on reducing thrips infestation in *Mangifera indica*

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As a promising subtropical crop responding to climate change, the cultivation area of mango has significantly expanded. In particular, the Gyeongnam region, with its favorable climate, competitive quality, and diverse cultivation methods, presents substantial potential for mango to become a high-income crop. However, information on pests and diseases affecting mango remains limited. From 2022 to the present, we investigated mango farms in the Gyeongnam region and identified 8 types of diseases and 8 types of pests. Key pests identified in the Gyeongnam mango farms include Frankliniella occidentalis (Western flower thrips), Thrips palmi (Melon thrips), and Scirtothrips dorsalis (Chilli thrips). Damage from thrips species was observed consistently across farms, regardless of location or cultivation years. Thrips infestation significantly affected fruit quality and yield, with the extent of damage varying based on control methods and timing of application. Effective control of thrips, which are major pests for mango farmers, requires early implementation of preventive measures such as chemical pesticide applications and the use of sticky traps. Additionally, eco-friendly soil mulching has proven effective in reducing thrips populations. While the impact of soil mulching was minimal during the early stages of low infestation density, its effectiveness increased as thrips density rose.

Key words: *Mangifera indica,* Thrips species, Eco-friendly soil covering

P147

Insecticidal activity of the *Monochamus alternatus* on foliar spray insecticides acetamiprid and fenitrothion

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The *Monochamus alternatus* is a vector for pinewood nematodes and is a target forest pest for control in Korea. This study was conducted as a basic study to determine whether the effectiveness of insecticides (acetamiprid and fenitrothion) registered as adult *M. alternatus*beetle control agents differs across regional populations of *M. alternatus*. The LC_{90} values for acetamiprid were 30.7 ppm on day 3 and 5.6 ppm on day 5, and those for fenitrothion were 41.6 ppm and 31.6 ppm, respectively. In order to compare the efficacy responses of local populations using small numbers of individuals such as the *M. alternatus*, it is thought that single-concentration experiments should be conducted based on these results.

Key words: control, efficacy, lethal concentration, resistance, test insect,

P148

Control technology for bean flower thrips (*Megalurothrips usitatus* Bagnall) occurring on frijol (*Phaseolusvulgaris* L.) in Guatemala

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Frijol, a variety of common bean (*Phaseolusvulgaris* L.), is one of the most important crops in Guatemala, Honduras, El Salvador and Mexico in Central America. Recently, due to climate change, bean flower thrips (BST, *Megalurothrips usitatus*) has occurred on frijol fields in the dry corridor region, and led to a decline in productivity by 80-100%. Several insecticides were tested to control BST, and selected neem oil and spinosad which showed high control efficacy. Production of frijol in test plots ranged from 0.99 to 1.45 ton/ha depending on the variety, so this result will be disseminated to farmers by combining a blue sticky trap next season.

Key words: frijol, bean flower thrips, neem oil, spinosad

P149

The regional and host-specific differences in outbreak species of *Artaxa subflava* (Lepidoptera: Erebidae)

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Artaxa subflava, along with *Lymantria dispar* and *Hyphantria cunea*, is one of the typical outbreak species in South Korea. It exhibits polyphagous and gregarious characteristics, causing damage to various plants. This species can also induce urticaria and dermatitis due to the hairs of both adults and larvae. The first outbreak in Korea occurred in 1936 in Hwanghae-do, followed by a second in 1957 in Gangwon-do. Subsequently, large-scale outbreaks took place nationwide from 1958 to 1959. In recent years, a large number of populations have been observed. In this study, we investigate the distribution, host plants, environmental conditions, and feeding behavior at the time of discovery to analyze the factors contributing to these outbreaks. In 2023, approximately 1,000 individuals of Artaxa subflava were collected from 19 populations across 11 regions. To analyze population genetics, mitochondrial COI haplotype analysis was conducted, along with microsatellite marker-based studies. These included genetic structure analysis (STRUCTURE), genetic differentiation (Fst), and principal coordinates analysis (PCoA).

Key words: outbreak species, pest management, agricultural impact, population getentics

P150

Evaluation of susceptibility of fig weevil (*Aclees taiwanensis*) to commercial insecticides

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Fig tree farms in the southern region of Korea are experiencing difficulty in fruit production due to the outbreak of the fig weevil, *Aclees taiwanensis,* which has been confirmed since 2020. Effective management measures for *A. taiwanensis*, including the selection of insecticides, are still required. The susceptibility of fig weevil adults was evaluated using 23 commercial insecticides under laboratory conditions. Five insecticides (Carbaryl, Carbosulfan, Phenthoate, Cartap Hydrochloride, and Chlorantraniliprole + Thiamethoxam) resulted in the pest survival rate below 13.3%. These selected insecticides are expected to be effective against *A. taiwanensis* under field conditions.

Key words: *Aclees taiwanensis,* Fig tree, Insecticide, Susceptibility

P151

Evaluation of pesticide resistance in *Tetranychus urticae* Koch on hydroponically grown perilla in the Miryang region

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점박이응애(*Tetranychus urticae* Koch)는 전 세계적으로 널리 분포하며, 채소, 과수, 화훼 등 다양한 농작물에 피해를 입히는 주요 해충으로 특히, 잎들깨에서는 심각한 피해를 유발하여 농가에 경제적 손실을 초래하는 것으로 알려져 있다. 점박이응애는 짧은 세대기간과 빈번한 발생으로 인해 살충제 저항성이 쉽게 발달하여, 다양한 살충제에 대한 저항성이 보고되고 있다. 본 연구는 밀양지역 수경재배 잎들깨에서 발생한 점박이응애의 살충제 저항성을 확인하기 위해, 밀양지역에서 주로 사용되는 7종의 살충제를 대상으로 살충 효과 및 저항성 검정을 수행하였다. 그 결과, 스피로메시펜을 포함한 5종의 살충제에서 저항성이 확인되었으며, 사이에노피라펜 등 2종의 살충제는 약 80% 이상의 살충 효과를 나타냈다. 해당 결과는 밀양지역 점박이응애의 살충제 저항성을 확인하고, 각 농가의 방제 효율성을 높이는데 중요한 기초 자료로 활용될 것으로 기대된다.

검색어: 점박이응애, 수경재배, 잎들깨, 살충제, 저항성

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Comparison of *Apolygus spinolae* occurrence on jujube orchards in Boeun area

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애무늬고리장님노린재는 장님노린재과에 속하며 대추의 어린 순, 잎, 꽃이나 과실을 흡즙하여 피해를 주는 것으로 보고되어 있다. 대추과원에서는 대추 눈의 인편사이에 알 상태로 월동을 하며 4월부터 부화를 시작하여 활동을 시작하는데, 구침으로 식물의 즙액을 흡즙하며 식물에 피해를 준다. 피해를 받은 식물의 잎은 구멍이 생기거나 기형적으로 자라서 정상적인 생육이 어려워진다. 대추과원에서 발생 경향을 분석하기위하여 시기별 발생개체수를 조사하였다. 2024년 5월 1일부터 8월 31일까지 충청북도 보은군 대추농장 3개소를 실험장소로 하여 페로몬트랩을 설치하여 채집된 개체수를 조사하였다. 조사 결과, 노지 무방제 포장(A)에서는 38개체, 비가림재배 포장(B)에서는 17개체, 노지 포장(C)에서는 23개체가 채집되었다. 3곳 모두 5월 하순에 애무늬고리장님노린재 성충이 처음으로 발생하였다. 6월 1일부터 7월 15일까지 가장 많은 양이 발생하여 조사기간 중 누적발생량의 76.3%, 70.6%, 95.7%로 조사되었다. 7월 15일 이후에는 발생량이 급감하였고, 8월 15일 이후 노지무방제 포장(A)에서 애무늬고리장님노린재 성충이 발생되었다.

검색어: 애무늬고리장님노린재, 대추과원, 페로몬트랩

P153

Disinfestation treatment using ethyl formate with cold treatment to control *Bactrocera dorsalis* on mandarin

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Cold treatment is a internationally accepted method for disinfesting traded citrus of fruit flies, typically requiring exposure to 1.7°C for over 15 days to control *Bactrocera dorsalis*. However, this prolonged treatment could lead to logistical challenges and impact fruit quality. This study explored an alternative approach by combining ethyl formate (EF) fumigation with shorter cold treatment periods. Mandarin fruit inoculated with *B. dorsalis* was treated with 145 and 212 g·h/m³ EF, followed by cold treatment at 1.7°C for 5 and 7 days, respectively. The results suggest that EF fumigation can significantly reduce cold treatment duration while maintaining effective disinfestation. Future research will focus on large-scale experiments with statistically significant insect populations to validate EF fumigation combined with cold treatment as an internationally acceptable disinfestation method.

