P1

One newly recorded *Paragabara* species (Lepidoptera, Erebidae, Boletobiinae) from Korea

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The genus *Paragabara* is recognized as a member of the subfamily Boletobiinae, with six species in the Eastern Palaearctic. In Korea, three species of this genus are known. Konoenko et al. (2010) designated a lectotype for *P. flavomacula* (Oberthür, 1880) and described a new species, *P. curvicornuta*. In this study, the misidentification of the Korean *P. flavomacula* as *P. curvicornuta* has been corrected. Additionally, one newly recorded species, *P. curvicornuta*, is reported from Korea. In total, four *Paragabara* species are recognized in Korea. All available information, images of adults, a checklist, and male and female genitalia, etc., are provided.

Key words: Boletobiinae, *Paragabara*, newly recorded, reidentification, Korea

P2

Review of the genus *Cephennodes* Reitter (Coleoptera: Staphylinidae: Scydmaeninae) in Korea with a new record

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The genus *Cephennodes* Reitter (Coleoptera: Staphylinidae: Scydmaeninae) comprises approximately 220 species worldwide within three subgenera (*Cephennodes*, *Aculeodes*, *Fusionodes*). In Korea, two species are recorded: *C*. (s. str) *japonicus* (Sharp) and *C*. (*Fusionodes*) *graeseri*Reitter. The two subgenera, *Cephennodes* and *Fusionodes*, can be distinguished by the form of the parameres in relation to the median lobe, whether fused or divided. In this study, we redescribed two species: *C*. (s. str) *japonicus* and *C*. (*Fusionodes*) *graeseri*. Additionally, *Cephennodes* (*Fusionodes*) *ussuricus* (Kurbatov) is recorded first time in Korea. Images of habitus, aedeagus, and a distribution map are provided.

Key words: *Cephennodes*, redescription, new record, Korea, taxonomy

P3

Taxonomic study of the genus *Spilonota* Stephens (Lepidoptera: Tortricidae: Olethreutinae: Eucosmini) with descriptions of two new species in Korea

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A taxonomic study was conducted on *Spilonota* Stephens, 1834 in Korea. As a result of the research based on materials from Incheon National University two new species; *S. samseong* Choi, Bae & Nasu, and *S. laticucullusa* Choi, Bae & Nasu from Korea. This study provides a brief description of the new *Spilonota* species in Korea, as well as comparisons with similar species and illustrations of adult and genital morphology.

Key words: leaf roller moth, distribution, new record, taxonomy

P4

3D Description of Stathmopodidae Type Species using Micro-CT

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Stathmopodidae, in the superfamily Gelechioidea, was first described by Edward Meyrick in 1913. This family has various characteristics, such as feeding on crops, moss, spores of fern, aphids, etc., but there is a lot of difficulty in identification due to morphological similarities between species. Therefore, it is necessary to understand the genitalia structure through dissection, but this process necessarily involves damage to the type specimen. To solve these problems, Micro-CT(Computed Tomography) which allows observation of internal structures without damage, was utilized to create a 3D model of the genitalia. In this study, the genitalia structure of *Stathmopoda pedella* (Linnaeus, 1761), the type species of Stathmopodidae, was imaged using Micro-CT under a resolution of 4 um conditions, providing a 3D description.

Key words: Stathmopodidae, genitalia, Micro-CT, 3D model

P5

First Record of genus *Dyseriocrania* Spuler, 1910 (Lepidoptera: Eriocraniidae), a Leaf Miner from Korea

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Eriocraniidae is a microleidopteran family (Lepidoptera: Eriocraniidae) that includes six genera and distributed to the Holarctic region. The larvae of this family are known leaf miners, typically infesting *Betula* and *Ouercus*. Herein. the first reord of the genus *Dyeriocrania* Spuler, 1910 in Korea is presented, including the previously undscribed species. Adult and female genitalia are provided based on illustrations.

Key words: Leaf miner, New record, *Dyseriocrania*, Korea, Taxonomy.

P6

A New Record of a Forest Lepidopteran Pest of genus *Acronicta* Ochsenheimer, 1816 (Lepidoptera: Noctuidae) from Korea with Molecular data

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The genus *Acronicta* Ochsenheimer, 1816 is known as a forest pest. The acronictine species is widely distributed across the Afrotropical, Oriental, Australian, and Neartic regions. This study presents a new record of an acronictine species from Korea, including descriptions, illustrations, and diagnostic characteristics. Additionally, the CO1 barcode data of the newly recorded species is compared with the global barcode reference at the species level. New data on the recently recorded species has been obtained from this study. This information will aid in the prompt identification and preparation for potential pest outbreaks.

Key words: Forestry pest, *Acronicta*, Noctuidae, Taxonomy, COI gene, DNA barcoding

P7

Species diversity comparisons of subtropical and tropical Lepidoptera in Vietnam: Noctuoidea fauna and flora

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Vietnam is a country in Southeast Asia, long from north to south, with temperate, subtropical, and tropical climates in different parts of the country. Based on the results of two years of insect surveys in the subtropical and tropical regions of Vietnam, we conducted a comparative analysis of the species diversity of the Noctuoidea (Insecta: Lepidoptera) in the two survey areas, Bach Ma National Park and Protected Forest in the Vạn Xuân region. In addition, the host flora of the identified moths were analysed to determine the differences in host communities.

검색어: fauna, flora, hostplant, Noctuoidea, Vietnam

P8

A new species of the genus *Altenia* (Lepidoptera: Gelechiidae) from Korea

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The family Gelechiidae (Lepidoptera: Gelechioidea) is known as one of the largest families in Microlepidoptera, encompassing about 600 genera and more than 5,000 described species worldwide. However, the genus *Altenia* Sattler, 1960 has been poorly studied in Korea, with only one known species. Here we introduce a new species, *Altenia parascriptella* sp. nov., from Korea, providing photos of adults and genitalia for both sexes, along with diagnostic characteristics.

Key words: Gelechiids, tribe Litini, new record, Korean peninsula

P9

Literature Review of Insect Pests on *Citrullus lanatus* in Korea

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전북특별자치도 수박(*Citrullus lanatus* (Thumb.) Matsum. et Nakai) 재배면적은 2,235ha이며, 익산과 정읍은 주요 수박 재배 지역이다. 본 연구는 수박에서 발생하는 해충 목록 작성을 위한 기초자료 구축을 목적으로 최근 20년간 보고된 문헌자료를 조사하였다. 문헌조사에 따르면, 수박에서 발생하는 주요 해충은 총 7목, 11과, 22종으로 정리되었다. 이 중 점박이응애(*Tetranychus urticae* Koch), 목화진딧물(*Aphis gossypii* Glover), 아메리카잎굴파리(*Liriomyza trifolii* Burgess) 등이 우점해충으로 다수의 문헌을 통해 확인되었다. 그 외 파밤나방(*Spodoptera exigua* Hübner), 꽃노랑총채벌레(*Frankliniella occidentalis* Pergande), 목화바둑명나방(*Diaphania indica* Saunder)등의 해충들이 최근 연구로부터 추가되었다. 본 연구 결과를 기반으로 앞으로 수박 해충에 대한 현장 조사 계획을 수립하고, 적합한 방제 전략을 세우고자 한다.

검색어: 수박, 해충, 분류, 문헌조사

P10

Revision of Genus *Addyme* Walker, 1863 (Phycitinae: Pyralidae: Lepidoptera) and its allied genera

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The family Pyralidae comprises over 6,000 species, and is composed of five subfamilies. Among those, the subfamily Phycitinae includes 3 genera, *Addyme* Walker, 1863, *Calguia* Walker, 1863, and *Coleothrix* Ragonot, 1888, with more than 3,300 species worldwide. However, several species of the genera have been erroneously stated and identified due to confusions caused by high morphological similarities. Therefore, we correct those errors through re-examinations of most of the type specimens, along with a diagnosis and table exhibiting the history of those genera. Additionally, we introduce two misidentified Korean pyralids belonging to the genus *Addyme*.

Key words: reinstatment, synonym, Malaysia, NHMUK

P11

A New record of *Hemipsocus chloroticus* (Hagen, 1858) (Psocodea: Hemipsocidae) in South Korea

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Hemipsocus chloroticus (Hagen, 1858) is a leaf litter barklice and has been recorded in Japan, China, Taiwan, South-East Asia, Sri Lanka, and North America. We collected *H. chloroticus* on Jinju-si, Sanchung-gun, Seoguipo-si, and Ulsan-si from 2022 to 2023. In this study, *H. chloroticus* is reported for the first time in Korea, and illustrations of diagonistic characters are provided.

Key words: Psocodea, new record, Hemipsocidae, *Hemipsocus chloroticus*, South Korea

P12

The first record of *Greenidea nigra* Maki, 1917 (Hemiptera: Aphididae: Greenideinae) from South Korea

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The Genus *Greenidea* includes 66 species worldwide. Only two species have been recorded in Korea: *G.kuwanai* and *G.nipponica*. We collected *Greenidea nigra* Maki, 1917 on *Quercus glauca* in Jeju. This species has been recorded in Japan and Taiwan. In this study, we report this species for the first time in South Korea, and describe morphological features of apterous viviparous females.

Key words: Aphids, Greenidea, *Quercus glauca*, South Korea

P13

Comparison of Male Genitalia of the *Coptolabrus smaragdinus* (Coleoptera: Carabidae) from South Korea

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Currently, 12 subspecies of *Coptolabrus smaragdinus* have been recorded in Korea, of which 7 subspecies are listed in South Korea. *C. smaragdinus* has limited movement due to degenerated hindwings, resulting in high intraspecific diversity due to geographic isolation. Previous studies have been mainly classified based on external characters or genitalia structure, but the differences between subspecies are very ambiguous. In this study, we aimed to more clearly distinguish at the subspecific classification level, by examining the male aedeagal and inflated endophallus. Additionally, we provide photos of adult, endophallus and the process of endophallus inflation.

Key words: Carabidae, Coleoptera, *Coptolabrus smaragdinus*, male genitalia, aedeagal, endophallus, South Korea

P14

Review of the subgenus *Plataphus* (Bembidiini: Bembidiina: *Bembidion*) of Korea

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The genus *Bembidion* is a prominent terrestrial group found in various regions around the world, encompassing a large number of species. Species of this genus have a reduced apical palpomere, as do all members of the tribe Bembidiini. This study reviews four species belonging to the subgenus *Plataphus*, which is included within the genus *Bembidion*. Descriptions and photos of adults are provided.

Key words: *Bembidion, Plataphus,* taxonomy

P15

A new record of the crane fly, *Dolichopeza* (*Oropeza*) *satsuma* (Alexander, 1918) (Diptera: Tipulidae), from South Korea

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The subgenus *Oropeza* Needham, 1908 (Diptera: Tipulidae: *Dolichopeza*) comprises 27 described species distributed across the Holarctic region. Certain *Oropeza* species have been reported in neighboring countries of the Korean Peninsula—6 species in Japan, 3 species in China, and 4 species in Russia. Some researchers, such as Byers (1961) and Savchenko (1983), suggested that the distribution of *Oropeza* cover the East-Palearctic regions, including the entirety of the Korean Peninsula. However, previous records of *Oropeza* from the Korean Peninsula have not been accepted because of the lack of comprehensive species-level investigations in this region. In this study, we present a new record of the species *Dolichopeza* (*Oropeza*) *satsuma* (Alexander, 1918) in South Korea, with redescription and photographs: general habitus, wing veins, and male genitalia. This finding marks the rediscovery of the subgenus *Oropeza* in the Korean Peninsula.

Key words: Diptera, Tipulidae, *Dolichopeza*, *Oropeza*, new record, taxonomy, South Korea

P16

A new species of *Plecoptera* Guenée 1852 (Lepidoptera: Erebidae) from Korea

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The family Erebidae (Lepidoptera: Noctuoidea) is known as one of the largest families in Lepidoptera, comprising about 1,760 genera and more than 24,569 described species worldwide. Within this family, the genus *Plecoptera* Guenée, 1852, belonging to the subfamily Anobinae, has been documented across the Palaearctic, Oriental, and Afrotropical regions. Here, we introduce the subfamily and genus for the first time in Korea, along with a new species. The diagnosis, description and photographs of adult and genitalia are provided here.

Key words: Macrolepidoptera, *Plecoptera* cf. *reflexa*, Korean fauna, Korean Peninsula.

P17

Expansion of Korean records for the family Coleophoridae (Lepidoptera, Gelechioidea): Four newly recorded species and two overlooked additions

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This study reports the first records of four coleophorids, namely *Coleophora kamchatica* (Anikin, 1999), *C. lativittella* Erschoff, 1877, *C. levantis* Baldizzone & Oku, 1988, and *C. citrarga* Meyrick, 1934, in Korea. Additionally, the presence of two species, *C. montaniella* Oku & Kusunoki, 2018, and *C. artemisicolella* Bruand, 1855, in Korea has been overlooked in the previous checklist of the family Coleophoridae in Korea, despite there being evidence of their existence. Consequently, with these additions, the total number of known species in Korea has been confirmed to be 42, expanding from the previously identified 36 species. Diagnostic characteristics and photographs of adults and genitalia for the four newly recorded species are provided, along with evidence supporting the presence of the two overlooked species in Korea.