Key words: Ethyl formate with cold treatment, *Bactrocera dorsalis*, Quarantine disinfestation

P154

Evaluating integrated light and odor barriers for insect pest control efficacy

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This study evaluates the effectiveness of employing LED lighting and plant-derived odor barriers as a dual strategy for insect pest control. Utilizing a range of LED lights that emit specific wavelengths (580 nm to 585 nm) while reducing others (300 nm to 500 nm), combined with an anti-insect odor barrier derived from Cinnamomum verum, Illicium verum, and Artemisia annua, we aimed to determine their impact on the behavior and frequency of insect pests in real storage conditions. The findings reveal significant changes in the frequency of various insect orders, indicating a differential response to light wavelengths and odor barriers. Notably, the introduction of the anti-insect light and odor barriers resulted in a decreased frequency of Diptera and Hemiptera, suggesting a potential reduction in pest intrusion.

Key words: Artificial light at night, LED, Stored product, Stored insect, Anti-insect scent

P155

Import risk analysis of fresh mango from Ecuador

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농림축산검역본부는 국제기준(ISPMs) 및 국내 법에 따라 외국 농산물 수입 시 유입이 우려되는 병해충의 위험을 경감시키기 위하여 수입위험분석(IRA)을 수행하고 있다. 에콰도르산 망고는 2012년 에콰도르 측의 수입허용 요청 이후, 에콰도르산 망고에 발생하는 병해충에 대한 평가를 실시하고 그 결과에 따라 위험관리방안을 마련하여 2024년 4월 수입이 허용되었다. 에콰도르산 망고 생과실의 주요 우려병해충으로는 지중해과실파리(*Ceratitis capitata*) 및 *Anastrepha*속 과실파리류 4종(*A. fraterculus, A. obliqua, A. serpentina, A. striata*) 등이 있다. 해당 과실파리류의 위험경감을 위해, 재배지 예찰조사를 통한 저발생을 유지하고, 온탕침지를 통한 사멸처리를 해야하며, 다음과 같은 조건을 적용하였다. 46℃의 물 속에서 망고 무게 375g이하는 65분, 376-500g은 75분, 501-700g은 90분, 701-900g은 110분을 처리한다. 최근 메가 FTA의 발효 등으로 동등성, 지역화, 투명성 등이 강화되고 있고 과학적인 위험분석이 보다 요구된다. 이에 따라 농림축산검역본부는 전문성 강화를 위해 노력하고 있지만, 병해충 전문가들의 적극적인 관심과 협조 또한 필요하다.

검색어: 수입위험분석, 검역, 망고, 저발생 유지, 온탕침지

P156

Import risk analysis of fresh grapefruit from Texas, USA

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농림축산검역본부는 국제기준(ISPMs) 및 국내 법에 따라 외국 농산물 수입 시 유입이 우려되는 병해충의 위험을 경감시키기 위하여 수입위험분석(IRA)을 수행하고 있다. 미국 텍사스주산 자몽은 2015년 미국 측의 수입허용 요청 이후, 미국 텍사스주산 자몽에 발생하는 병해충에 대한 평가를 실시하고 그 결과에 따라 위험관리방안을 마련하여 2024년 6월 수입이 허용되었다. 미국 텍사스주산 자몽 생과실의 주요 우려병해충으로는 진균병(*Septoria citri*), 장미둥근홈바구미(*Pantomorus cervinus*), 멕시코과실파리(*Anastrepha ludens*), *Argyrotaenia citrana* 등이 있다. 해당 병해충들은 세부적인 방법은 다르지만 시스템즈 어프로치를 적용하여 예찰조사, 재배지검역 등을 통한 무발생포장 증명을 위험관리방안으로 적용하였다. 최근 메가 FTA의 발효 등으로 동등성, 지역화, 투명성 등이 강화되고 있고 과학적인 위험분석이 보다 요구된다. 이에 따라 농림축산검역본부는 전문성 강화를 위해 노력하고 있지만, 병해충 전문가들의 적극적인 관심과 협조 또한 필요하다.

검색어: 수입위험분석, 검역, 자몽, 시스템즈 어프로치

P157

Import risk analysis of fresh pomelo from Vietnam

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농림축산검역본부는 국제기준(ISPMs) 및 국내 법에 따라 외국 농산물 수입 시 유입이 우려되는 병해충의 위험을 경감시키기 위하여 수입위험분석(IRA)을 수행하고 있다. 베트남산 포멜로는 2018년 베트남측의 수입허용 요청 이후, 베트남 포멜로 발생 병해충에 대한 평가를 실시하고 그 결과에 따라 위험관리방안을 마련하여 2024년 7월 수입이 허용되었다. 주요 우려병해충으로는 과실파리류 4종(*Bactrocera carambolae, B. correcta, B. cucurbitae, B. dorsalis*) 및 나비목 2종(*Citripestis sagittiferella, Prays endocarpa*)이 있다. 과실파리류 4종은 증열처리를 통한 사멸처리를 해야하며, 다음과 같은 조건을 적용하였다. 포화증기를 이용하여 과육 중심부 온도 47℃ 이상 도달 후 20분 또는 46.5℃이상 도달 후 40분간 증열처리한다. 나비목 2종은 시스템즈 어프로치를 적용하여 예찰조사를 통한 저발생유지, 절개검사를 통한 무감염 증명을 위험관리방안으로 하였다. 최근 메가 FTA의 발효 등으로 과학적인 위험분석이 보다 요구되기 때문에, 농림축산검역본부는 전문성 강화를 위해 노력하고 있지만, 병해충 전문가들의 적극적인 관심과 협조 또한 필요하다.

검색어: 수입위험분석, 검역, 포멜로, 증열처리, 시스템즈 어프로치

P158

Occurrence characteristic of *Scirtothrips dorsalis* to kiwifruit in plastic-film house in Jeju, Korea and control using organic agricultural materials

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The damage of citrus by *Scirtothrips dorsalis* Hood appears since 2007 in Jeju, and recently they have also been damaging kiwifruit, but there is no information of their occurrence characteristics and control measures. This study was conducted from 2022 to establish the occurrence characteristics and control measures for *S. dorsalis* occurring to kiwifruit in plastic film house in Jeju. As a result, The *S. dorsalis* occur throughout the year in plastic film house, with the main occurrence period being July to October. In Particular, Sine the pesticides that can applied after September are limited, a pest control strategy using organic agricultural materials was necessary. For control of *S. dorsalis,* five types of plant extracts, two types of insect-pathogenic fungi were used to select organic agricultural materials, and control effects were 55.6~92.6%. Among them, three materials with high pest control effects were selected and tested for efficacy and phytotoxicity on kiwifruit sapling. As a result, the pest control effects of the extracts of 70% Derris, 90% of Sophora, and 60% of Neem were 55.6~92.6% and there are no phytotoxicity. As pest occurrence patterns change due to climate change, it is thought that research using organic agricultural materials should be expanded to comply with PLS(Positive List System).

Key words: Scirtothrips dorsalis, Kiwifruit, Occurrence characteristic, Organic agricultural materials, Control

P159

Chromosome-level genome assembly of a Plusiinae pest, *Ctenoplusia agnata* (Lepidoptera: Noctuidae)

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Ctenoplusia agnate is a polyphagous pest of bean crops and cruciferous vegetables in several East Asian countries, including Korea. Occasionally, it causes outbreaks in some areas and significant damage. As of September 2024, 10 species of the Subfamily Plusiinae, including *C. agnate*, have been registered in NCBI. Here, we present the chromosome-level genome assembly of a Korean C. agnate (Yanggu strain, looper_JK_23b) obtained using PacBio Revio long-read (ca. 235X) sequencing with Pore-C scaffolding. The final assembly (ASM4114632v1, 406.7Mb) consists of 70 scaffolds, of which the most significant 31 scaffolds account for 95.1% of the assembly, confirming the expected number of chromosomes (n = 31). Complete BUSCOs values were 98.8% and 36% GC contents. Scaffold N50 was 13.2 Mb, Scaffold L50 was 14, and Repeat contents were 28.57%. Based on this assembly, genome annotation predicted 12,726 protein-coding genes and 12,635 genes were functionally annotated. The Plusiinae, which includes *Trichoplusia ni*, a globally important pest, is essential not only as a pest but also for understanding the evolution of Noctuidae. Therefore, the genome information of *C. agnata* obtained in this study will provide vital information for understanding the evolution of Noctuidae and Plusiinae.

Key words: *Ctenoplusia agnata*, genome assembly, Plusiinae, Noctuidae, host-insect evolution

P160

RNAseq-based carboxylesterase *Nl-EST1* gene expression plasticity identification and its potential involvement in fenobucarb resistance in *Nilaparvata lugens*

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Carbamate insecticides have been used for over four decades to control brown planthopper *Nilaparvata lugens*, but resistance has been reported in many countries, including Korea. Compared to the susceptible strain, the 2015 and 2019 strains exhibited resistance levels 3.27 and 24.02 times higher, respectively. To elucidate the reason for the varying levels of resistance to fenobucarb in these strains, mutations in the *ACE1* gene, the target gene of carbamate, were investigated, but no previously reported mutations were confirmed. Through RNAseq analysis focusing on the expression of detoxification enzyme genes as an alternative resistance mechanism, it was found that the carboxylesterase gene *Nl-EST1* was overexpressed 2.4 times in the 2015 strain and 4.7 times in the 2019 strain compared to the susceptible strain. This indicates a strong correlation between the level of resistance development in each strain and the expression level of *Nl-EST1*. Previously, *Nl-EST1* was reported in an organophosphorus insecticide-resistant strain of Sri Lanka 2000. Thus, *Nl-EST1* is crucial for developing resistance to organophosphorus and carbamate insecticides. Resistance-related genes such as *Nl-EST1* could serve as expression markers for resistance diagnosis, and it can apply to integrated resistance management of *N. lugens*.

Key words: Brown planthopper, carbamate resistance, RNA-seq analysis, *Nl-EST1*, metabolic resistance

P161

Plasticity in gene expression patterns in response to sub-lethal dose treatment in an etofenprox-resistant population of white-backed planthopper, *Sogatella furcifera*

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White-backed planthopper (WBPH) is a sap-sucking pest that affects rice crops in various Asian countries, including Korea. A bioassay was conducted on three WBPH populations collected from rice fields to assess the effectiveness of different insecticides. Induction tests were performed on the Jindo population using etofenprox at LC_{10} (25 ppm) and LC_{30} (100 ppm) concentrations. The gene expression patterns were compared with those of the untreated sample. The analysis indicated that the 25 ppm treatment group exhibited the most significant difference in gene expression compared to the untreated group, suggesting a notable individual variation in response to low-level sub-lethal doses. It was hypothesized that more genes could be regulated diversely when exposed to sufficiently surmountable foreign substances. However, when the population was exposed to etofenprox at a concentration of about 100 ppm or higher, the gene expression pattern remained consistent across repetitions. Instead, it was found that the gene expression pattern became similar to that of the untreated group. These findings highlight the complex and dose-dependent nature of gene expression responses to etofenprox in WBPH, suggesting potential resistance mechanisms and the importance of considering sub-lethal effects in pest management strategies.

Key words: White-backed planthopper, insecticide resistance, RNA-seq analysis, mutation, metabolic resistance

P162

Introduction of auto-rolltrap and its application

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Monitoring is the most important method for an efficient and effective pest control. However, more labor and higher expenses are required. For monitoring pests, colored sticky traps have been used for those small insects like thrips, aphids, whiteflies, etc and also such sex pheromone traps as delta trap, wing trap, and so on have been used sticky plate for capturing lepidopteran pests. Auto-Rolltrap was developed to monitor insect pests having been conduced with those traps. One of the signature of Auto-Rolltrap is a self refreshing function. A part of a roll-typed sticky trap in the trap is unwrapped and exposed to the outside for capture. Captured pests on the exposed are taken by dual cameras inside while wrapping. All images taken are sent to the server for user. This make it possible the unmanned monitoring for a long time until a roll-type sticky trap are consumed.

Key words: Auto-Rolltrap, Insect, Monitoring

P163

Biological control potential of the insecticidal beauvericin produced by *Beauveria bassiana* 331R against cotton aphid

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Beauveria bassiana was identified as an eco-friendly alternative to chemical pesticides, producing lethal blastospores and secondary metabolites that weaken insect immunity. This study focused on mass-producing the insecticidal metabolite, beauvericin (BEA) from *B. bassiana* 331R and assessing its effectiveness against cotton aphids. While carbon sources did not significantly impact metabolite production, different nitrogen sources notably affected yields. BEA production surpassed 10 ppm with bacto-peptone and skim milk. A combination of yeast extract and skim milk resulted in over 300 ppm of BEA. When 30 ppm of BEA was applied to cotton aphids, it achieved 83% insecticidal activity by the third day. The findings demonstrate the potential of the metabolite for sustainable pest control in agriculture, contributing to eco-friendly crop protection strategies.

Key words: *Beauveria bassiana*, bioinsecticide, beauvericin, cotton aphid

P164

Prediction of stink bug density when creating a new eco-friendly apple orchard Possible ways to utilize surrounding environment analysis

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This study selected five eco-friendly apple orchards and categorized the surrounding environment into farmland, buildings, and forest patches. The analysis revealed a positive (+) correlation between the forest environment patches and stinkbug population density, while a negative (-) correlation was observed with the surrounding farmland patches. No correlation was found between the building environment patches and stinkbug population density. The correlation coefficient between the oak species patches within the forest environment and stinkbug density was found to be 0.9, indicating a very strong positive correlation.

Key words: Eco-friendly apple orchard, Stinkbug, Environmental patching, Oak species

P165

Evaluation of insecticidal ingredients and efficacy of extracts from pyrethrum flowers cultivated in South Korea

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Research on using plant extracts for eco-friendly pest control is being conducted worldwide to reduce reliance on chemical products. While pyrethrum plants are widely recognized as a source of pyrethrin for insecticides, studies focusing on the extraction and efficacy of products from Korean-grown plants remain limited. This study compared methods to extract pyrethrins from Dalmatian variety grown in Korea. Furthermore, it examined the efficacy of the isolated pyrethrin-containing extracts against three plant pests. Pyrethrin extracts from the Dalmatian variety were used for further studies. The amount of pyrethrins extracted increased with the ethanol concentration used for extraction, reaching the highest level (6,064 ppm/100 g dry flower mass) with 95% ethanol. Total pyrethrin content and the pyrethrin I/II ratio were highest in flowers harvested at full bloom. *In vitro* bioassays of the extract showed LC50 values of 34 ppm for green peach aphids, 69 ppm for cabbage diamondback moth larvae, and notably, 0.1 ppm for juveniles of the root-knot nematode. These findings indicate that the ethanol extract from Dalmatian flowers grown in Korea could serve as a valuable alternative for developing botanical pesticides. These results suggest the potential of extracts from Korean-grown *T. cinerariifolium* var. Dalmatian flowers in providing effective and eco-friendly control of plant pests in local agriculture

Key words: *Tanacetum cinerariifolium*, Pyrethrins, Botanical extract, Bio-insecticides

P166

Establishing the optimum cultivation methods for pyrethrum in Korea

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The pyrethrin extracted from *Tanacetum cinerariaefolium* accounts for two-thirds of the global plant-based insecticide market and is registered as a material that can be used in all countries worldwide. However, due to insufficient research on domestic cultivation techniques for *T. cinerariaefolium*, a study was conducted to establish cultivation methods by investigating the growth (plant height, width) and flower characteristics (flower weight) and flower yield (number of flowers per plant) of *T. cinerariaefolium* varieties (Gyetong 0721 and Dalmatian) under different planting densities (30×30cm, 30×40cm, 30×50cm, 40×40cm). The plant height of Dalmatian *T. cinerariaefolium* was significantly greater than that of the Gyetong variety at planting densities of 30×30cm and 30×40cm, compared to 30×50cm and 40×40cm. The width was also significantly greater for Dalmatian *T. cinerariaefolium* at all planting densities than for the Gyetong variety. There were no significant differences in flower yield across different planting densities. Pyrethrin contents were significantly higher in pyrethrin preparations from *T. cinerariifolium* var. Dalmatian compared to a French-imported cultivar, Gyetong. Our results indicated although there was no significant difference in flower yield between the Gyetong variety and Dalmatian *T. cinerariaefolium*, the Dalmatian variety demonstrated a higher pryethrin content, indicating its superior for cultivation where high pyrethrin levels desired.

Key words: *Tanacetum cinerariifolium*, Pyrethrins, Bio-insecticides, Cultivation Techniques

P167

Seasonal occurrence patterns of mature *Ephemera orientalis* nymphs in Han River

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Ephemera orientalis is known for its mass emergence in spring and autumn. To understand its life cycle and emergence patterns, *E. orientalis* nymphs were monitored at three sites along the Han River from 2023 to 2024. Mature nymphs, characterized by dark wingpads, were grouped based on occurrence timing and the head capsule width (HCW) using the K-means algorithm. Emergence timing of each group was modeled as a log-normal function of degree-days (DD) (> 8.51 °C). In spring, a single size group (mean HCW = 2.02 mm) of mature nymphs occurred at approximately 364 DD across all sites. In contrast, the emergence patterns of mature nymphs in autumn exhibited variation among the study sites. Two size groups (mean HCW = 1.63 mm, 2.73 mm) emerged at 1,718 DD at Gungchoncheon and Dangjeong Island, while a single size group (mean HCW = 1.87 mm) emerged at 2,785 DD at Wangsukcheon. This study highlights the potential impact of environmental factors and habitat characteristics on the growth and emergence of *E. orientalis*, and suggests the necessity for continuous monitoring to provide a detailed life cycle analysis.