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

P18

Molecular epidemiological investigation of the invasive pest Drywood termite (*Cryptotermes domesticus* Haviland) in South Korea, 2023

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Drywood termite (*Cryptotermes domesticus*), native to South East Asia, is distributed in India, China, Taiwan, Australia and so on. In China, it is considered an economically important pest causing damage to wood. It lives in dry wood environments such as furniture, buildings, and structural timber. It is difficult to find drywood termite within a structure but it can be detected by the presence of alate flight and small egg-like pellets of excreta. It was found in a house in Seoul, Korea in July 2023 and was investigated joint by APQA, National Institute of Ecology, National Institute Biological Resources, National Institute of Forest Science, Cultural Heritage Administration and Gyeongsang National University. The *COII* barcode region was analized with PCR method and compared with the sequences of all *C. domesticus* registered in NCBI 557bp of base sequence. Genetic difference ranged from a minimum of 0.0072 to a maximum of 0.0557. Among these, the individual with the minimum genetic distance was from Guangdong Province, China.

Key words: drywood termite, barcode, population, invsion, *COII*

P19

Molecular epidemiological investigation of the invasive pest Western drywood termite (*Incisitermes minor* (Hagen)) in South Korea, 2023

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Western drywood termite, Incisitermes minor, is distributed southwestern USA and northern Mexico. Invasions had been reported to Canada, China, Hawaii and Japan. Incisitermes minor may be introduced through wooden structures. In California and Arizona, it caused economic damage of about $250 million. In September 2023, it was discovered in a house in Changwon-city, Korea and a joint investigation was conducted by APQA and other government agencies. The 16S rRNA sequence was used in the molecular epidemiological investigation to trace the origin of the invasion. Five individuals found in Changwon and 18 foreign sequences collected by NCBI were compared. A total of 462bp of base sequences were compared, and the genetic distance was observed to range from a minimum of 0.000 to a maximum of 0.1791. They were most genetically similar to the California individual in the United States.

Key words: western, termite, barcode, population, invsion, 16S rRNA

P20

Not Presented

P21

Reconciling the molecular phylogeny and fossil records by total evidence tip-dating in cave crickets (Rhaphidophoridae: Orthoptera)

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Rhaphidophoridae (Orthoptera: Ensifera), commonly known as cave crickets, are a wingless family and considered the most ancient lineage within Tettigoniidea. However, previous molecular phylogenetic studies and morphological hypotheses have shown inconsistencies. Although their fossils have been found in Baltic amber, their systematic placement remains unrevealed. This study reconstructed a comprehensive phylogeny integrating both extant and fossil lineages. Initially, we revealed relationships within extant lineages through molecular phylogenetics including all extant subfamilies for the first time. Subsequently, using a cladistic approach based on morphology, we confirmed the systematic position of fossil taxa †Protroglophilinae with a report of a new species. Integrating molecular and morphological phylogeney by total evidence tip-dating, we present the comprehensive phylogeny of Rhaphidophoridae considering both extant and fossil groups.

Key words: Orthoptera ,Bayesian, tip-dating, fossil, Biogeography

P22

To fly, or not to fly—that is the question: Wings in Melanoplinae

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Despite having enabled insects to become the most abundant and successful group on Earth, wings have been lost in numerous insect lineages, including Orthoptera. Melanoplinae, a subfamily that includes over 100 genera and more than 800 species in Acrididae, exhibits various wing-types and dispersal abilities. Some species possess extensive flight capabilities with long wings, while many groups that inhabit alpine environments tend to reduce their wings and dispersal ability. In order to infer the evolutionary history of Melanoplinae and their wings, we conducted molecular phylogenetic research. We established the phylogeny using seven mitochondrial (Cox1, Cox2, CytB, Nad2, Nad5, 12S and 16S) and two nuclear genes (H3 and Wg) for 139 taxa. By investigating the wing types in Melanoplinae, we estimated the ancestral state of the wings and traced their evolutionary history. Our results present that loss and recovery of wings occurred multiple times within Melanoplinae, showing distinct histories across inner taxa within the subfamily.

Key words: Orthoptera, Acrididae, Melanoplinae, Ancestral reconstruction, Wing

P23

Complete mitochondrial genome of the *Vespa binghami* (Hymenoptera: Vespidae) and comparison to other species in *Vespa*

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Vespa binghami (Hymenoptera: Vespidae) is one of the 10 species in the genus *Vespa* distributed in South Korea and is the only nocturnal wasp. In this study, we sequenced complete mitochondrial genome (mitogenome) of the species using the Sanger method and using *Vespa*-specific 30 primer sets. The length of *V. binghami* was 15,957 bp and the total A/T content was 80.6%. The A+T-rich region of *V. binghami* was 152 bp, and other *Vespa* species ranged from 39 bp (*V. velutina*) to 2,230 bp (*V. v. auraria*). Compared to the majority of insects, the gene arrangement of *V. binghami* had differences as followings: *trnY-trnI-trnM-trnQ*, *trnN-trnE-trnS*$_1$*-trnF*, and *trnS*$_2$*-trnL*$_1$. However, all species in the genus *Vespa* registered in GenBank to date were composed of the same arrangement. Phylogenetic analysis using 13 PCGs and 2 rRNA genes showed the sister relationship between *V. binghami* and *V. orientalis* with the higher nodal supports.

Key words: mitochondrial genome, *Vespa binghami*, gene arrangement, phylogeny

P24

Complete mitochondrial genome of *Tropilaelaps mercedesae* Anderson and Morgan, 2007 (Acari: Laelapidae)

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Tropilaelaps mercedesae Anderson and Morgan, 2007 (Acari: Laelapidae) is a serious ectoparasite of the brood of several honey bee species. Among the four recognized species of *Tropilaelaps*, Korean population was renamed as *T. mercedesae* from *T. clareae* on the basis of morphological evidences and genetic data. In this study, we report the complete mitochondrial genome (mitogenome) sequence of *T. mercedesae*. The 15,119-bp long mitogenome has an identical gene arrangement to that of Chinese sample reported previously. Comparison of two geographic samples showed *COII, ND5*, *ND4*, *ND6*, *CytB,* and *ND1* to have higher number of variable sites than *COI*, which is often used for population-level study, suggesting these genes to have potential usefulness for population genetic study. The mitogenome sequence of *T. mercedesae* from Korea could be useful for species identification for geographic samples, trace of the origin of local populations, and illustration of evolutionary distinction among *Tropilaelaps* species either using part of or whole genome.

Key words: *Tropilaelaps mercedesae,* Mitochondrial genome, Laelapidae.

P25

Morphological identification of subfamily Plusiinae (Lepidoptera: Noctuidae) using the patterns of forewings based on multivariate analysis

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본 연구는 검거세미밤나방(*Agrotis ipsilon*) 성페로몬 트랩에 혼재하여 유살되는 은무늬밤나방아과 형태적 분류와 동정법 수립을 위해, 날개 무늬의 형태계측학 분석을 실시하였다. 은무늬밤나방아과 개체는 2023년 11월부터 12월까지 제주도 애월읍 일대에서 채집되었으며, 콩 해충으로 알려진 콩은무늬밤나방(*Ctenoplusia agnata*)을 비롯하여, 다양한 농작물을 가해하는 것으로 알려진 붉은금무늬밤나방(*Chrysodeixis eriosoma*)의 수컷 성충이 포획되었다. 앞날개의 형태 및 무늬를 가지고 현장에서 쉽게 동정할 수 있는 형태적 특징을 도출하기 위하여, 각 성충 개체의 앞날개를 잘라 현미경 카메라로 촬영하고, 앞날개의 내횡선, 아외연선, 반점 크기 등 15개의 형질을 측정하였다. 또한 각 형질 간의 상관관계를 분석하였으며 빈도분포를 통하여 두 종간 분리되는 형질을 파악하였다. 최종적으로 다변량 분석법을 적용하여 두 집단이 어떻게 군집을 이루는지 분석하고, 날개형태만으로 붉은금무늬밤나방과 콩은무늬밤나방을 구분할 수 있는 방안을 제시하였다.

검색어: 밤나방과, 성페로몬 트랩, 형태적 동정, 형태계측학 분석, 다변량 분석

P26

Host preferences of *Spodoptera frugiperda* by corn varieties and nutrient composition by corn cultivar

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Fall armyworm (FAW, *Spodoptera frugiperda*) is a major pest worldwide, and since its first domestic invasion was confirmed in 2019, its damage has been steadily increasing in crops such as corn until recently. In order to provide basic data for the management of FAW, we conducted a comparison of host preference and nutritional composition analysis of corn varieties. A total of 12 varieties of corn were selected for the experiment. To investigate the preference among the varieties, we examined the host preferences at the population level and the individual level, and found no statistically significant differences. In the population-level experiment, the highest damage rate was observed for Saekso 4 and the lowest for Heukgeom 2. In the individual-level experiment, the highest damage rate was found for Kangilok and the lowest for Oryun 2 when using leaves, and the highest for Saekso 1 and the lowest for Dreamok when using stems. As a result, the population-level and individual-level results were not consistent, suggesting that FAW's corn variety preference is not clear and may vary depending on various conditions such as corn tissue. Composition analysis of the 12 varieties showed no correlation between composition and FAW preference among the varieties, and considering the feeding behavior of FAW, which are highly polyphagous, it is recommended to control FAW as early as possible to improve control effectiveness.

Key words: *Spodoptera frugiperda*, host preference, corn variety, composition, control

P27

Studies on some biological characteristics and summer diapause of the *Euonymus* defoliator moth, *Pryeria sinica* Moore (Lepidoptera: Zygaenidae) in Seoul, Korea

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The *Euonymus* defoliator moth, *Pryeria sinica* Moore (Lepidoptera: Zygaenidae), is a pest that causes considerable damage to the *Euonymus* genus, especially *Euonymus alatus* and *Euonymus japonicus*. The biological characteristics of *P. sinica* have been studied in China, Japan, Taiwan, and the United States, but there has been no research conducted on this species in Korea. Also, *P. sinica* has two dormant phases in each generation, one as eggs in winter and the other as pupae in summer. Our purposes are to study the biological characteristics of Korean populations of *P. sinica* and to examine the effects of temperature and photoperiod on summer diapause. The biological characteristics were investigated in laboratory conditions (25 ± 1 ℃, 65 ± 1% R.H., 16L:8D) and the number of eggs in an egg mass, developmental periods and mortality rate in each larvae stage, and adults' life span were determined. The results showed that 190.7 ± 31.64 eggs were contained in one egg mass and it took 25.57 ± 0.61 days from 1st larval stage to the pre-pupal stage. *P. sinica* has 4 larval stages and each stage took 4.28 ± 0.21, 6.2 ± 0.55, 6.02 ± 0.68, and 8.93 ± 0.88 days. The mortality rate of larvae peaked at 22.5% in 3rd larval stage. The adults' life span was 4.67 ± 0.97 days in males and 4.61 ± 1.82 days in females. To study summer diapause, we divided pupae into 4 groups. Both low temperature and short daytime were effective in shortening the pupal stage. The pupal stage was the shortest in group D (122.12 ± 1.24 days), in which the initial condition was 25 ℃-16L:8D and the altered condition was 16 ℃ -12L:12D, and the longest in group A (161.92 ± 3.15 days, 25 ℃-16L:8D). These data could be utilized to propose the optimal timing for controlling the population of *P. sinica*.

Key words: *Euonymus* defoliator moth, *Pryeria sinica* Moore, biological characteristics, summer diapause

P28

Survey on the diversity of visiting and pollinating insects in major gardens at Sejong national arboretum

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현재 기후변화 및 산업화 등으로 생물다양성 감소, 환경오염에 대한 위기가 확산되고 있어 지속가능한 미래설계에 대한 관심이 높아지고 있다. 이에 따라, 본 연구에서는 대표 도시숲인 국립세종수목원에 조성된 총 16개 전시원을 대상으로 총 6차례에 걸쳐 방문곤충과 화분매개곤충 다양성을 조사하였다. 조사시기별 분석결과로 2차('23.7.31) 조사 시기에 가장 다양한 종을 확인할 수 있었으며(총 80종), 전시원별 분석결과 숲정원에서 가장 다양한 종을 확인할 수 있었다(총 59종). 또한 주요 식물 6종(배롱나무, 나무수국, 무궁화, 좀개미취, 범부채, 부처꽃)에 7~10월 기간 중 양봉꿀벌, 애황나나니, 호박벌, 네발나비, 호랑나비, 흰점박이꽃무지, 호리꽃등에, 배짧은꽃등에가 화분매개 행동을 하는 것을 확인하였다. 본 발표에서는 2023년 국립세종수목원 전시원 내 방문곤충 및 화분매개곤충 다양성 연구의 구체적인 결과를 제시하고, 곤충의 보전 필요성, 도시숲 내 체계적인 방문곤충 및 화분매개곤충 조사의 중요성에 대하여 논하고자 한다.

검색어: 국립세종수목원, 도시생물다양성, 도시숲, 방문곤충, 수분매개곤충

P29

Seasonal occurrence of forest insect pests (Scolytinae, Cerambycidae) on the border of South and North Korea

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최근 국제적인 기후변화로 인해 다양한 산림해충들이 새로운 국가 또는 인접한 지역으로의 분포 확대가 증가하고 있는 추세이다. 국내외의 대표적인 산림해충 분류군인 나무좀아과와 하늘소과에는 넓은 기주식물 범위를 가지고 있어 산림 생태계에 직간접적으로 피해를 야기하는 종들이 다수 포함되어 있다. 본 연구에서는 2023년 5월부터 10월까지 남북 접경지(강원 철원군, 양구군, 고성군) 내 혼합림에서 린드그렌 퍼넬 트랩(Lindgren funnel trap)을 활용하여 4가지 유인제(Ipsenol, Ipsedienol, Alpha-pinene, Monochamol) 조건별 나무좀류와 하늘소류의 유인효과와 시기별 발생 양상을 조사하였다. 연구 결과, 나무좀아과는 총 26속 45종 7,743개체, 하늘소과는 총 35속 42종 649개체를 확인하였다. 본 발표에서는 남북 접경지에서의 시기별, 지역별 나무좀류와 하늘소류 발생 양상과 4가지 유인제별 효과에 대한 결과를 보고한다.

Key words: Scolytinae, Cerambycidae, wood-boring insect pests, Korean Peninsula

P30

Insect fauna of Gotjawal Provincial Park and Seonheulgot Dongbaek-Dongsan in Jeju, Korea

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본 조사는 2023년 국가생물다양성 기관연합 공동조사의 일환으로 제주도 곶자왈도립공원 및 선흘곶 동백동산 일대의 곤충류 분포현황을 파악하고, 자연자원의 발굴 및 관리에 대한 기초자료를 확보하고자 수행되었다. 곤충류 현지조사는 주요 곤충류가 출현하는 시기인 2023년 5월 22~26일 및 8월 28일~9월 1일 총 2회에 걸쳐 채집조사가 수행되었다. 조사방법으로는 조사지 주변에 깔때기 트랩을 설치하여 조사 마지막날 수거하였으며, 주간에는 포충망을 이용하여 채어잡기, 쓸어잡기, 털어잡기, 직접찾기 및 사진촬영 등을 수행하였다. 야간에는 조사 시 식생이 양호한 지역을 선정하여 일몰 전에 유아등을 설치한 후 자정 이전까지 야간조사도 병행하였다. 현지조사를 통하여 채집된 곤충은 연구실로 가져온 후 건조표본 및 액침표본으로 제작되었으며, 각 분류군별 도감을 참고하여 종 수준까지 분류 및 동정 작업을 수행하였다. 조사결과 총 10목 69과 264종의 곤충류가 조사되어 비교적 다양한 분류군이 출현하는 것으로 확인되었다. 또한 금번조사 결과 멸종위기야생생물 II급에 해당되는 애기뿔소똥구리 1종이 확인되었으며, 국외반출 승인대상종 46종, 유용곤충 17종, 분포특이종 12종, 해충 9종, 고유종 5종 등을 포함하여 총 70종의 특정종이 확인되었다.

검색어: 제주도, 곶자왈도립공원, 선흘곶 동백동산, 곤충상

P31

Assessing the effectiveness of combined application of *Beauveria bassiana* (Balsamo) Vuillemin AAD16 and azadirachtin against *Plodia interpunctella* Hubner larvae in laboratory

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Indian meal moth, *Plodia interpunctella* (Lepidoptera: Pyralidae), is a serious pest of stored products. We assessed the efficacy of combined application of *Beauveria bassiana* AAD16 and azadirachtin against *P. interpunctella* under laboratory conditions by using filter paper dipping method. *P. interpunctella* larvae showed lowest LT_{50} in combined application of AAD16 and azadirachtin compared to the application of only azadirachtin. The mycosis rate of *P. interpunctella* larvae was 100% after 14 days of the combined application while AAD16 only application showed 93%. These findings suggest that *B. bassiana* AAD16 and azadirachtin combined solution can be an effective controlling technique against *P. interpunctella* larvae.

Key words: *Beauveria bassiana* AAD16, Azadirachtin, Mortality, Mycosis rate.

P32

Confirmation of the mycological characteristics and insecticidal activity of *Metarhizium pemphigi*

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Aphids are well-known insect pests that, due to their feeding habits, affect various crops' productivity and marketability. Additionally, they cause significant damage worldwide as vectors of viruses. Chemical pesticides are widely used to control these agricultural pests. However, due to resistance to various chemical pesticides, pest control is becoming difficult in agricultural environments. Entomopathogenic fungi such as the genus *Metarhizium* and *Beauveria* are being extensively researched as alternatives to these chemical pesticides. In this study, the mycological properties of isolated from soil *Metarhizium pemphigi* IPBL-H and the insecticidal activity of this strain against *Myzus persicae* and *Aphis gossypii* were evaluated for potential of development as a biopesticide.

Key words: Aphid, Entomopathogenic fungi , *Metarhizium pemphigi*

P33

A comparison of biological characteristics between *Metarhizium anisopliae* strains

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Entomopathogenic fungi have been studied to control insect pests as an alternative to chemical insecticides. However, all fungi haven't a high virulence against pests. In this study, we compared the biological characteristics of *Metarhizium anisopliae* strains. First, we selected four *M. anisopliae* strains and compared the thermotolerance, conidial productivity, and virulence. For the thermotolerance test, conidial suspensions were exposed to 0, 30, 60, and 90 min at 45 °C. As a result, the conidial germination rates were over 95% when exposed for 0 min but, were 64, 37.7, 6, and 3% when exposed for 30 min at 45°C, respectively. To compare conidial productivity, 200g of millet were used and inoculated with a conidial suspension of 1 ml (1×107 conidia/ml). Conidial productivity was investigated after 14 days. As a result of conducting a virulence test against mealworms using a spray method, differences in virulence between strains were confirmed.

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

P34

Investigating the interaction between mosquitoes and fungi through transcriptome analysis

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Entomopathogenic fungi serve as eco-friendly alternatives to chemical pesticides. In this study, we investigate the interactions between mosquitoes and *Metarhizium anisopliae* JEF-157, which showed high insecticidal activity against mosquitoes, by RNA-seq analysis. RNA from mosquitoes 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 mosquitoes. 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. These results are crucial for elucidating the mechanisms of fungal invasion and interaction in insects, providing insights for future pest management strategies.

Key words: mechanism, *Metarhizium anisopliae*, mosquitoes, transcriptome analysis

P35

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

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The two-spotted spider mite, *Tetranychus urticae* Koch, is one of the economically important agricultural pests globally, as it attacks a wide range of vegetable and horticultural crops. In this study, we evaluated spatial repellent and oviposition deterrent activities of *T.urticae* in response to fifteen compounds derived from ester-containing natural products. To evaluate the tests, we used bridge two-choice test and host two-choice test in laboratory conditions. Among the eight compounds showed spatial repellent and oviposition deterrent activities against *T. urticae* at the 20 mg dose and some compounds had the activities at lower dose. We also conducted two-choice test with a blend and single compounds to determine which showed stronger spatial repellent and oviposition deterrent activities. In host two-choice test, we evaluate repellence between distance of compounds. This study concluded that series compounds from ester-containing natural products have the potential to be used managing *T. urticae* in the field.

Key words: two-spotted spider mite, two-choice test, blend, host choice

P36

Development and assessment of microencapsulation-based formulation of Autographa californica multiple nucleopolyhedrovirus

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Spodoptera exigua is one of the worldwide distributed agricultural pest insects and has been known to show high resistance to conventional chemical insecticides. *Autographa california* multiple nucleopolyhedrovirus (AcMNPV) has been used as eco-friendly biological control agent for *S. exigu*a, as it exhibits high level of host specificity, stability and safety. In this study, for formulation of AcMNPV, the optimal conditions for mass-production of AcMNPV polyhedra was established using *S. exigua* larvae. Mass-produced AcMNPV polyhedra was formulated as wettable powder using microencapsulation method and its control efficacy against *S. exigua* was evaluated both in laboratory and semi-field experiment. Chinese cabbage treated with the AcMNPV formulation showed significantly reduced damage rates, suggesting that the AcMNPV formulation in this study could be useful for control of *S. exigua*

Key words: *Spodoptera exigua*, AcMNPV, mass-production, formulation

P37

Mass-production and Formulation of *Bacillus thuringiensis* IMBL-B9 Strain

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Bacillus thuringiensis (Bt) is widely used as an environmentally friendly insecticide compared to chemical insecticides. However, challenges such as difficulty in direct practical application, limited efficacy duration, and stability have been identified. To solve these issues, formulation-based research is being extensively conducted. In this study, the high insecticidal activity strain Bt IMBL-B9, identified in previous research, was subjected to large-scale cultivation using a fermentor. Subsequently, various formulations were developed through formulation processes. and characteristics such as their wettability, suspensibility and particle size were assessed to select the optimized formulation.

Key words: *Bacillus thuringiensis*, biopesticide, formulation

P38

Investigation of the insect pests and natural enemies of *Cnidium officinale* Makino in Korea

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천궁(*Cnidium officinale* Makino, COM)은 산형과(Umbelliferae)에 속하는 산림약용자원 중 하나로 뿌리나 지하부를 건조한 후 약용으로 사용하는 여러해살이 산림약초 중 하나이다. 천궁(COM)은 고혈압, 진통 및 진정 등에 효과가 있다고 알려져 있어, 산림약용자원으로서 재배되는 품목 중 하나이지만 해충의 피해가 심각하여 방제에 어려움이 많이 있다. 천궁은 뿌리가 약재로 사용되지만 종근에 피해를 가하는 응애류 및 파리류 해충은 지하부에 활동하는 생태특성을 가지고 있어 피해초기에 발견하기 어려울 뿐만 아니라 방제가 어려운 실정이다. 천궁(COM)은 연작이 되지 않은 작물 중에 하나이므로 재배포장을 매년 바꿔가면서 재배되고 있는 실정이다. 수확시기는 가을이므로 재배하는 동안에는 정확한 병해충조사가 쉽지 않을 뿐만 아니라 정확한 발생시기 및 피해정도를 확인하는 것이 어려운 실정이다. 본 연구의 목적은 천궁의 해충 및 천적곤충에 대해 조사하여 천궁의 해충종류 및 발생에 대해 이해하고 이를 기반으로 친환경 방제를 위한 천적류의 정보수집 및 분석 등을 위한 기초자료로 제공하고자 한다.

검색어: 천궁, 해충, 천적, 예찰, 생물적방제

P39

Report on Mosquito Monitoring Results through a smart high-altitude insect net

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모기류는 흡혈을 통해 원충, 바이러스, 사상충 등 다양한 병원체를 보유하며 말라리아, 일본뇌염, 웨스트나일열, 뎅기열 등을 사람에게 매개하는 위해성이 있는 위생해충이다. 이번 연구에서는 해외유입 모기류 감시를 위해 경남 고성지역에 설치한 스마트 고공포집기를 이용하여 2022년부터 2023년까지 모기류들을 모니터링하였다. 조사기간 동안, 총 3속 5종 43개체가 채집되었으며, 이중 삼일열 말라리아를 매개하는 *Anopheles belenrae*를 경남지역에서 처음으로 발생함을 확인하였다. 본 연구는 해외유입 모기류에 대한 감시망 구축의 최초 시도로서, 고공포집기를 활용하여 모기류 감시가 가능함을 확인하였다.

검색어: 모기류, 위생해충, 스마트 고공포집기, 해외유입, 모니터링

P40

Exploring host-parasite interactions between human and the body louse via miRNA

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Parasites have co-evolved with their host for a long period of time, resulting in unique parasitic systems tailored to each host species. This makes them suitable for research on physiological function control through cross-species molecules like miRNA. The body louse, a vector of bacterial pathogens, is particularly valuable as a model insect due to their frequent feeding on human blood, which results in the continuous ingestion of human-derived miRNA and injection of salivary gland-derived miRNA into the human body. In this study, we conducted miRNA sequencing on body lice with mixed stages and identified 105 miRNAs, including 50 novel miRNAs. Sequence analysis of human miRNAs remaining in body lice and the functional analysis of these miRNAs are in progress.