Key words: oriental mayfly, burrowing mayfly, mass emergence, phenology

P168

Ecosystem-disturbing insects in Environmental impact assessment area

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환경영향평가 자연생태환경 분야의 환경보전목표 설정 시 생태계교란 생물 분포 현황 및 미치는 영향 정도를 고려해야 하며, 생태계교란 생물에 대한 관리 방안 및 관리 계획을 수립하여야 한다. 현재 곤충 은 꽃매미, 미국선녀벌레 등 9종이 생태계교란 생물로 지정되어 관리 중이다. 본 연구에서는 2021년에 접수된 환경영향평가서 120건을 대상으로 개발지 유형에 따른 생태계교란 생물 중 곤충의 출현 양상을 파악하였다. 분석 결과 51개의 사업에서 교란 곤충이 확인되었고, 꽃매미 36개 사업, 미국선녀벌레 22개 사업, 갈색날개매미충 20개 사업순으로 확인되었다. 13가지의 사업 유형 중 도시개발 사업과 산업단지 조성사업에서 생태계 교란종이 가장 많이 확인되었다. 교란종이 확인된 51개 사업 대상지의 식생보전등급은 Ⅴ등급지 78%, Ⅳ등급 11%, Ⅲ 10.5%로 식생보전등급이 낮은 지역에서 교란 곤충의 출현 빈도가 높게 나타났다. 본 연구 결과는 환경영향평가 사업 유형 및 개발 대상지 식생보전등급에 따른 생태계교란 생물에 대한 출현 양상을 예측하고 이에 대한 관리 계획을 수립하는데 기초자료로 활용될 수 있을 것으로 사료된다.

검색어: 환경영향평가, 생태계교란 생물, 꽃매미, 갈색날개매미충, 미국선녀벌레

P169

Influence of climate on the occurrence pattern of pine caterpillar, *Dendrolimus spectabilis* (Lepidoptera: Lasiocampidae) based on monitoring records

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기후가 솔나방 개체군 동태에 미치는 영향을 분석하기 위해 1968년부터 2000년까지 국립산림과학원 전국 22개 고정조사지에서 수집된 자료를 분석하였다. 솔나방 밀도는 매년 5월, 10월에 조사하였다. 고정조사지내 소나무 수관 상부와 하부 가지를 1개씩 임의적으로 선택하여 가지 100cm^{2}당 유충 밀도를 조사하였다. 고정조사지 당 조사 본수는 20본이었으며 각 조사목간 간격은 최소 5m 이상이었다. 기후자료는 북반구 지표 평균 기온, Nino 3.4 지역 (열대태평양의 엘니뇨, 라니냐 감시구역) 평균 수온의 anomaly 값을 활용하였다. 통계분석은 cross convergent mapping 방법을 활용하였다. 솔나방 밀도는 1970년 대발생 이후 급격히 감소하는 경향을 보였다. 북반구 평균 기온과 Nino 3.4 지역 평균 수온 anomaly 모두 솔나방 밀도 변동에 영향을 주었으나 북반구 평균 기온의 영향이 상대적으로 큰 것으로 확인되었다.

검색어: 개체군, 기후, 모니터링, 솔나방, 시계열분석

P170

2024 parasitism survey of *Anastatus orientalis* (Hymenoptera: Eupelmidae), released for biological control of spotted lanternfly

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The parasitism rate of *A. orientalis* was investigated in 2024, following surveys conducted in 2022 and 2023. For the survey, 34 SLF egg masses were collected from each of the sites in Buyeo and Gimje. Insects that had hatched were identified based on hatching marks (hole-type) on the collected egg masses. Egg masses from which wasps were still emerging were excluded from the parasitism rate calculation. The average parasitism rates in Buyeo and Gimje were 11.11% and 14.09%, respectively, showing a significant decrease compared to the average parasitism rates of 46.76% and 72.37% at each site in 2023.

Key words: egg parasitoid, field invertigation

P171

Ecological characteristics and damage analysis of *Anoplophora horsfieldii*

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Anoplophora horsfieldii(Hope, 1843), 국명 노랑알락하늘소(가칭)는 아열대성 기후지역(중국, 인도, 라오스, 대만, 태국 등)에 주로 분포한다. 팽나무속, 동백나무류, 멀구슬나무, 종가시나무 등이 기주로 알려져 있으며 성충은 살아있는 나무를 섭식하여 산란하고 유충은 목질부로 파고들어 가해한다고 한다. 외국에서는 팽나무에서 많이 발생하는 것으로 알려져 있으나, 생태적 특성에 대하여 불분명한 점이 많다. 2019년 제주도 용연계곡에서 처음 발견되었으며, 2023년에 국내 정착이 보고되었다. 제주도는 팽나무, 동백나무, 종가시나무 등이 많이 분포되어있기 때문에 노랑알락하늘소에 대한 위협을 많이 받고 있는 실정이다. 실내에서 가지의 굵기에 따른 노랑알락하늘소의 섭식과 산란 선호성을 조사하였다. 실내 케이지 환경에서 암컷 성충은 주로 직경 50mm 이상 굵기의 산란목에 성공적으로 산란하였으며, 섭식은 직경 2~3mm의 가지를 포함하여 가는 가지를 선호하였다. 기타 제주에서 성충 발생정도와 팽나무 피해에 대하여 고찰하였다.

검색어: 노랑알락하늘소, 제주도, 팽나무, 산란목, 가지 섭식

P172

Seasonal prevalence of the western conifer seed bug, *Leptoglossusoccidentalis* Heidemann from cone of Korean white pine and diurnal activity time

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소나무허리노린재는(*Leptoglossus occidentalis* Heidemann)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 가평군 잣나무 구과에서 피해가 확인되었다. 잣나무 구과는 산림에서 경제적으로 매우 중요한 소득작물로 이로 인한 피해가 문제가 되기 시작하였다. 잣나무 구과에서 소나무허리노린재 발생소장 조사를 위해 2021년부터 2023년 까지 3년간 경기도 가평군 5개 지역의 잣나무 상부에 타임랩스 카메라(TLC2020,Brinno)설치하고 영상분석을 통해 잣 구과에서 소나무허리노린재 발생소장을 조사한 결과, 4월부터 11월 초순까지 잣나무 구과에서 활동이 관찰되었으며, 연간 2세대 발생하는 것으로 추정되었다. 잣나무 구과에서 오전 6시부터 오후 8시까지 모든 시간대에서 관찰되었으나, 오전보다는 기온이 올라가는 오후에 관찰되는 개체가 많았다.

검색어: 소나무허리노린재, 발생소장, 잣나무 구과, 일주활동, 타임랩스 카메라

P173

Distribution of orchard Coloptera communities in the Honam region

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농경지 생물상 변동 평가의 일환으로 호남권 과수원에서 채집된 딱정벌레목을 대상으로 군집분석을 실시하였다. 대상작물(조사지역)은 사과(무주), 배(부안), 블루베리(완주), 복숭아(익산), 단감(담양)이었다. 조사지점으로 각 작물별 친환경 및 관행재배지 1지점씩 총 10지점을 선택하였다. 재배양식별 딱정벌레목의 발생 상황을 조사한 결과, 5작목 모두 관행재배보다 친환경재배에서 종 풍부도가 높은 것으로 나타났다. 과수원에서 딱정벌레 군집간에 조사 위치에 따른 관계를 보면, 과수원 내부와 과수원 둑 간의 두 군집 대부분이 겹쳐 서로 큰 차이가 없는 것으로 판단된다. 과수 종류와 딱정벌레목 군집간의 관계를 보면, 복숭아와 블루베리, 사과와 단감 간에 유사성이 나타나며, 나머지 작물과는 유사성이 적고, 단감과 블루베리는 약간 겹치나 유사성이 있다고 보기 어려웠다. 배는 다른 작목과 유사한 부분이 없는 것으로 나타났고, 거리상 사과보다는 블루베리와 유사하게 나타나는 것으로 판별되었다. 이러한 결과는 앞으로 친환경재배에서 생물다양성의 가치를 재조명하는 자료로 활용이 기대된다.

검색어: 과수원, 딱정벌레목, 관행, 친환경, 분포

P174

Outbreak of *Pimelocerus perforatus* (Coleoptera: Curculionidae) on the cultivated olive tree, a newly introduced crop, in Korea

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Pimelocerus perforatus (Roelofs) is an herbivore on woody plants of the family Oleaceae, native to Northeast Asia. It causes minimal economic and ecological harm in native landscapes, maintaining small population sizes. However, its destructive nature has been discovered on cultivated olive trees, *Olea europaea* L., a crop of Mediterranean origin, in Japan. More severe damage was recently reported in China on the green ash trees, *Fraxinus pennsylvanica* Marshall, another introduced Oleaceae tree. In Korea, serious infestations were recognized from two localities in west Jeju-do, for the first time in 2023, with 84 percent of mortality and 49 percent of morbidity. It discusses the host preference shift of *P. perforatus* from native to introduced Oleaceae trees and the potential for the weevil to become an invasive non-native pest outside the native range, affecting both agricultural, urban and forestry landscapes.

Key words: Climate change, introduced crop, non-native induced outbreak, potentially invasive pest

P175

Parasitic rate of *Phanuromyia ricaniae* (Hymenoptera: Scelionidae) against *Ricania* spp. (Hemiptera: Ricaniidae) in 2024

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Ricania spp. (Hemiptera: Ricaniidae) is a sporadic pest that can cause significant damage to economically important fruit and ornamental trees in agricultural and mountainous areas. This pest punctures young branches and lays eggs, leading to branch damage and interrupted plant growth. The egg-parasitic natural enemy of *Ricania* spp., *Phanuromyia ricaniae*, was identified in 2015 in Gurye, Jeollanam-do, South Korea, and its temperature-dependent developmental characteristics and overwintering behavior have been studied extensively. In 2024, we investigated the egg parasitism rate of *Phanuromyia ricaniae* by collecting egg masses from various regions. The study confirmed the distribution of this natural enemy across several previously unreported areas, suggesting a wider range than earlier studies indicated. These findings provide fundamental data for the development of effective management and ecological strategies to control *Ricania* spp.

Key words: *Ricania* spp., *Phanuromyia ricaniae*, Egg mass, Parasitism

P176

Damage and morphological characteristics of *Syllepte pallidinotalis* in vineyards

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국내 포도 주요 재배 품종인 '캠벨얼리'에서 잎의 가장자리를 말고 그 속에서 갉아먹는 해충의 피해가 흔하게 관찰되고 있으며 기존에 포도들명나방이라고 알려져 있었다. 포도원에서 포도잎을 가해하는 유충을 사육하여 얻은 성충의 유전자와 생식기를 검정한 결과 연무늬들명나방으로 동정하였다. 연무늬들명나방의 형태적 특징은 다 자란 유충은 몸길이가 18mm 정도이며 1~3마디와 9~10마디 위에 검은색의 무늬가 있다. 번데기는 몸길이가 10mm 정도이며 진한 갈색이고 성충은 몸길이가 12mm 정도이며 연갈색으로 앞날개 전연부 중간에 노란색의 원형무늬가 있다. 유충에 의한 피해는 6~9월에 나타나며 가을이 되면 다 자란 유충이 땅으로 떨어진 후 낙엽으로 타원형이나 불규칙한 원형의 고치를 짓고 그 속에서 월동하며 우리나라에서 출판된 포도 해충 관련 책자에 기록된 포도들명나방(*Herpetogramma luctuosalis*)과는 형태적 으로 차이가 뚜렷한 특징이 있다.

검색어: 포도, 연무늬들명나방, 특징

P177

Climate change and pest occurrences in major apple cultivation area

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사과는 국내 주요 6대 과종 중 하나로 많은 재배면적을 차지하고 있다. 최근 기후변화는 전 세계적인 문제로 대두되고 있다. 국내 사과 주요 재배지의 기온변화와 해충발생에 대하여 분석하였다. 영주와 의성 두 지역의 연도별 1~6월 사이에는 온도가 높아지는 경향을 보였으며 연도별 월 평균기온의 변동이 컸다. 통계적으로 유의하게 변화가 있는 월은 1, 2, 3, 5, 6, 9, 10, 11월이었다. 특히 1, 2, 3월의 증가율이 높고 3월의 증가율이 온도 상승에 30%로 가장 크게 기여하였다. 1997년부터 2022년 최근 25년간 군위지역 연평균온도 변화는 연간 차이가 나타났지만, 재배지 월평균기온과 같이 증가하는 경향은 뚜렷이 나타나지 않았다. 군위지역에서 사과에 피해를 주는 3종 나방류와, 2종 노린재류의 초 발생일과 1세대 발생최성기, 발생량의 선형회귀분석 결과 복숭아순나방, 복숭아심식나방, 사과굴나방의 통계적으로 차이는 없었으나 연도별 발생시기의 변동폭이 큰 것으로 나타났다. 발생량은 복숭아순나방의 발생밀도는 줄어든 반면, 복숭아심식나방은 증가하였으며, 사과굴나방은 차이가 없었다. 갈색날개노린재와 썩덩나무노린재의 초발생일은 차이가 없었으나, 1세대 발생최성기는 썩덩나무노린재에서 빨라지는 경향을 보였고, 발생밀도는 증가하였다.

검색어: 사과, 기후 변화, 해충, 발생

P178

A preliminary study on dispersal potential of the introduced grey house spider *Badumna longinqua* in Korea using species distribution modeling

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Badumna longinqua (Araneae: Desidae) is known to native in Australia and widely introduced worldwide. This species has been continuously observed around several southern coastal cities in Korea since 2021. In this study, current distribution range of this invasive spider species is estimated by using a species distribution model algorithm, maximum entropy model (MaxEnt), based on species records obtained in Korea. Additionally, two future climate change scenarios, RCP 4.5 and RCP 8.5, are used along with bioclimatic variables from the UKESM model to predict its potential distribution in the 2050s. As a result, the distribution range of *B. longinqua* is assumed throughout the southern coastal region of Korea under RCP 4.5, and even to be expanded into inland under RCP 8.5 scenario in the future.

Key words: Araneae, *Badumna longinqua*, climate change, invasive species, species distribution model

P179

Current status of coffee pests in Uganda

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Uganda is the 8th largest coffee exporter in the world and the 2nd largest in Africa, and many people depend on the coffee industry for their livelihood. However, the threat of pests and the lack of knowledge about them are negatively affecting coffee production in Uganda. In this study, we will discuss the characteristics and control methods of two major pests that occur in Ugandan coffee farms: the coffee berry borer (CBB, *Hypothenemus hampei* Ferrari) and the black coffee twig borer (BCTB, *Xylosandrus compactus* Eichhoff). CBB occurs mainly in lowlands and damages coffee fruits, while BCTB penetrates branches, causing yield reduction and pathogen infection. In order to control these threatening pests, research is needed on economical and sustainable control methods that apply not only chemical pesticide selection but also timely cultivation, shade tree planting, resistant variety cultivation, and integrated pest management (IPM). In addition, precision agriculture(PA) using artificial intelligence(AI) will also be a good means of responding to pests in the future.

Key words: coffee, management, *Hypothenemus hampei Xylosandrus compactus*, Uganda

P180

Growth period by temperature of *Pluterlla xylostella* (Linnaeus) (Lepidoptera: Plutellidae)

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배추좀나방(Pluterlla xylostella)은 나비목(Lepidoptera) 좀나방과(Plutellidae)에 속하며, 주로 배추과 식물(배추, 양배추, 무, 케일 등)을 가해하여 막대한 피해를 주며, 전 세계적으로 분포하고 있는 광역 해충이다. 우리나라에서는 1980년대 후반부터 중요해충으로 등장하였고, 제주도와 대관령을 포함한 모든 지역으로 분포가 확산되어 발생중이다. 배추좀나방을 6개 온도(15.0, 20.0, 25.0, 30.0, 32.5, 35.0℃), 65±5%, 16L:8D의 조건에서 발육기간을 조사하였다. 알부터 번데기까지의 발육기간은 각각 47.4, 27.0, 15.4, 11.9, 10.6 및 10.9일이었고, 발육영점온도는 10.5℃, 유효적산온도는 232.6DD였다. 성충의 생존기간은 각각 16.5, 16.8, 9.7, 7.5, 6.4 및 5.0일이었다.

Key words: 배추좀나방, 발육기간, 생존기간

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Patterns research of termite damage in wooden cultural heritage in Korea

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흰개미는 생태계 내에서는 고목을 섭식하여 분해하는 분해자 역할을 하지만 인간세계에서는 목조 건축물을 가해하여 구조적인 문제를 초래하는 해충으로 알려져 있다. 우리나라에 서식 중인 흰개미는 지중 흰개미 로 외부에 노출하지 않고 땅속에 서식처를 만들어 서식하기 때문에 쉽게 발견하기 어렵다. 이 때문에 흰개미는 외부로 노출하지 않은 채 목재 내부로 침투해 속을 비우는 공동화 현상을 일으켜 겉으로 보기엔 멀쩡해 보이는 기둥도 속이 비어 피해가 심각한 경우에는 건물이 무너질 수 도 있어 목조건축물에서는 매우 위험한 해충으로 보고되어 있다. 우리나라에 분포하는 사찰들은 대부분 산속지형에 있기 때문에 흰개미가 주로 서식하는 산림지대와 매우 가깝게 있어 흰개미 가해 영역에 포함되어 있다. 이러한 목조건축물은 국보, 보물 및 국가 민속 문화유산으로 지정된 문화유산으로 보존 및 관리가 필요하다.

국립문화유산연구원에서는 2011년부터 전국의 국가 지정 목조문화유산에 대한 생물피해 조사를 정기적으로 실시하여 흰개미 및 다른 가해 해충에 의한 피해 여부를 조사하고 있다. 조사 방법으로는 흰개미 탐지견의 후각을 이용하여 흰개미를 탐지하거나 육안으로 보이는 피해여부와 흰개미가 서식할만한 주변 환경 등을 파악하여 기록하였다. 조사 결과는 매년 정리하여 보고서를 발간하였으며 국내 연구자들이 공동으로 활용할 수 있도록 배포하였다.