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

P41

Development of Molecular Diagnostic Protocols for Simultaneous Identification between Common Bed Bugs and Tropical Bed Bugs

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The recent increase in the occurrence of common bed bug and tropical bed bug in shared areas highlights the need for rapid species identification at infestation sites, which is crucial for implementing targeted control measures due to differences in genetic and physiological traits. In this study, molecular diagnostic methods were developed using species-specific *ITS2* sequences. Both multiplex PCR and loop-mediated isothermal amplification (LAMP) protocols with a DNA release method successfully distinguished between the two bed bug species regardless of developmental stages in 0.5~2.5 hours, even with dead specimens. Especially, LAMP's simplicity and speed make it applicable for rapid and accurate bed bug diagnosis at infestation sites.

Key words: Bed bug, multiplex PCR, LAMP, molecular diagnosis, on-site diagnosis

P42

Genome Analysis of *Anopheles kleini* and *Anopheles pullus*, Vectors of Vivax Malaria in South Korea

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This study focused on the genomic analysis of *Anopheles kleini* and *Anopheles pullus*, both vectors of vivax malaria within the *Anopheles* Hyrcanus group. Using Illumina NovaSeq600 and Oxford Nanopore platforms, we identified 126 and 116 contigs, along with 40,420 and 32,749 genes from *An. kleini* and *An. pullus*, respectively. The assembled genome sizes were 282 Mb for *An. kleini* and 247 Mb for *An. pullus*, which are within a similar range to the sizes previously estimated by digital PCR (249 Mb and 226 Mb). We are currently also estimating the genome sizes of other *Anopheles* spp. and manually curating key genes determining vectorial capacity.

Key words: *Anopheles* Hyrcanus group, Genome analysis, Genome size estimation, digital PCR, vectorial capacity

P43

Development of a Point-of-Care Testing (POCT) Kit for Scabies Diagnosis

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Scabies, caused by an infestation of the skin with the itch mite (*Sarcoptes scabiei*), is highly contagious and classified as a prevalent neglected tropical diseases. The current diagnostic approach relies solely on clinical judgment based on symptoms, history, and microscopic observation by an experienced dermatologist. To enhance sensitivity and specificity, we developed an alternative method based on mite-derived DNA. Our method involves a quick DNA release from skin scraping samples and Loop-Mediated Isothermal Amplification (LAMP) targeting the scabies mite-specific DNA sequences, enabling diagnosis within 30 minutes. Importantly, no cross-reactivity was observed when the sample was contaminated by two house dust mite species, and false positives were barely detected. Currently, we are in the process of developing a Point-of-Care Testing (POCT) kit for a scabies survey targeting school-age children in Timor-Leste as a global health project.

Key words: Scabies, LAMP, POCT, Neglected Tropical Disease

P44

Negative effect of exposure to four pesticides on homing ability and expression of genes associated with 'learning and memory' in honey bee, *Apis mellifera*

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Honey bee plays an important role in pollinating plants. Recently, however, declines in honey bee populations have been reported in many countries, and pesticides have been pointed out as one of the factors contributing to honey bee loss. To determine the effects of pesticides on honey bee behavior, we investigated the homing ability of honey bee exposed to four pesticides (acetamiprid, imidacloprid, fenitrothion, and carbaryl). In addition, the changes in expression levels of genes associated with 'learning and memory' (*cGMP-dependent protein kinase foraging*, *Kruppel homolog 1*, *Adenlyate cyclase 3*, *Early growth response protein 1*, *Hormone receptor 38*) were examined after pesticide treatment in forager bee. The four pesticides tested in this study generally reduced the homing ability of foragers. In the examination of gene expression, learning and memory-related genes were induced by the exposure to acetamiprid, imidacloprid, and carbaryl, whereas fenitrothion decreased the expression of these genes in honey bee. Although further studies are needed, this suggests that pesticides may have negative effects on honey bee behavior and behavior-related gene expression.

Key words: Honey bee, Forager bee, Pesticide, Homing ability, Learning and memory

P45

Expression of genes associated with putative pathway for chemical tolerance in *Drosophila melanogaster*

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The habitat of *Drosophila melanogaster* is the environment of fruit decay/fermentation which emits high concentrations of chemicals. Our recent studies revealed that *D. melanogaster* has been evolutionarily adapted to its habitat through tolerance to chemicals and induction of antimicrobial peptides (AMPs) plays an important role for chemical tolerance. To determine the correlation between AMPs and the chemical tolerance pathway, we hypothesized that expression of AMPs is induced by tissue damages or ROS caused by chemical exposure and AMPs activate antioxidant enzymes, thereby inducing chemical tolerance in *D. melanogaster*. Therefore, in this study, we investigated the induction levels of genes associated with necrosis (*EGR* and *BSK*), apoptosis (*Dronc*, *Dcp1*, and *Drice*), antioxidant physiology (*SOD1*, *SOD2*, *CAT*, *Trxr1*, *GstD2*, and *GstD5*), and SAM metabolism (*Gnmt* and *Foxo*) in *D. melanogaster* exposed to three chemicals, 2-phenylethanol, ethanol, and acetic acid. As a result, above genes were induced in chemical-exposed fly, and this supports our hypothesis of chemical tolerance pathway in *D. melanogaster*.

Key words: *Drosophila*, environmental chemicals, tolerance, antimicribial peptide, pathway analysis

P46

Transcriptome profiling reveals differential gene expression of detoxification and mitochondrial-related enzymes in *Tribolium castaneum* responding to carbonyl sulfide

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A new fumigant, carbonyl sulfide (COS), has potential for use as a replacement for methyl bromide, yet its mechanism of toxicity to insects remains poorly understood. In this study, transcriptome analysis was performed on *Tribolium castaneum* malpighian tubules and fat bodies, which are known to play an essential role in energy storage and utilization in insect species. In total, upon exposure to COS, 3,034 and 2,973 genes were differentially expressed in the *T. castaneum* malpighian tubules and fat body, respectively. These differentially expressed genes comprise a significant number of detoxification-related genes, including 105 P450s, 18 glutathione S-transferases (GSTs), 82 ABC transporters, 25 UDP-glucosyltransferases and 42 carboxylesterases and mitochondrial–related genes, including 9 complex I genes, 2 complex II genes, 1 complex III gene, 9 complex IV genes, 8 complex V genes from both malpighian tubules and fat body tissues. Moreover, KEGG analysis demonstrated that the upregulated genes were enriched in xenobiotic metabolism by ABC transporters and drug metabolism by other enzymes. We also investigated the role of carbonic anhydrases (CAs) in toxicity of COS using dsRNA treatment in *T. castaneum*. These results show that CA genes have a key role in toxicity of the COS. Furthermore, the results of transcriptomic analysis provide new insights into the insecticidal mechanism of COS fumigation against *T. castaneum* and eventually contribute to the management of this important stored grain pests.

Key words: red flour beetle, carbonyl sulfide, mode of action, carbonic anhydrase

P47

A chromosome-scale and annotated reference genome assembly of *Plecia longiforceps* (Diptera: Bibionidae)

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Urbanization is a driving force of global biodiversity changes, and species that successfully adapt to city environments can become pests with the assistance of human factors. Here we present the first genomic data of *Plecia longiforceps*, an invasive pest exhibiting intensive outbreaks in the Seoul Metropolitan Area of Korea. HiFi and Pore-C sequencing data were used to construct a highly continuous genome assembly with a total size of 707 Mb and 8 major pseudochromosomes. Gene annotation using transcriptome data and *ab initio* predictions revealed significant numbers of genes related to detoxification and heat tolerance. Comparison to the *Bibio marci* genome showed high levels of synteny with some regions of chromosomal rearrangement. Our data will serve as an essential resource for population and functional genomic studies on dispersal and outbreaks of *P. longiforceps*, and facilitate research on eco-evolutionary processes of dipterans in urbanizing habitats.

Key words: invasive species, lovebug, march fly, Pore-C, urban pest

P48

MicroRNA expression profiling of *Spodoptera frugiperda* under Chlorantraniliprole, Indoxacarb and Thiamethoxam exposure

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The fall armyworm, *Spodoptera frugiperda*, has developed extremely high levels of resistance to chlorantraniliprole and other classes of insecticides in the field. As microRNAs (miRNAs) play important roles in various biological processes through gene regulation. we examined the miRNA profile of *S. frugiperda* in response to Chlorantraniliprole, Indoxacarb and Thiamethoxam. Transcriptome analysis showed significant changes in the abundance of some miRNAs after treatment of *S. frugiperda* larvae with LC_{20} concentrations of three insecticides. A total of 197 miRNAs were systematically identified from *S. frugiperda*, and 16, 9, 2 miRNAs were differentially expressed after treatments of three insecticides. Importantly, three miRNAs were significantly downregulated and three were upregulated by RT-qPCR after treatment the LC_{50} of three insecticides with *S. frugiperda* larvae. Microinjection of agomirs of these six miRNAs into *S. frugiperda* larvae resulted in significant changes in mortality rates when exposed to three insecticides. Additionally, we also screened potential target genes for some of differentially expressed miRNAs, which may play important roles in insecticide resistance development. These findings provide valuable insights into the molecular mechanisms of insecticide resistance and underscore the potential of miRNAs as targets for the development of novel pest control strategies in *S. frugiperda*.

Key words: *Spodoptera frugiperda*, miRNA, Chlorantraniliprole, Indoxacarb, Thiamethoxam

P49

Gryllus bimaculatus densovirus suppression using RNAi in two-spotted cricket (*Gryllus bimaculatus*)

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쌍별귀뚜라미는 국내에서 식용 및 파충류의 먹이로 사용되는 중요한 산업곤충으로 알려져있다. 2023년 국내 쌍별귀뚜라미 농가에서 쌍별귀뚜라미 덴소바이러스 감염이 확인되었으며 바이러스 억제제가 요구되는 실정이다. RNA 간섭(RNAi)은 dsRNA를 이용해 목적 유전자의 발현을 억제할 수 있는 작용기작을 가지며, 바이러스 특이적 시퀀스를 이용한다면 효과적으로 타겟 바이러스의 증식을 저해할 수 있다. 본 연구에서는 덴소바이러스에 감염된 귀뚜라미에 덴소바이러스 특이적 dsRNA를 제작하여 주입(injection)하고, 바이러스 발현 저해 효과를 관찰했다. 바이러스 감염 수준은 qPCR로 평가하였으며 dsRNA를 접종한 결과 체내 바이러스양이 감소함을 확인했다. 이 연구는 향후 RNAi를 이용한 쌍별귀뚜라미 덴소바이러스 억제제 개발에 도움이 될 것으로 기대된다.

검색어: RNAi, 쌍별귀뚜라미, 덴소바이러스, qPCR

P50

Evaluation of Next Generation Sequencing assembly software for the genome of Oryctes rhinoceros nudivirus

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차세대 염기서열 분석(Next Generation Sequencing, NGS)은 대량의 병렬 데이터 생산으로 유전체의 염기서열을 고속으로 분석하는 기술이며, 이 기술은 바이러스 유전체 분석에도 광범위하게 사용되고 있다. 하지만, 바이러스의 전장 유전체가 100kb를 넘을 경우, 동일한 raw data라도 분석 방법 및 소프트웨어 그리고 매개변수(parameter)에 따라 유전체의 크기와 구조가 다르게 결정된다. 따라서 유전체가 큰 바이러스 분석 시, 최적화된 NGS 분석 방법을 선택하는 것이 중요하다. 본 연구는 장수풍뎅이 누디바이러스(Oryctes rhinocerous nudivirus, 120kb) 유전체를 기반으로, 다양한 Assembly 소프트웨어(metaviralSPAdes, metaSPAdes, velvet, shovill, Geneious, megahit)를 사용하여, 최적화된 NGS 분석 방법을 고안하였다. Assembly 소프트웨어에 따라 바이러스 유전체 크기와 특징(Single Nucleotide Polymorphism, Insertion&Deletion, repetitive genomic variants)의 차이를 확인하였다. Assembly 소프트웨어 간의 차이가 있는 염기서열은 Sanger sequencing을 통해 재확인하여, 참조 유전체(reference sequence)를 구축하였다. 이 참조 유전체를 기반으로 가장 정확한 Assembly 소프트웨어와 parameter를 평가하였다. 본 연구는 분석 방법에 따라 달라지는 유전체의 특성을 이해하고, 바이러스 유전체를 정확하게 구축하는 분석 파이프라인을 제공할 것으로 기대된다.

Key words: Next-generation sequencing, Nudivirus, Genome, Bioinformatics

P51

Prevalence of virus in the Ascomycota and Zygomycota fungus in Korea

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마이코바이러스는 곰팡이를 감염시키는 바이러스로 자낭균류, 담자균류 및 난균류에서 주로 발견되며 일부의 경우 곰팡이의 표현형에 영향을 끼치는 것으로 알려져 있다. 이번 연구에서는 대한민국 토양 샘플에서 분리된 65개의 자낭균류 및 접합균류 균주의 전체 핵산을 추출하고, 전기영동을 통해 바이러스 특이적 밴드를 스크리닝하였다. 스크리닝 결과 65개의 균주 중에서 *Tolypocladium* spp. 균주 2개와 *Marquandomyces marquandii* 균주 1개에서 바이러스 특이적 밴드를 발견하였다. 그 후, Cellulose Chromatography를 이용하여 double-stranded RNA를 분리하고 DNase I 및 S1 Nuclease 처리를 통해 DNA와 single-stranded RNA를 제거하여, *Tolypocladium* sp. 균주 1개와 *Marquandomyces marquandii* 균주에서 발견한 특이적 밴드가 dsRNA임을 확인하였다. 추후 virus-free isogenic line을 확보하여 virus 유무에 따른 표현형 변화를 확인하고, 마이코바이러스와 곰팡이 간의 상호작용에 관해 연구할 계획이다.

검색어: 마이코바이러스, dsRNA, *Tolypocladium* spp., *Marquandomyces marquandii*

P52

Molecular characterization of virus in the entomopathogenic fungus *Metarhizium pinghaense*

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Mycoviruses are a group of viruses that infect filamentous fungi. While most hosts infected with mycoviruses do not show any symptoms. In some cases, mycoviruses induce various phenotypic changes include alterations in morphology, drug resistance, pathogenicity, virulence, sporulation, and growth. Entomopathogenic fungi are one of the integrated pest management agents as an alternative to conventional insecticides. Mycoviruses have the potential as supportive agents, enhancing the efficiency of the insecticidal activity of the fungi. Studies about mycoviruses themselves and their interaction with their hosts, especially entomopathogenic fungi, are needed to realize their full potential. In this work, the sequence of the dsRNA element isolated from the entomopathogenic fungus *Metarhizium pinghaense* 4-2 strain was determined. Through this study, we report the sequence of a dsRNA virus isolated from the *Metarhizium pinghaense* for the first time. In further studies, the ORF of the mycovirus that induces a phenotype change in the host will be researched.

Key words: RLM-RACE,

P53

Differences in immune response between *Aphis gossypii* adults and nymphs against entomopathogenic fungal infection

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Aphis gossypii is a representative pest that transmits plant viral diseases. It is difficult to control with chemical pesticides alone due to their high pesticide resistance. Entomopathogenic fungi are biological control agents that can replace chemical pesticides and have characteristics of high host specificity and safety to humans. Therefore, we investigated the immune pathways of aphids against initial infection by entomopathogenic fungus. We treated aphids with the *Beauveria bassiana* JEF 544 strain and examined the immune response in early infection by qPCR. furthermore, we also studied changes the molting time of nymphs and changes in adult nymphal production caused by entomopathogenic fungi.

Key words: *Aphis gossypii*, entomopathogenic fungi

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Profiling of destruxins, the toxin from entomopathogenic fungi *Metarhizium* against *Aphis gossypii*

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*Metarhizium*은 대표적인 곤충병원성 진균 중 하나로, 종에 따라 매우 다양한 곤충에게 병원성을 일으키는 폭 넓은 기주범위를 형성한다. 이들이 주로 생성하는 것으로 알려진 destruxins (DTXs)이라는 2차 대사산물은 살충 활성 뿐만 아니라 항바이러스, 항증식, 항암 등 다양한 분야에서 효능이 연구되고 있어, 해당 물질에 대한 관심이 집중되고 있다. 살충 물질로서의 DTXs는 여러 곤충에 있어 병원성을 나타내는 것이 확인되었으나, 해충으로서 전 세계적으로 심각한 경제적 피해를 일으킴과 동시에, 화학 살충제 저항성 문제가 야기되고 있는 목화진딧물에 대해서는 아직 DTXs의 역할이 연구되지 않고 있는 실정이다. 본 연구에서는 목화진딧물에 대해 곤충병원성 진균 *Metarhizium* spp.의 병원성 발현에 DTXs가 미치는 역할을 간접적으로 확인하기 위해, qPCR을 활용하여 진균 처리 후 목화진딧물 사망 시간과 관련하여 충체 내 DTX 합성효소의 발현을 비교 분석하였다.

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

P55

Construction of optimal expression forms for efficient production of hand, foot, and mouth disease virus like particles

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Hand, foot, and mouth disease (HFMD) is a highly contagious disease with no specific treatment. Since it is common in immunocompromised children under the age of 5, there is a need to develop a safe vaccine. Virus-like particles (VLPs) are similar structures to viruses with the lack of genetic material which makes them impossible to replicate and infect, and therefore have a high level of biological safety and are considered to have high value as vaccines. In this study, the insect virus expression system that is widely used for vaccine and drug production due to its high post-translational modification efficiency, was used to produce VLPs for Coxsackievirus type A6 and A10, which are recently reported to be the main causes of HFMD. For this purpose, the selection of promoters that can control the timing and intensity of expression of 3CD protein, which is essential for VLPs assembly but has been reported to be cytotoxic, was conducted to construct an optimal expression form for HFMD-VLP.

Key words: Hand, foot, and mouth disease, Virus-like particles, Insect virus expression system

P56

Increasing the efficiency of target protein production by regulating VLF-1 in insect cell expression system

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The baculovirus expression system (BES) utilize the *p10* or *polyhedrin* promoter, a very late promoter that exhibits strong transcriptional activity primarily at the end of viral infection, to produce useful recombinant proteins. The burst sequence of the very late promoter is essential for strong transcription, and VLF-1 is a transcription factor that binds specifically to the burst sequence, and it has been reported that it can regulate the amount and timing of expression of protein by the very late promoter. Recently, a VLF-1 constitutively expressing cell line was constructed to increase the production of the target protein, but the effect was minimal. In this study, to find the optimal VLF-1 expression conditions to increase target protein production efficiency, we controlled the expression of VLF-1 through various promoters and evaluated the target protein expression efficiency by the *p10* promoter accordingly.

Key words: BES, VLF-1, *p10* promoter, burst sequence

P57

Biological potential of Bacteria 'Ch-1' isolated from Chinese Tiger Beetle (*Cicindela chinensis*) against Fungi and Antibiotics

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우리는 길앞잡이(*Cicindela chinensis*)의 장에서 다양한 공생 미생물들을 분리하였다. 그중 다양한 곰팡이 성장을 억제하는 세균을 동정하였고 "Ch-1"이라 명명하였다. 우리는 Ch-1 균주를 사용하여 10종의 식물 병원성 곰팡이와 2종 곤충 병원성 곰팡이의 생장 억제를 확인하였다. 또한 8종의 항생제에 대한 저항성을 확인하였다. 동시에, 본 균주의 genomic sequence를 수행하였고 유전적, 생화학적, 생리적 특성을 조사하였다. Ch-1균주는 특허등록과 친환경 미생물제제로 등록하였고 향후 생물학적 방제제로써 활용될 수 있을 것으로 판단한다.

검색어: 길앞잡이, 장내 미생물, 길항작용, 항생제, 생물학적 방제

P58

Biochemical characterization and IAA activation test of potential plant growth promoting bacteria *Enterobacter roggenkampii* isolated from *Monochamus alternatus* gut

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우리는 솔수염하늘소(*Monochamus alternatus*) 장에 존재하는 공생미생물들을 분리하였다. 그중 다양한 식물들을 대상으로 성장 촉진 효과가 보고된 세균을 단일배양 분리하였다. 이 세균은 16S rRNA sequencing을 통하여 *Enterobacter roggenkampii*로 동정되었다. 우리는 분리된 *E. roggenkampii*에 대하여 genomic sequencing을 수행하였고 유전학적 특성을 확인하였다. 우리는 *E. roggenkampii*가 식물의 성장을 촉진할 수 있는 다양한 유전자들을 가지고 있는 것을 확인하였고 그 중 IAA-Asp hydrolase 유전자를 가지고 있음을 알 수 있었다. 동시에, 분리된 *E. roggenkampii*와 같은 속의 세균을 대상으로 다양한 API kit와 기질 첨가 배지를 이용하여 생화학적 특성을 비교하였다. 향후 IAA-Asp 가수분해효소를 생산하는 잠재적인 식물 생장 촉진 비료 미생물로 등록하여 다양한 작물을 대상으로 생장 촉진 효과를 확인할 것이다.

검색어: 곤충 장내 미생물, 생화학, 식물 생장 촉진

P59

Taxonomic review of the genus *Nycteola* Hübner (Lepidoptera, Nolidae) in Korea

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Here we review the genus *Nycteola* of the Nolidae (Lepidoptera). As the result of this study, we recognized already synonymized species *N. costalis* Sugi, 1959 of *N. coreana* (Leech, 1900) and newly recorded species *N. dufayi* Sugi, 1982. Whlie the number of Korean *Nycteola* species remain unchanged, the composition has been changed.

Key words: endemic species, Japan, hostplant, synonym, Palearctic region

P60

First report of the western drywood termite *Incisitermes minor* (Hagen, 1858), a new invasive alien species in South Korea

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서부마른나무흰개미(신칭)는(*Incisitermes minor*) 미국 서부와 멕시코 북부를 포함하여 북미 서부가 원산인 종이며 주택을 포함한 목조 구조물에 치명적인 해충이다. 국내에선 2023년 9월 외래생물신고센터를 통해 경남 창원시 진해구의 한 가정집에서 흰개미 유시충이 발견되었다는 민원 신고로 처음 확인되었다. 그 이후 주변 지역 조사 결과 민원인 주택 주변에서 군집비행하는 흰개미 유시충 및 목재 피해 흔적을 통해 군체를 발견 확인하였다. 또한, 최초발견지에서 약 1km 떨어진 한 아파트 단지의 정자 및 그 일대에서 추가 군체가 확인되었다. 본 연구에서는 채집된 흰개미의 형태와 유전자 정보를 통해 대상종을 확인하였고, 발견 및 피해 상황 정보를 통해 향후 해당 종의 관리를 위한 기초자료를 제공하고자 한다.

검색어: 서부마른나무흰개미, *Incisitermes minor*, 외래생물

P61

A report of two provisional micro-lepidopteran pests from Jeju island

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Jeju Island has been facing to threat of high-risk invasive pests from tropical areas. To protect domestic agriculture from those invasive pests, APQA has conducted a regular monitoring program on Jeju Island. We collected especially phototactic heteroceran pests by light bucket trap and identified them using their superficial appearances, and also mitochondria COI gene. As a result, a total of 24 families, 136 genera, 193 species, and 819 individuals were collected from around Jeju Island in 2023. Among them, two unidentified epidopteran pests, *Palpita* sp. (Crambidae) and *Xyrosaris* sp. (Yponomeutidae) were collected.

In the present study, we report two unidentified micro-lepidopteran pests using superficial characteristics and mitochondria COI gene.

Key words: COI, jeju, micro-lepidoptera, plant quarantine

P62

Two species of the genus *Grapholita* (Lepidoptera: Tortricidae) new to Korea

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The genus *Grapholita*, belonging to the tribe Grapholitini under the family Tortricidae, which is small to medium-sized moths ranging from 7mm to 16mm. It is a relatively diverse group in Grapholitini, comprising more than 150 species worldwide. This group is generally distributed throughout the world, with the majority of its species occurring in the Holarctic region. Some species in the genus *Grapholita* are known worldwide as serious pests that feed on leaves, roots, fruits and other plant parts. In Korea, the genus is known to have 8 described species up to date.

In this study, we report two newly recorded species of the genus *Grapholita* from Korea, including a brief description and illustrations of adult and genitalia. Additionally, all available information including distribution, host plants and a taxonomic key to Korean *Grapholita* species is provided.

Key words: Lepidoptera, Tortricidae, Olethreutinae, Grapholitini, *Grapholita*, new record, taxonomy, pest

P63

First records of *Acerocnema* Becker, 1894 (Diptera: Scathophagidae) from South Korea

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This study reports the first Korean records of the genus *Acerocnema* Becker, 1894, with one new species, *Acerocnema saurischia* sp. nov., and one newly recorded species, *A. flavifrons*. A key to the Korean Scathophagidae is provided with morphological diagnosis and images of habitus and male genitalia structures. To assist in species identification, mitochondrial cytochrome c oxidase subunit I (COI) gene sequences were obtained from all specimens to conduct DNA barcoding.

Key words: *Acerocnema*, new species, Scathophagidae, COI barcoding, South Korea

P64

A new species of *Pararhabdepyris* Gorbatovsky (Hymenoptera, Bethylidae) from the Korean Peninsula with an updated key to the world species

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Pararhabdepyris Gorbatovsky, 1995, is a small genus in Bethylidae (Hymenoptera, Chrysidoidea), currently comprising only six valid species worldwide. A new species is described and illustrated from South Korea. *Pararhabdepyris* sp. nov., which appears closely related to *P. paradoxus*, is characterized by the combination of the following characters: the basal two-thirds of the scape are dark castaneous, coxa and femora are dark castaneous, the median and submedian metapectal-propodeal disc is rugulose, and the transverse posterior carina is straight. Images of diagnostic characteristics and an updated key to the seven world species of the genus are presented.