검색어: 흰개미, 목조문화유산, 목조건축물, 생물피해

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Seasonal occurrence of major insect pests by cropping period in green bean (*Phaseolus vulgaris*) greenhouse

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기후변화 대응과 새로운 소득작물로 아열대작물이 도입되어 재배면적이 증가하고 있는데, 이중 그린빈은 아메리카 중남부가 원산지인 콩과 작물로 최근 수요가 증가하면서 재배면적이 확대되고 있다. 봄 재배 그린빈에서 총채벌레류는 생육초기부터 28% 이상의 잎에 발생하였고 6월부터는 95% 이상의 피해엽률이 발생하여 가장 큰 피해를 주는 해충이었다. 굴파리류는 생육초기부터 발생하여 피해를 주었으며, 응애류는 5월 하순부터 발생하였다. 여름 재배 그린빈에서 굴파리류와 가루이류는 7월 하순부터 발생이 급증하여 생육후기까지 큰 피해를 주었다. 총채벌레류와 응애류는 생육초기에 발생과 피해가 적었으나 8월 중순부터 피해가 증가하였다. 이에 따라 그린빈 주요 해충의 방제적기로 봄 재배는 5월 중순, 여름 재배는 7월 하순으로 판단되었다.

검색어: 아열대채소, 그린빈, 해충, 방제적기

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Seasonal occurrence of major moth pests in Jeonbuk, Korea

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최근들어 평균 온도가 평년보다 높게 경과하는 등 기상환경이 변화됨에 따라 2024년 4월부터 전북지역(정읍, 김제, 고창, 부안) 밭 작물에 발생하는 멸강나방, 열대거세미나방, 파밤나방, 담배거세미나방, 담배나방의 발생소장을 성페로몬트랩으로 조사하였다. 조사기간 중 담배거세미나방>파밤나방>담배나방 순으로 발생이 많았다. 담배거세미나방과 파밤나방은 각각 4월 하순과 4월 중순부터 채집되기 시작하여 1차 발생최성기는 6월 하순이었고, 8월부터 채집밀도가 급증하는 경향이었으며 고창과 부안에서 채집량이 많았다. 담배나방 발생량은 5월 하순부터 증가하였고 멸강나방은 5월 상순부터 6월 하순까지만 채집되고 이후에는 없었다. 열대거세미나방 채집량은 9월부터 증가하였다.

검색어: 성페로몬트랩, 나방, 발생소장

P184

An improved rearing method for western flower thrips, *Frankliniella occidentalis*

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After rearing the yellow flower thrips in various ways, I would like to introduce an improved rearing method that saves time and space. The improvements include using the harvested cotyledons as they are without washing them, and maintaining the humidity inside the breeding dish by using dental cotton swabs during the egg collection period, and supplying moisture from outside the breeding dish until the pupae emerge after egg collection. This method can be used to stack breeding dish in layers, especially during the larval and pupal stages. Egg collection dish can also be stacked in steps during the adult stage. By doing this, the time required to prepare the egg collection dishs was reduced by 64-71% compared to the existing method, the area occupied by 10 egg collection dishs was reduced to 62%, and the area occupied by 10 larval and pupal breeding dishs was reduced to 7% (93% savings).

Key words: bioassay, humidity maintenance, kidney bean, test insect

P185

Identification of pest species and assessment of their damage in corn cultivation in Korea

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Due to climate change, new pest species have emerged in corn cultivation areas, and pest occurrence patterns have shifted. Damage to corn ears caused by stink bugs and the outbreak of *Spodoptera frugiperda* (fall armyworm) in 2019 have emerged as new issues for corn production. This study identified the major pests affecting corn and assessed the damage they caused. *Ostrinia furnacalis* (Asian corn borer) was observed nationwide, causing over 50% damage in some regions. *S. frugiperda* larvae were observed in Jeju (early May), Boseong-gun (mid-June), and Gyeongju-si (late July), causing approximately 5% damage. Stink bugs were observed in most monitoring areas, causing sap-feeding damage to tassels and ears. The dominant stink bug species in domestic corn fields were *Dolycoris baccarum* and *Cletus punctiger.* Additionally, *Metcalfa pruinosa,* introduced in 2004, and *Ricania sublimata*, introduced in 2009, were also found in corn fields.

Key words: maize pest, species identification, cytochrome C oxidase I, dominants

P186

Monitoring of ant species surrounding the port of South Korea

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외래곤충의 유입과 확산은 무역, 교통의 발달 등 인간의 활동으로 전 세계로 확산이 가속화되고 있으며, 특히 항구는 개미를 비롯한 외래곤충이 유입되는 허브이자 침입 경로이다. 본 연구는 국내 주요 항만 주변지역 개미류의 분포와 현황을 파악하고, 외래개미의 정착과 확산의 위험을 줄이기 위해 2021년부터 2023년까지 8개 항만(감만항, 군산항, 평택당진항, 광양항, 대산항, 인천항, 울산항, 영일만항) 주변지역 개미를 함정트랩을 이용하여 조사하였다. 채집된 개미는 총 4아과 26속 44종 316,975개체로 확인되었고 주름개미(*Tetramorium tsushimae*), 고동털개미(*Lasius niger*), 왕침개미(*Brachyponera chinensis*), 스미드개미(*Nylanderia flavipes*) 등이 우점하였다. 채집된 종 중 외래개미는 감만항에서 붉은불개미(*Solenopsis invicta*), 열대불개미(*Solenopsis geminata*), 열대긴수염개미(*Paratrechina longicornis*), *Nylanderia bourbonica*, *Trichomyrmex destructor* 등 5종, 광양항, 울산항에서 열대긴수염개미(*Paratrechina longicornis*) 1종이 확인되었다. 군집분석 결과 우점도지수는 인천항 0.25, 다양도지수는 대산항 2.00, 균등도지수는 대산항 0.71, 풍부도지수는 감만항 2.13으로 높게 나타났다. 따라서 본 연구는 항만 주변지역의 개미류를 조사하여 외래개미에 대한 서식현황을 파악하고 확산을 선제적으로 대응하기 위한 기초자료를 제공하고자 한다.

검색어: 침입외래생물, 외래개미, 모니터링, 붉은불개미

P187

Distribution and emergence patterns in relation to overwintering period on the solitary bees *Osmia cornifrons* and *O. pedicornis* (Hymenoptera: Megachilidae)

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Osmia cornifrons and *O. pedicornis* are a cavity-nesting solitary species used mainly as an apple pollinator in Korea. To elucidate the characteristics of those bees for the efficient the pollination of agricultural crops, we investigated the distribution, the number of cocoons per straw and sex ratio at different locations in 2023. We collected two species of mason bees consisting of *O. cornifrons*, *O. pedicornis* in Mungyeong, Sangju, Gimcheon, Bonghwa, Yeongwol and Danyang locations. According to the regional distribution of two species, *O. cornifrons* dominated in Mungyeong, Sangju, Bonghwa, and Danyang, which accounts for 51.6% to 87.5% in the four locations. *O. pedicornis* dominated in Gimcheon and Yeongwol, which accounts for 62.4% to 66.3% in the two locations. The mean number of Osmia spp. was varied in different 6 locations. The sex ratio of two species were from 1 : 1.0 to 1 : 2.7 on *O. cornifrons* and from 1 : 1.8 to 1 : 4.1 on *O. pedicornis.* The sex ratio of *O. cornifrons* and *O. pedicornis* was different in 6 locations. In winter survival and emergence day following incubation at 25.0±0.3°C, *O. cornifrons* and *O. pedicornis* exposed to 7 artificial overwintering treatments differing in duration (30, 60, 90, 120, 150, 210, and 270 D) at 5.0±2.3°C. For all treatments, survival was highest at 120D on both sex of *O. cornifrons*, at 90D and 120D(female and male) on *O. pedicornis.* In emergence days after incubating, for *O. cornifrons* female, the highest emergence rate was observed 5 to 8 days after 120 days of overwintering, while for *O. pedicornis* female, the highest emergence rate was observed between 16 to 30 days after 60 days of overwintering.

Key words: mason bee, *O. cornifrons*, *O. pedicornis*, Distribution, Sex ratio, winter survival

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Oviposition characteristics of *Zeugodacus tau* walker on host fruits and vegetables

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The pumpkin fruit fly, *Zeugodacus tau*, 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. We investigated the oviposition characteristics of *Z. tau* on twelve fruits and nine vegetables. *Z. tau* marked the oviposition places on every crop tested. *Z. tau* laid eggs into the fruits and vegetables. We examined the adult emergence from infested crops.

Key words: *Zeugodacus tau,* adult emergence, host crop, oviposition

This research was supported by the research program of RDA (PJ017506).

P189

Effects of CO_2 concentration on the population parameters and growth of *Aphidius colemani* Viereck (Hymenoptera: Braconidae) on the green peach aphid

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We investigated the effects of CO_2 concentrations on development, longevity and fecundity of *A. colemani* at different CO_2 concentrations, 400, 600, and 1,000ppm, respectively. In this study, we collected detailed data on development periods, longevity and fecundity of *A. colemani* at three different CO_2 concentrations. We analyzed the life table parameters of *A. colemani* using age-stage, two-sex life table program. The intrinsic rate of increase, finite rate of increase, and fecundity were the highest at 1,000ppm.

Key words: *Aphidius colemani,* Life table parameter, Population growth, CO_2 concentration

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P190

Guild structure of rice field spiders in Korea

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Spiders play an important role as a predator group in regulating insect pests in the agricultural ecosystem. Therefore, understanding their guild structure according to their ecological function is very important for the active application of useful biological resources for long-term sustainable agriculture. A total of 5,525 spiders collected in 5 areas (Anseong, Gyeonggi-do/ Nonsan, Chungcheongnam-do/Imsil and Namwon, Jeonbuk-do/Gurye, Jeollanam-do) in rice fields in 2021 were identified as 64 species of 17 families. The species richness by main ecological functional group was high in orb weavers and ground runners, the abundance was high in ground runners and wandering sheet weavers. Species richness of each ecological functional group averaged from 4.00±1.00 to 10.33±0.88 and species diversity of that averaged from 0.48±0.27 to 1.60±0.10.

Key words: guild, species richness, species diversity, rice field, seasonality, spiders

P191

Survey on the occurrence of sporadic, subtropical and migratory insect pests

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기후변화에 따른 국내 농작물 해충의 발생상 변화를 살펴보기 위해 2021년도부터 2023년도까지 3년간 돌발, 남방계 및 비래 해충에 대하여 전국적으로 발생 실태를 조사하였다. 실태조사는 벼멸구, 애멸구, 흰등멸구, 썩덩나무노린재, 담배거세미나방, 미국선녀벌레 등 5종 해충을 대상으로 실시하였다. 2021년 5월부터 2023년 11월까지 스마트공중포집기를 이용하여 애멸구 비래 밀도를 조사한 결과 연 평균 1,300마리 정도가 포획되었으며, 포획량이 가장 많은 해는 2023년이었다. 애멸구를 대상으로 RT-PCR을 이용하여 벼줄무늬잎마름병(RSV) 보독률을 조사한 결과 257마리 개체 중 약 5마리에서 RSV가 검출되었다. 벼멸구의 경우 2021년에 가장 많은 개채수가 포획되었고 2023년도의 포획 개체수가 가장 작았다. 남방계 해충인 썩덩나무노린재는 2022년과 2023년에 7,9월 2회에 걸쳐 발생량을 조사한 결과 2020년에 비해 2022년, 2023년에 발생량이 증가하였고, 7월보다 9월에 발생량이 많은 것으로 조사되었다. 돌발해충인 미국선녀벌레는 2022년은 6월 약충발생 시기에 조사주당 밀도가 가장 높았으며, 충남 금산, 당진, 경기 가평에서 발생량이 특히 많았고, 경북지역은 발생지역이 늘어나고 있는 것으로 나타났다.

검색어: 실태조사, 벼멸구, 애멸구, 흰등멸구, 썩덩나무노린재, 담배거세미나방, 미국선녀벌레

P192

Seasonal monitoring of temperature and humidity in honey bee (*Apis mellifera*) colonies in response to external climate in South Korea

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Vernacular and commercially introduced species in the country are struggling to survive due to rapid climate change. Notably, honey bees, which hold ecological and economic importance, face challenges adapting to this change, necessitating relevant research. This study monitored year round temperature and humidity in honey bee colonies alongside external climate factors to identify seasonal events. Data were collected on internal temperature and humidity changes during stages like post-wintering growth, foraging, heat stress, and wintering preparation. The study also identified how colonies regulate these conditions in response to external climate influences. These findings provide fundamental data for evaluating domestic honey bees' temperature and humidity patterns and their reactions to climate changes throughout the year.

Key words: climate change, phenology, managed pollinator,

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Development of foot-and mouth disease virus antigen candidates using the baculovirus expression vector system

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배큘로바이러스 발현벡터계 (Baculovirus expression vector system: BEVS)는 세포 전체 단백질 중 약 50% 수준까지 다각체를 발현하는 polyhedrin 프로모터를 이용하는 가장 강력한 진핵 세포 발현계 중 하나로 다양한 응용이 가능한 발현계이다. 이러한 강력한 프로모터를 외래 유전자 발현에 이용함으로써 BEVS는 다양한 백신 항원 개발 및 유용 단백질 개발에 널리 이용되고 있다. 본 연구는 BEVS를 이용하여 가축 전염병인 구제역 예방 백신 후보물질을 개발하고자 하였다. 구제역 바이러스는 우제류에서 발견되는 전염성이 높은 질병으로 세계동물보건기구에서 제1종 가축 전염병으로 지정하였다. 구제역 바이러스는 P1 구조단백질이 3C 효소단백질에 의해 3개의 폴리프로테인으로 절단 후 자가조립을 통해 바이러스 입자를 형성한다. 구제역 바이러스 항원을 개발하기 위해 나노파티클 형태로 BEVS를 이용하여 구조단백질을 발현하였고, 특성 분석을 통해서 특정한 구조를 형성하는 것을 확인하였다. 더불어 동물 실험을 통해서 우수한 면역원성을 확인하였으며, 구제역 바이러스 예방 백신의 개발 가능성을 확인하였다.

검색어: BEVS, polyhedrin, 구제역, 구제역 바이러스

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Profitability analysis of black soldier fly (*Hermetia illucens*) farming

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동애등에는 음식물 등 유기물 분해능력이 탁월하여 음식물쓰레기 처리에 이용되고 있으며, 주로 동물의 사료로 이용되는 사료곤충 중 하나이다. 이에 곤충 사육 농가의 동애등에에 대한 관심이 증가함에 따라 동애등에 사육의 수익성을 분석하여 경영정보를 제공하고자 본 연구를 수행하였다. 2023년 전국 동애등에 사육 경영체는 203호로 조사되었으며, 이 중 26호를 대상으로 경영 현황을 조사하였다. 조사표는 농촌진흥청 농축산물 소득조사표를 바탕으로 작성하였고, 경영체에 방문하여 면접청취 조사를 실시하였다. 동애등에 사육의 수익성을 분석한 결과, 120,000kg 사육 기준, 음식물처리 수익 37,377천 원을 포함한 총수입은 130,132천 원이었으며, 소득률은 29.5%로 소득은 38,444천 원이었다. 생산비는 131,943천 원으로, 고용노동비(22.0%), 자가노동비(17.6%), 대농구상각비(11.9%), 고정자본용역비(11.5%) 등의 순으로 비중이 높게 나타나, 동애등에 사육 시 노동비가 가장 큰 부담이 되는 것으로 조사되었다. 이때 노동 투입시간은 고용노동 1,426시간, 자가노동 1,271시간으로, 작업단계별 노동 투입 시간을 조사한 결과, 배설물 분리 작업(11.5%), 유충 먹이 공급(11.0%), 건조 작업(9.8%) 순으로 노동력이 많이 투입되는 것으로 조사되었다. 본 연구 결과는 영농인의 작목전환 및 경영의사결정을 위한 기초자료로 활용될 수 있을 것으로 보인다.

검색어: 동애등에, 경영성과, 수익성, 곤충산업, 곤충소득

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Profitability analysis of white-spotted flower chafer (*Protaetia brevitarsis*) farming

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흰점박이꽃무지 유충은 다른 곤충에 비해 단백질과 불포화지방산 함량이 특히 높고, 간 기능 개선 및 당뇨병 치료 등 다양한 효능이 있는 것으로 나타나 기능성 식품소재로 인기를 끌고 있다. 이에 곤충 사육 농가의 관심이 증가함에 따라 흰점박이꽃무지 사육의 수익성을 분석하여 경영정보를 제공하자 본 연구를 수행하였다. 2023년 전국 꽃무지 사육 경영체는 814호로 조사되었으며, 이 중 22호를 대상으로 경영 현황을 조사하였다. 조사표는 농촌진흥청 농축산물 소득조사표를 바탕으로 작성하였고, 경영체에 방문하여 면접청취 조사를 실시하였다. 흰점박이꽃무지 사육의 수익성을 분석한 결과, 2,000kg 사육 기준, 총수입은 54,415천 원이었으며, 소득률은 52.4%로 소득은 28,503천 원이었다. 생산비는 59,253천 원으로, 자가노동비(49.0%), 사료비(11.0%), 영농시설상각비(7.6%), 종충비(6.4%) 등의 순으로 비중이 높게 나타나, 흰점박이꽃무지 사육 시 자가노동 비율이 매우 높은 것으로 조사되었다. 이때 노동 투입시간은 고용노동 92시간, 자가노동 1,698시간으로, 작업단계별 노동 투입 시간을 조사한 결과, 유충 먹이 공급(12.3%), 성충 분리(8.5%), 성충 먹이 공급(8.2%) 순으로 노동력이 많이 투입되는 것으로 조사되었다. 본 연구 결과는 영농인의 작목전환 및 경영의사결정을 위한 기초자료로 활용될 수 있을 것으로 보인다.