Key words: Classification, flat wasp, Old World, Palaearctic region, Scleroderminae

P65

Three newly recorded species of the genus *Argyresthia* Hübner (Lepidoptera: Argyresthiidae) from Korea

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The genus *Argyresthia* Hübner, [1825] of the family Argyresthiidae is known to comprise over 150 species worldwide. Among them, more than 70 species are recognized in the Palearctic region. The Korean fauna of the genus *Argyresthia* includes 11 described species to date.

In this study, we report three species of the genus *Argyresthia* for the first time in Korea: *A. brockeella* (Hübner, [1813]), *A. longalbella* Liu, Wang & Li, 2017, and *A. mala* Liu, Wang & Li, 2017. All available information, images of adults and genitalia for species are provided.

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

P66

Complete mitochondrial genome of the clearwing moth, *Synanthedon bicingulata* (Lepidoptera: Cossoidea: Sesiidae)

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The clearwing moth, *Synanthedon bicingulata* (Staudinger, 1887), is a pest that infests various species of cherry trees. However, genetic information regarding the genus *Synanthedon* including *S. bicingulata*, is limited. In this study, we sequenced a complete mitochondrial genome (mitogenome) of the species. The 16,255 bp of *S. bicingulata* mitogenome differs from the typical gene arrangement formed in Lepidoptera: *trnQ-trnS$_2$-trnM-trnI* arrangement between the A+T-rich region and the *ND2* junction. Moreover, the genome has untranslated repetitive sequences in the intergenic space between *lrRNA* and *trnV*, as well as the CGA start codon in *COI* and the TTG start codon in *ATP8*. Similar observations are noted in species belonging to the tribe Synanthedonini within the genus *Synanthedon*.

Key words: *Synanthedon bicingulata*, clearwing moth, mitochondrial genome, gene arrangement

P67

Integrative species delimitation and mitochondrial heteroplasmy of the East Asian genus *Aphaenomurus* Yosii (Tomoceridae, Collembola)

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To assess the accuracy of species delimitation in the genus *Aphaenomurus* Yosii, we conducted a comparative micro-morphological study and molecular analysis using two mitochondrial (COI, 16S) and two nuclear genes (18S, 28S) on 118 specimens from 24 localities. The results showed that the morphological characters of *A. vicinus* and *A. interpositus*, as presented in the original description, were intermixed in phylogenetic lineages within the genus and did not form independent lineages. Furthermore, there were enough differences among *Aphaenomurus* individuals to be considered as morphologically distinct species (Th. III is 1+1 or 2+2, Abd. I is 2+2 or 3+3, Abd. II is 2+2 or 3+3), but they do not form an independent lineage. Molecular and morphological analyses have determined that *A. vicinus* and *A. interpositus* are the same species, exhibiting morphological variation in dental spines formula, claws, chaetotaxy, and other features. Additionally, the genus *Aphaenomurus* forms a monophyletic clade, which is further divided into several lineages within the genus. No morphological differences were observed to distinguish these lineages. This cladistic divergence is attributed to heteroplasmy, which is supported by previous studies that have suggested the possibility and problems of heteroplasmy in Collembola, and by the high genetic distances between individuals in the mitochondrial genes of *Aphaenomurus*.

Key words: *Aphaenomurus*, morphologcial variation, species delimitation, heteroplasmy

P68

Preliminary research on fruit fly (Diptera: Tephritidae) larvae

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우리는 식물검역 과정에서 검출되는 파리목 유충을 효과적으로 동정하기 위하여 대화형 검색표를 제작하고 있다. 파리목은 농업 분야와 식물검역 분야에서 매우 중요한 해충이며, 특히 과실파리과는 다양한 식물에 피해를 주는 대표적인 분류군이다. 과실파리과는 예전부터 형태, 생태, 분자, 분류, 모니터링, 방제 등 다양한 주제로 연구가 이루어져 왔으며, 현재까지 다양한 연구가 이루어지고 있다. 본 연구에서는 과실파리과를 연구하는데 중요한 기초자료로 활용될 수 있도록 1)과실파리과 유충의 형태학적 특징을 포함하여 2)과실파리과의 일반적인 특징과 3)생태학적 특징 등 관련 정보를 수집하고 분석하여 결과를 종합정리하였다.

검색어: 과실파리, 유충, 형태적 특징, 생태적 특징

P69

Investigation of insect diversity on the golf course using light traps

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The effective management of insect pests requires decisions based on monitoring information. In this study, we aimed to monitor insect species diversity and monthly occurrence patterns on the golf course using light traps. Sampling was conducted at Anyang Country Club, Korea, from May to October 2023. A total of 5,149 individuals were collected, with Lepidoptera and Coleoptera being the most abundant orders. Among them, there were six species (*Agrotis ipsilon*, *Blitopertha orientalis*, *Heptophylla picea*, *Maladera orientalis*, *Parapediasia teterrella*, and *Spodoptera depravata*) of insect pests that caused serious damage to the turfgrass. The results of this study could be used as data to establish efficient management strategies for turfgrass insect pests.

Key words: golf course, turfgrass insect pests, insect diversity, light trap

P70

Impacts of arsenate on the size and fecundity of *Myzus persicae* across generations

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Herbivorous insects can be exposed to soil contaminants via trophic transfer. To assess the effect of accumulated arsenate (As(V)) in host plants on aphids across generations, *Myzus persicae* were reared for several generations on pepper (*Capsicum annuum*) grown in soil treated with 0, 2, 4, and 6 mg of As(V) per kg. In the first generation, the body length of *M. persicae* significantly ($p < 0.05$) increased on As(V)-treated plants ($\mu = 1.29$ mm) compared to untreated plants ($\mu = 1.21$ mm). Aphids showed higher fecundity on plants treated with 2mg/kg of As(V) (15.3) compared to untreated ones (10.6), but it decreased again under the 4mg/kg (11.4) and 6mg/kg (11.2) treatments. When newborns were transferred to untreated plants after being reared on each treatment for two previous generations, they exhibited higher fecundity as their parents were treated with higher levels of As(V). While more research is needed to understand the unexpected beneficial effects, this study highlights the complex impacts of soil As(V) on aphid dynamics which span multiple generations.

Key words: green peach aphid, heavy metal, trophic transfer, ecotoxicology

P71

Computational behavior applied to spatio-temporal movement of individuals and groups in insects

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Group movements of insects are bases for unravelling origin of social behavior of animals and are important in both theoretical (e.g., evolution) and practical (monitoriing) aspects. Automatic recognition and effective computational methods were developed for characterizing multi-individual interactions in laboratory conditions. Movements of *Drosophila* species in different genetic strains were continuously observed across days. Characteristic behaviors are objectively expressed based on parameter extraction and data structure visualization. Group activities, including aggregation, inter-individual interactions and arena positioning were objectively characterized in different photo- and scoto-phases according to machine-learning and spatio-termporal patterning techniques. Individual-group relationships are presented regarding how individual movements would contribute to formulating group activities. Usefulness of automatic monitoring of insect group movement is further discussed for a basis for genetic functioning in behavioral aspect.

Key words: Drosophila, automatic movement detection, Geo-SOM, crowding, computational behavior

P72

Field monitoring and genetic diversity of the large copper butterfly *Lycaena dispar* (Lepidoptera: Lycaenidae), a near-threatened species in South Korea

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The large copper butterfly *Lycaena dispar* (Haworth, 1803; Lepidoptera: Lycaenidae) has been categorized as a near-threatened species (NT) in South Korea from 2012 mainly due to limited distribution. In this study, we visited 36 sites spread across all South Korean provinces to verify the distributional range of the species and sequenced mitochondrial COI for 53 individuals from nine sites. We observed *L. dispar* at 15 sites in six provinces, including the two previously known provinces, indicating a southward range expansion. The in-field monitoring and genetic data collectively suggested that *L. dispar* does not have a limited distribution nor is it isolated, indicating that it should be reclassified as less vulnerable. Our study demonstrates that the combination of field and genetic data can provide a more reliable assessment of the stability of a species.

Key words: *Lycaena dispar*, near-threatened species, range expansion, genetic diversity, field monitoring

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Characteristics Investigation of *Apis cerana* RX Genotype in JEONBUK STATE

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본 연구는 우수한 꿀벌 신품종 육성을 위해 국립농업과학원에서 육성된 재래꿀벌 RX계통을 분양받아 '23~'24년까지 부안군 변산면에 위치한 전북농업기술원 잠사곤충시험장 양봉사에서 꿀벌세력, 수밀력, 질병저항성, 온순성, 질병발생, 월동능력을 한라벌 품종과 비교하여 조사하였다. 8~11월 RX계통의 꿀벌세력 감소는 3.9%로 한라벌 39.8% 대비 상대적으로 낮았고, 수밀력, 청소능력, 온순성은 유의적 차이가 없었다. 낭충봉아부패병 등 질병은 전북동물위생시험소에서 병성검정한 결과, 두 시험군 모두 항원이 검출되었으나 임상증상은 없었다. 그리고 월동 중 한라벌 품종은 폐사한 반면, RX계통은 모든 시험군이 월동에 성공하였고, 또한 월동전·후 먹이감 소량이 적어 월동능력이 우수한 것으로 판단하였다. 본 연구는 국립농업과학원 공동연구사업(PJ01504205)의 지원을 받아 수행하였다.

검색어: 꿀벌, 동양종꿀벌, 신품종, 재래꿀벌, 전북특별자치도, 지역적응시험

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Comparison of biomass of herbivores using macromoths in two forest characteristics

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대표적인 초식곤충인 나방은 기주식물 특이성을 갖고 있어 기주식물 분포에 따른 식생구조나 서식지 유형을 이해하는데 사용이 가능한 분류군이다. 나방은 종 다양성이 높고 분류학적으로 잘 알려져 있어 조사가 많이 이루어져 풍부한 데이터가 존재하여 이들의 공간적, 시간적 규모의 생물량 변화 추세를 확인할 수 있다. 본 연구에서는 공간적인 유형에 따라 나방의 생물량을 비교하고자 하였다. 생물량을 추정하기 위해 이용된 분류군은 자나방과, 밤나방과, 태극나방과로 이들 분류군의 앞날개 길이를 기준으로 종별로 계산을 하였다. 공간적인 유형은 숲의 위치(연속된 숲, 파편화된 숲)와 숲의 구성(침엽수림, 활엽수림, 혼효림)을 사용하였다. 그 결과 숲의 위치에 따라 생물량은 차이가 존재했지만(F = 16.76, P < 0.001), 숲의 구성(F = 1.54, P = 0.22)과 숲 위치와 구성의 상호작용은(F = 0.34, P = 0.71) 생물량의 차이를 확인하지 못하였다. 숲 구성에 따라 차이가 나타날 것으로 예상하였지만 나타나지 않은 데에는 추후 분류군을 더 늘려 확인하는 것이 필요하다. 또한 식물 생물량 추정을 통한 곤충과 먹이자원의 가용 관계를 파악하는 연구도 필요할 것으로 예상한다.

검색어: 나방, 생물량, 초식, 공간수준, 상호작용

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Injury symptoms and diagnosis result caused by *Cuphodes diospyrosella* Issiki of Persimmon in Gyeongsangbuk-do Province

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2023년 경상북도 상주시 떫은감 과수원에서 잎 표피아래 굴을 파고 들어가면서 원형 또는 부정형의 식흔자국을 남기는 증상을 관찰하였다. 해충의 유충은 녹색에서 적색으로 변하며 번데기 단계를 거쳐 성충(길이 3㎜, 갈색)이 되어 탈출하였다. 본 해충에 대해 잎에서의 피해증상과 실험실에서 유전분석 결과 Genbank(GU816671,486bp DNA liner, 2016)에 등재되어 있는 감잎가는나방(*Cuphodes diospyrosella*)으로 동정되었다. 일본에서 1957년 최초 보고 후 우리나라에서는 주로 경남 창원과 진주의 농약 무살포 및 유기농 단감원에서 발생하였으나, 이번 경북지역에 처음 발견되어 떫은감 재배 농업인과 현장지도원의 감잎가는나방에 대한 피해증상 진단에 활용할 수 있을 것으로 생각된다.

검색어: 해충, 피해증상, 감잎가는나방, 감, 경북지역

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Ecological characteristics and control of three invasive termites (*C. domesticus, C. gestroi, I. minor*) and potential risk species in South Korea

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2023년에 국내에서 보고된 적이 없던 외래흰개미 3종이 각각 인천, 서울, 창원에서 발견되었다. 종 동정 결과, 인천에서 출현한 종(*Coptotermes gestroi*)은 Subterranean termite로 밝혀졌으며, 서울과 창원에서 출현한 종(*Cryptotermes domesticus, Incisitermes minor*)은 Drywood termite로 밝혀졌다. 본래 우리나라에는 Subterranean termite 흰개미가 2종이 분포하고 있다고 보고되어 있었으나, 새로운 과 또는 속의 외래흰개미가 발견되면서 국민들의 우려가 커지고 있다. 국내에서는 일부 외래흰개미를 법적으로 지정(유입주의 생물 2종, 관리병해충 15종)하여 관리하고 있는데, 해당 흰개미와 그 외의 신규 흰개미의 출현으로 인한 피해가 우려되는 상황이다. 본 연구에서는 '23년 유입된 3종 및 기존 법정관리 외래흰개미, 그리고 국내 유입과 위해가 우려되는 외래흰개미 5과(Archotermopsidae, Kalotermitidae, Rhinotermitidae, Termitidae, Termopsidae)를 조사하였으며, 이들의 생태적 특징과 외국의 사례를 통해 외래흰개미 대비 방법에 대하여 고찰하였다.

검색어: 외래생물, 외래흰개미, 유입주의 생물, 관리병해충

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Attraction test method for effective Codling moth (*Cydia pomonella*) pheromone trap

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코드린나방은 사과, 배, 복숭아 등 과실류를 비롯한 다양한 작물에 피해를 주는 해충으로써, 대한민국 식물방역법상 금지해충에 속해있다. 검역실적으로는 2016년 6월에 1건, 2018년 6월에 2건이 모두 인천공항으로 수입된 우즈베키스탄산 양벚에서 검출되었다. 코드린나방은 국내 침입이 매우 우려되는 해충 중의 한 종으로써 한국, 일본, 대만을 제외한 거의 모든 온대지역에 분포하고 있다. 따라서 우리나라는 본 해충에 대한 정밀하고 지속적인 표적 예찰이 필수 불가결이다. 효과적인 예찰을 위한 페로몬 트랩 개발을 위해 다음 사항들을 고려할 수 있다. 우선 페로몬 성분비에 따른 유인력의 차이를 검정해 효과적인 성분비를 찾는 것이 중요한데, 그 방법으로는 GC-MS/MS 분석법을 통해 루어의 페로몬 구성비율을 분석한다. 이후 적합한 실험환경을 설정하고 페로몬 혼합물을 적용한 여과지를 케이지에 달아 일정 시간 동안 여과지에 접촉한 횟수를 기록 후 통계분석을 통한 유의성 검정을 실시한다. 이어서 페로몬을 루어에 주입, 흡착시킨 후 페로몬 트랩을 현장에 설치해 포획된 수컷 성충수를 조사해 효과적인 약량 및 루어형태 등을 선별하게 된다. 이를 통해 효과적인 코드린나방 트랩 개발을 위한 기초연구를 수행하고자 하며, 우리나라의 농업과 자연환경 보호에 기여하고자 한다.

검색어: 코드린나방, 유인제, 금지해충

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A comprehensive analysis of global measures implemented to control the spread of the Khapra beetle during quarantine

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In countries without strong biosecurity systems, Khapra beetle, *Trogoderma granarium* poses a continuing threat to agriculture. Even when quarantine laws exist, the risk is greater if one of the world's most serious pests becomes introduced to imported stored grain. The rate of Khapra beetles introduced is rising sharply with increased transport, trade, travel, and tourism between countries and continents. Species identification is usually the key to success in Khapra beetle control programs. Countries that export/import grains, such as Australia, Canada, Russia, Korea and USA, must ensure that their ports, grain storage facilities, and transportation systems are free of khapra beetle. Researchers so far developed effective quarantine treatments and eradication strategies to deal with khapra beetle infestations that occur upon import at inland port. Khapra beetle introductions are likely to be impacted by a variety of factors, including trade flow and quarantine laws. In this study, we provide an overview of the current global quarantine laws, invasions of khapra beetle, and its control strategies.

Key words: Quarantine pests, Genetic control, World economy, Stored products

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Genetic techniques for controlling stored food products insects

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Numerous Dermestidae insects are considered significant pests because of their capacity to inflict substantial economic harm on stored food items. Trogoderma and Attagenus genera members are commonly discovered in imported grain and other food products. Usually, infestations of these species consist of various species that reproduce quickly and spread effortlessly. The small size of Attagenus and Trogoderma stored-product stages makes it extremely challenging to identify them based on their morphological characteristics. Hence, it is imperative to have precise identification techniques in place to ensure the safety and dependability of the grain industry, as well as to streamline efficient plant quarantine measures. Various molecular methods have been employed for insect species identification, such as restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism (AFLP), random amplified polymorphic DNA (RAPD), single-strand conformation polymorphism (SSCP), DNA sequence analysis, and species-specific primer PCR (SS-PCR) techniques. Despite the considerable focus on quickly identifying these species in stored products in recent years, there is a notable absence of systematic molecular identification. This research highlights the use of genetic techniques to differentiate between Trogoderma and Attagenus species.

Key words: Quarantine pests, pest control, stored products

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Managing early invasion of alien species in Korea: a perspective from the differential grasshopper, *Melanoplus differentialis* (Orthoptera: Acrididae)

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Melanoplus differentialis (Thomas, 1865) is a widely distributed Orthopteran species in North America, including the United States and Mexico. Known for causing damage to various crops such as vegetables and grains throughout its lifecycle. In South Korea, it has been observed concentratedly in the vicinity of the Onsan National Industrial Park in Ulsan and was designated as "Ecosystem Disturbing Species" by Ministy of Environment in 2020. This study aims to present foundational data on pest management strategies for *Melanoplus differentialis* identified within the Onsan National Industrial Park. Through collaborative efforts between the National Institute of Ecology, related agencies, and tenant private companies from 2020 to 2023, we will demonstrate the reduction in habitat area as a result of proactive pest control measures.

Key words: Invasive alien species, *Melanoplus differentialis*, Alien species Management

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Survey of scrub typhus vectors at epidemic season in Honam region, Korea 2023

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A surveillance of chigger mites was performed to monitor the incidence of scrub typhus vectors at four environmental collection points in two locations (Sunchang and Haenam) in the Honam region of Korea from August to December 2023. During the surveillance period, 4,174 chigger mites were collected and the predominant species were *Leptotrombidium scutellare* (94.3%). The density of chigger mites had the peaked at 44 week (10.26~11.1), while the density of patients peaked at 45 week (11.2~11.8) respectively. A positive correlation (r=0.69) observed between scrub typhus patients and vectors. This result suggests that this vector surveillance method will be useful for alarm system of tsutsugamushi disease. However, the relationship between scrub typhus cases and chigger mite density will be studied through long-term periodic surveillance.

Key words: scrub typhus, chigger mites, *Leptotrombidium scutellare*, correlation, alarm system

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Reporting on molecular authentication and counterfeit distribution cases of animal-derived medicine 'O-gong,' the centipedes through DNA barcode analysis

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국내에서 유통되는 한약재 오공(蜈蚣)의 정·위품 유통 현황 파악과 유전자 감별법 개발을 위해 서로 다른 6개 유통사에서 오공으로 판매중인 전형약재를 구매하여 각 약재 포장 단위별 크기, 색깔, 무늬 등 형태적으로 차이가 있는 개체를 분류하여 국내에서 채집된 왕지네 표본 2개체를 포함 총 30개 시료를 대상으로 DNA 바코드 분석을 실시하였다. 확보한 미토콘드리아 COI 염기서열 정보와 기 등재된 NCBI GenBank 염기서열 정보를 이용하여 계통 분석을 실시한 결과, 28개 약재 시료 중 국산 및 중국산 전형약재 유통품 13 개체는 모두 대한민국약전외한약(생약)규격집에 정품 기원종으로 수재된 *Scolopendra subspinipes mutilans*로 확인되었으며, 이들은 국내 채집 왕지네 개체들과 함께 하나의 단계통군을 형성하였다. 하지만 인도네시아산 전형약재 유통품 15 개체의 경우 4개의 그룹으로 구분되었는데, 그 중 3개 그룹은 *S. dehaani*, *S. subspinipes*, 그리고 명확한 종을 알 수 없는 *Scolopendra* sp.로 *Scolopendra* 속으로 확인되었고 나머지 그룹을 형성하는 한 개체는 *Scolopendra* 속에 속하지 않고 *Rhysida singaporiensis*와 89%의 유사도를 보였다. COI 바코드 분석을 통해 국내 유통되는 오공은 원산지가 한국 또는 중국인 경우 모두 정품 기원종으로 확인되었으며, 원산지가 인도네시아인 경우에는 모두 위품인 것으로 확인되었다. 또한 위품으로 확인된 유통약재는 총 4개의 종으로 분류되었고, 대부분은 정품인 *Scolopendra*속의 분류군이었으며 *Rhysida*속과 가까운 분류군도 오공으로 수입되어 유통되고 있는 것으로 확인되었다.

검색어: 오공, *Scolopendra*, 유전자 감별, COI, DNA 바코드

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The effect of rapid cold hardening followed by low temperature treatment on the expression of glycerol kinase gene in fall armyworm, *Spodoptera frugiperda*

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겨울과 같은 환경에서 곤충은 생존과 번성을 위해 생리학적, 생화학적 및 행동적 메커니즘을 이용하고 있다. 대부분의 곤충은 생리학적 적응가운데 급속내한성(Rapid cold hardiness, RCH) 유기를 통해 기온이 급격히 낮아지는 외부 환경에 대해 빠르게 적응하고 저온조건에서 생존율을 높인다. 열대거세미나방의 경우 행동적 메커니즘을 통해 따뜻한 곳을 찾아 장거리 비행을 하며, 생존에 유리한 환경으로 이동한다. 본 연구에서는 열대거세미나방의 생리적 월동능력과 RCH 능력에 관해 조사하였다. 그 결과, RCH에 의해 혈중 글리세롤의 농도가 증가와 체내빙결점이 하강하는 것을 확인할 수 있었다. 또한, RCH(-10℃, 1h)에 노출된 2령 유충기를 대상으로 4령과 5령 유충기에 단기저온(5℃, 30min)에 노출 시 글리세롤 생합성에 관여하는 유전자(glycerol kinase 1, 2)의 발현이 RCH에 노출되지 않은 대조구와 비교하여 빠르게 발현되었다. 이는, 열대거세미나방의 유전자 수준에서 저온에 대한 단기기억이 존재하는 것을 제시한다.

검색어: 열대거세미나방, 급속내한성, 글리세롤 키나제, 단기기억, 유전자

P84

Computational movement analysis of behavioral modulation by cGMP-dependent protein kinase of the western flower thrips, *Frankliniella occidentalis*

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Behavioral modulation by genetic changes garners a special attention nowadays as an effective means of revealing genetic function on the one hand and broadening the scope of *in situ* monitoring on the other hand. The cGMP-dependent protein kinase was treated to the western flower thrips, *Frankliniella occidentalis*. Automatic recognition techniques and computational methods were utilized to investigate behavioral changes across photo- and scoto-phases. Movement behaviors are objectively expressed according to parameter extraction and data structure visualization in different light phases. By comapring with the individuals without treatment, activities of treated thrips were changed including decrease in circadian rhythm. Usefulness of automatic monitoring of insect movement in different genetic strains is further discussed for providing useful information on monitoring and diagnosing natural and unntatural genetic disturbances.

Key words: Behavior detection, machine learning, circadian rhythm, movement parameter, monitoring

P85

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

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Insect cuticular extracellular matrices (ECM) including the eggshell and exoskeleton play vital roles in protecting them from natural environmental stresses. However, these chitinous ECMs must be degraded at least in part during embryonic and post-embyonic molting periods to accommodate continuous growth all the way to the adult stage. In this study we investigated the functions of groups I and II chitinases, TcCHT5 and TcCHT10, in turnover of the eggshell and cuticle in *Tribolium castaneum*. RNAi and TEM analyses revealed that TcCHT10 is required for digestion of chitin in the serosal cuticle for embryo hatching as well as in the old cuticle during post-embryonic molts including larval-pupal and pupal-adult metamorphosis. However, although TcCHT5 is apparently involved in these vital physiological events, TcCHT10 could substitute for TcCHT5 except during the pupal-adult molting when both enzymes are indispensable to degrade chitin in the old pupal cuticle.

P86

Development of genetic database for detected quarantine pests

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With the increasing indroduction and spread of invasive quarantine pests, accurate diagnosis of pests detected in quarantine sites has become crucial. DNA barcoding, a standardized method that complements morphological analysis for rapid and precise species identification, is actively researched worldwide. In this study, we established a molecular biological identification system for major pests encountered during the import and export of agricultural and forestry products. By analyzing the DNA barcode sequences of pests collected domestically and those detected in quarantine inspections, we compiled genetic information for 1,292 individuals representing 472 species, 108 families across 11 insect orders. Among these, order Lepidoptera had the highest diversity, with 251 species across 27 families. We also secured barcodes for 52 species, 24 families in order Hemiptera, and 70 species, 20 families in order Coleoptera. By constructing a comprehensive biological foundation and database for various pests detected in quarantine sites, we aim to enhance the quarantine system by enabling rapid and accurate identification of invasive pests, thereby blocking early.