검색어: 흰점박이꽃무지, 경영성과, 수익성, 곤충산업, 곤충소득

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Pollination effect of bumblebee (*Bombus terrestris* L.) with a ventilation system in high-temperature greenhouse cultivation of cherry tomatoes

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This study compared the internal environment and pollination efficiency of ventilated and non-ventilated bumblebee colonies under high-temperature conditions in August during cherry tomato cultivation. The maximum and minimum temperatures inside the greenhouse were recorded as 32.8±4.4℃ and 30.8±3.3℃, respectively. The internal temperature of the ventilated colonies reached a maximum of 31.4℃ and a minimum of 27.0℃, while the non-ventilated colonies reached a maximum of 34.3℃ and a minimum of 27.4℃. Although there was no significant difference in minimum temperature, the maximum temperature in the ventilated colonies was, on average, 3℃ lower. Additionally, CO_2 concentrations in the ventilated colonies ranged from 612.9 ppm to 454.8 ppm, compared to 865.8 ppm to 517.3 ppm in the non-ventilated colonies, showing a maximum difference of 253 ppm. Analysis of hourly bee activity showed that the ventilated colonies exhibited peak activity at 8:00 AM and 7:00 PM, with a total daily activity level 1.2 times higher than the control. Consequently, the fruit set rate was 32% in the non-ventilated colonies, compared to 47% in the ventilated colonies, a 1.5-fold increase. These findings confirm that ventilation improves the pollination efficiency of bumblebees in high-temperature conditions exceeding 35℃ in greenhouses.

Key words: Bumblebee, *Bombus terrestris* L., pollination, cherry tomato greenhouse

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Changes in the appreance of wetland creature in Jeju and changes in the biological cycle of artificially reproducted *Lethocerus deyrolli* (Hemiptera: Belostomatidae) due to abnormal climate in 2024

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변온동물인 양서류는 5℃ 이상의 온도에서 동면을 타파 후 번식을 하고, 이 때 부화한 유생들이 습지 생물들의 먹이가 된다. 24년의 경우 21~23년과 비교하였을 때 겨울(1~2월)의 강수량이 많았고, 2월의 온도가 높았다. 이로 인해 양서류의 동면이 이르게 타파되었으나, 3월의 온도가 낮아지면서 부화한 유생들이 살아남지 못해 개체수가 줄어들어 습지 생물의 출현 시기가 변화한 것으로 보인다. 온도와 강수량은 멸종위기 야생생물인 물장군의 인공증식 개체에도 영향을 주어 번식하는 시기가 21년~23년과 비교하여 20일 정도 늦어졌으며, 알이 부화하는 시기 또한 7일 이상 지연되었다. 앞으로 지구온난화로 인하여 이상 기후가 빈번할 것으로 보이며 멸종위기 야생생물의 보존을 위해서라도 지속적인 관찰이 필요할 것이다.

검색어: 멸종위기 야생생물, 인공증식, 기후, 제주 습지

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Analysis of honey and propolis mixture for anti-cancer effects according to manufacturing method

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국내 대표 양봉산물인 꿀과 프로폴리스를 혼합하여 섭취 가능한 제형을 제작하고, 이에 대한 암세포주에 대한 항암 효과를 분석하였다. 꿀과 프로폴리스 혼합 과정에서 두 가지 방식에 따라 제작하였는데, 첫 번째는 꿀과 프로폴리스를 혼합하고 세포주에 적용하기 위해 필터링을 거쳐 준비하였고, 두 번째로는 꿀과 프로폴리스 각각을 먼저 필터링한 후 혼합하였다. 암세포주인 PANC-1 세포주에 대한 두 제형의 세포 사멸 효과를 확인한 결과, 혼합 후 필터링한 시료의 경우 세포 사멸 효과가 나타나지 않았으나, 먼저 필터링한 다음 혼합한 시료의 경우 암세포주에 대한 세포 사멸 효과를 나타냈다. UPLC를 이용하여 두 시료가 포함하는 성분의 차이를 확인한 결과, 필터링한 다음 혼합한 시료의 경우 20분 위치에서 특정 성분의 peak이 나타났다. 그러나 혼합 후 필터링한 시료의 경우 다른 시간대에서는 모두 동일한 peak이 나타났지만, 20분대의 위치의 성분이 나타나지 않았다. 이는 두 제형의 혼합 및 필터링 순서에 따라 포함되는 성분이 다르게 나타나는 것이며, 이 부분에 해당하는 성분이 암세포 사멸에 대해 생물학적 기능을 수행하는 주요 성분임을 나타내고 있다.

검색어: 꿀, 프로폴리스, 항암, UPLC

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Development of bioinsecticides using a entomopathogenic fungus, *Beauveria bassiana* 331R

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Entomopathogenic fungi are mainly 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 the shortcomings of solid culture technology., achieving high insecticidal substance activity and spore density. In order to develop an optimal formulation of the natural plant protection agent using *B. bassiana* 331R, a comparison of economic viability was conducted, resulting in the development of one optimal formulation (WP, wettable powder). Due to the hydrophobic nature of the raw material, research focused on identifying suitable adjuvants, ultimately selecting two surfactants and one carrier based on their physical properties and cost-effectiveness. The WP formulations were prepared with varying active ingredient concentrations, and the viable cell counts were measured, yielding results of 4.38E+07 CFU/mL, 6.63E+07 CFU/mL, and 9.00E+07 CFU/mL, respectively. Based on these findings and considerations of economic feasibility, a formulation with an appropriate concentration of WP was finalized.

Key words: Entomopathogenic fungus, *Beauveria bassiana* 331R, liquid culture technology, Process Development

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Results of pesticide resistance testing of the *Aphis citricola* in major apple production areas in South Korea

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조팝나무진딧물(*Aphis citricola*)은 사과 어린잎에 발생하여 수액을 흡즙하고 바이러스를 매개하는 등 피해가 심각하다. 이를 방제하기 위해 오랜기간 동안 화학 살충제에 의존해 왔으나, 그 결과로 약제 저항성이 발달하여 방제전략에 어려움을 초래하고 있다. 본 연구는 국내 주요 사과 주산지 5권역(영남, 강원, 경기, 충청, 호남)의 10개 지역(영주, 군위, 의성, 안동, 홍천, 평창, 포천, 충주, 영동, 장수, 무주)에서 2022~2024년에 걸쳐 사과원에 발생하는 조팝나무진딧물의 약제저항성을 판별하여 지속가능하고 효율적인 방제 전략을 수립하기 위해 수행되었다. 등록 약제 10개(acetamiprid, benfuracarb, flonicamid, spirotetramat, flupyradifurone, sulfoxaflor, pyrifluquinazon, esfenvalerate, imidacloprid, afidopyropen)의 약제 저항성 발현 양상을 평가한 결과 일부 지역에서 pyrifluquinazon, afidopyropen, esfenvalerate의 약제에서 저항성이 발현된 것으로 나타났다. 본 연구는 2022~2024년도 농촌진흥청 공동연구사업(RS-2022-RD010420)의 지원에 의해 이루어진 것임.

검색어: 조팝나무진딧물, 저항성, 살충제, 사과

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RNA-sequencing of *Beauveria bassiana*-infected *Thrips plami* reveals change of host homeostasis

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RNAs were extracted from the non-treated thrips and day-2 and day-4 infected thrips with three biological replicates. In the day-4 thrips enriched lysosome and insect hormone biosynthesis pathways were remarkably suppressed, although some other pathways were actively expressed such as serine and glycine metabolism, Toll/Imd and circadian rhythm pathways. Many lysosomal hydrolase genes including protease, glycosidase, sulfatase and lipase were significantly down-regulated and particularly glycosidases were strongly down-regulated. Some hydrolase precursor-related genes at Golgi body were actively expressed, but they didn't further proceed to the hydrolase biosynthesis. Juvenile hormone biosynthesis was up-regulated at the up-stream of the pathway, but many genes were significantly down-regulated at the down-stream, finally failing in juvenile hormone biosynthesis. In ecdysone biosynthesis, cytochrome P450 genes at the down-stream were up-regulated, but at the up-stream expressions of cholesterol desaturase and P450 gene were inhibited, consequently down-regulation of ecdysone biosynthesis. In summary, this fungus seems to attack different organs or pathways in melon thrips compared to currently used pesticides.

Key words: *Thrips palmi*, *Beauveria bassiana*, lysosome, Glycosidase, Juvenile hormone