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

P87

Study on the breeding satisfaction survey of Orthoptera breeding kits

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The purpose of this study is to select various insect species for healing resources and develop a healing program in order to use insect as a healing agriculture. In this study, there are two kinds of breeding kit were developed, one for Gryllus bimaculatus and the other for Oxya chinensis sinuosa. Using these insect breeding kits, we conducted a survey of 60 children and the elderly. In the case of children, the results of the insect breeding satisfaction showed that 30.6% said that the sound of crickets was very good, and 11.1% said that it was good. In addition, the higher the child's awareness of insects, the higher the proportion of children who wanted to raise insects in the future. As a result of a survey of seniors, 45.2% do not like insects and 51.6% are not interested, meaning that most seniors are not very interested in insects. However, the emotions after breeding insects showed positive results, with 45.2% saying their personality became brighter, 48.4% reducing their anger, 48.4% relieving their irritation, 54.8% relieving loneliness, 58.1% feeling more responsible, and 51.6% developing intimacy.

Key words: Emotional insects, Insect Healing Program, Mass rearing of the insect

P88

Addition of agricultural byproducts to feeding substrate affects growth performance and nutritional value of mealworms, *Tenebrio molitor* (Coleoptera: Tenebrionidae)

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갈색거저리 유충의 사료인 밀기울은 대부분 수입에 의존하고 있는데 일부 국가의 식량 수출 중단 조치 등에 따른 국제 곡물가격 상승으로 밀기울 가격은 인상되고, 식용곤충 판매가격이 하락하면서 생산비 절감을 위한 사료 개발이 요구되고 있다. 농업부산물 3종을 50% 이상 급이하게 되면 유충 생육이 저하되었기 때문에 본 연구는 적정한 배합비율을 선정하기 위해 첨가사료 20, 30% 함량으로 밀기울과 혼합하여 사료를 급이하였을 때 갈색거저리 유충의 생육 특성과 영양성분 변화에 대해 밀기울만 제공한 대조구와 비교하였다. 부산물 A와 B, C를 각각 30% 함유한 처리구에서 갈색거저리 유충 무게는 대조구와 차이가 없음을 확인하였다. 먹이소화율은 부산물B를 20% 함유한 처리구가 80.5%로 대조구에 비해 높았고, 부산물C 30% 처리구에서 72.6%로 가장 낮았다. 갈색거저리 유충의 생육일수 100일 기준으로 부산물B 30% 처리구에서 용화율이 76.1%로 대조구보다 1.6배 높았으며, 부산물A 20% 처리구는 29.2%로 용화율이 가장 낮았다. 갈색거저리 유충의 조단백질 함량은 부산물 C 30% 처리구에서 대조구보다 10.3% 증가하여 아미노산 분석을 진행한 결과 sarcosine과 ornithine이 2.5배 이상 증가하였다. 이를 통해 부산물 B나 C를 30% 함유한 사료를 급이하였을 때 사육 원가를 절감하여 유충을 생산할 수 있을 것으로 사료된다.

검색어: 갈색거저리, 사료, 생육특성, 영양성분

P89

Trend of ants (Hymenoptera: Formicidae) at quarantine and surveillance sites in South Korea

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We analyzed trends of ants intercepted on imported plants and lumber over the past 30 years, using data extracted from the Pest Information System (PIS). There were 1,629 cases of about 112 species (5 subfamilies, 45 genera) from planting plants such as *Asparagales*, *Alismatales*, and *Saxifragales*, and 2,217 cases of about 86 species (7 subfamilies, 42 genera) from lumbers such as square lumber, pellets, and solid wood. For intercepted trends by continent, Asia was the most frequently detected at 91%, followed by Europe at 1% and North America at nearly 1%. Among Asian countries, Malaysia (27%) represented the highest number of interceptions, followed closely by Indonesia at 26%.

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

P90

Management of Storage Pests in grain exporting countries and Detection status of Stored Grain Pests at Quarantine Sites

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The current inspection count for imported grains is 37,072. The scientific management of stored grain, which includes methodical pest identification and control procedures, is highly prioritized in the nations that export these grains. International documents on stored grain pests include a thorough description of all life phases, including mites and larvae, as well as methodical treatment techniques. They are more valuable than domestic manuals because of their comprehensive coverage and methodical management strategies. There is lack of genetic resources and photographs since the identification of stored grain pests in the domestic have been based on data from before 2017.

During the course of 13 years(2010-2022) 1,469 incidences of stored grain pests were detected. Of these, 7 orders 34 families and 81 species had cases where the identification was confirmed down to the species level, for a total of 963 cases. This number shows that about 18% of the domestic quarantine site's stored grain pests are not species-identified. Objectives in this study are to present genetic barcode data, high-resolution photoes for classification and identification, and information on international stored grain pest management techniques. Building on this, a new identification manuals for stored grain pests might be created, which would improve the site's taxonomic identification levels.

Key words: identification, interception, genetic barcode, taxonomic key

P91

Unrecorded genus *Psectra* and *Psectra diptera* (Neuroptera: Hemerobiidae) new to Korea

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The Genus *Psectra* is a small group of Hemerobiidae, and *Psectra diptera* is one of the rare and attractive species in this group because of hindwing variation. They are well known to have their hindwing reduced, similar to flies, depending on their habitat environment. We report Genus *Psectra* and *Psectra diptera*, new records from Korea. We provide brief descriptions and photos of adults and genitalia.

Key words: Neuroptera, Hemerobiidae, brown lacewing, *Psectra*, *Psectra diptera*

P92

New record of genus *Necyla* (Neuroptera: Mantispidae: Mantispinae) from Korea

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Mantidflies or Mantid lacewing (Mantispidae) is a morphologically interesting group of Neuroptera. This group is a general predator of arthropods and is equipped with raptorial forelegs similar to praying mantis. In Korea, only three species, *Climaciella quadrituberculata*, *Mantispa harmandi*, and *Mantispilla japonica*, are recorded until now. Here we report Genus *Necyla* and *Necyla formosana*, new records in Korea. We provide diagnostic character and photos of adult and genitalia.

Key words: Neuroptera, Mantispidae, *Necyla*, *Necyla formosana*

P93

Taxonomic study of *Trichophysetis* (Crambidae, Lepidoptera) in Korea

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The genus *Trichophysetis* is one of the taxa that has recently undergone frequent changes in its taxonomic position. Only four species have been recorded in Korea, including synonymized Hendecasis species. Recent studies on the taxonomic classification of *Trichophysetis* have not addressed any species inhabiting Korea. Therefore, it is necessary to conduct a renewed morphological analysis of Korean species. In this study, we compare and analyze four Korean *Trichophysetis* species with one newly recorded species.

Key words: Glaphyriinae, morphology, wings, key, Amur

P94

Native insect Bio-scan project for Korean islands

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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).

Approximately 1,000,000 species of insect known worldwide (Costello et al., 2012), and 20,710 species are known in Korea (NIBR, 2023). Among these, there are 6,117 species in Korean islands (HNIBR, 2022).

Native insect Bio-scan project for Korean islands is to estimate the number of insect species on Korean islands. We attempted to estimate the number of insect species on Korean islands using Barcode Index Number (BIN), and also found unrecorded species. The samples were collected four times from April to July at five locations in the Amtedo, an island located in Shinan-gun Jeollanam-do. We tried to obtain a minimum of one to usually a maximum of four samples per morphospecies to enable DNA barcoding.

Key words: Bio-scan, Korean islands, insect fauna, Lepidoptera

P95

A first record of invasive species, *Lepisiota frauenfeldi* (Mayr, 1855) (Hymenoptera: Forcmicidae) from Korea

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Native to southern Europe, *Lepisiota frauenfeldi* (Mayr, 1855) is an invasive species that has been introduced worldwide through cross-border trade. It has been documented to be distributed in the Mediterranean, Middle East, Africa, and Indo-Malaya. This species, also known as Browsing ant, was first found around a warehouse in Gwangyang, Jeollanam-do, South Korea, and was probably introduced into the country via cargo. The external morphology and gene sequences were checked for taxonomic identification, and it was identified as *Lepisiota frauenfeldi* based on comparative analysis of the morphological classification key and NCBI data. This study is the first report of a newly invasive alien ant and provides basic data on the species, including external morphological and ecological features and sequencing results.

Key words: Hymenoptera, *Lepisiota frauenfeldi*, Invasive Alien Species, Browsing ant

P96

New species of the genus *Olethreutes* (Lepidoptera: Tortricidae: Olethreutinae) in Korea

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The genus *Olethreutes,* established by Hübner in 1822, is based on the type species *Phalaena arcuella* Clerk, 1759. *Olethreutes* is one of the largest group within the family Tortricidae, with more than 130 species worldwide. As of now, about 31 species of the genus *Olethreutes* have been reported in the Korean peninsula. The proposes of this study is to describe one new species, with three similar species form Korea.

Key words: Tortricoidea, Palearctic Region, taxonony, new species

P97

Taxonomic notes on the genus *Hypsopygia* Hübner, 1825 (Lepidoptera, Pyralidae, Pyralinae) in Korea

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The genus *Hypsopygia* was established by Hübner, 1825, with type species *Phalaena costalis* Fabricius, 1775. *Hypsopygia* is characterized by the elongated uncus and valva, and pointed saccus in the male genitalia. It consists of 105 described species (Nuss *et al*., 2003–2024) in the world, and 11 species have been recorded in Korea (Kim & Paek, 2020; Shin *et al*., 2023). In this study, we reported one newly recorded species in Korea. Illustrations of adults provided, with information of host plants of all examined species.

Key words: Lepidoptera, Pyraloidea, taxonomy, new record, host plants.

P98

Taxonomy of the Subfamily Miltogramminae (Diptera: Sarcophagidae) in Korea

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The Miltogramminae (Diptera: Sarcophagidae) includes 600 species divided into more than 40 genera. The biological feature of the miltogrammine species is being kleptoparasites in the nests of solitary wasps and bees, but insect parasitoids and termite inquilines have been also recorded. In Korea, only three species in two genera have been recorded.

In this study, five unrecorded species (*Amobia oculata*, *Metopia inermis*, *Metopia nudibasis*, *Miltogramma angustifrons* and *Phylloteles formosana*) are reported for the first time in Korea. The diagnosis, photographs and checklists are provided herein.

Key words: Taxonomy, Diptera, Sarcophagidae, Miltogramminae

P99

New record of the genus *Megastylus* Schiødte, 1838 (Hymenoptera, Ichneumonidae, Orthocentrinae) from South Korea

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The genus *Megastylus* is a moderate group of the subfamily Orthocentrinae, comprising 38 species in two subgenera from worldwide. The subfamily Orthocentrinae is a high proportion of the genera are cosmopolitan in distribution. Orthocentrines are known as almost solitary koinobiont endoparasitoids. We report this genus for the first time from South Korea. In this study, descriptions of some new species, photographs of diagnostic characterists are provided.

Key words: new record, new species, Orthocentrinae, parasitoids, wasps

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P100

eDNA analysis of some terrestrial insects in Korea

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eDNA(enviromental DNA)는 물, 토양, 대기 등 다양한 환경에서 채취한 생명체의 유전자 또는 그 유전자를 채취·분석하는 기술로 생물을 직접적으로 관찰하지 않아도 생물이 남긴 흔적을 통해 종의 동정이 가능하다는 장점이 있다. 따라서, 야외에서 해충의 예찰조사, 외래종 감시 및 멸종위기종 모니터링 등 다양한 목적으로 활용될 수 있는 장점이 있다. 최근, 국제적으로 미생물, 수생태계 및 육상곤충 등 다양한 방면으로 eDNA가 연구되고 있으나 국내에서는 eDNA 연구가 수생태계, 미생물 등 일부 분야에서만 진행 중이며 육상곤충의 eDNA 연구는 미비한 실정이다.

따라서, 금번 연구에서 육상곤충에 활용할 수 있는 eDNA 실험방법 확립을 위해 기존문헌 참고 및 곤충분야에 접목하여 활용 가능한 육상곤충 샘플링 방법을 탐색 및 정리하였으며, 추후 eDNA 연구에 기반을 마련하고자 한다.

검색어: eDNA, 육상곤충, 분류학, 동정, 분자진단

P101

Morphological characteristics of the reproductive system and DNA barcoding for the classification of the Herminiinae (Lepidoptera, Erebidae) in Korea

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줄수염나방아과는 나비목 중에서 가장 큰 분류군 중 하나인 밤나방과에 속한다. 분류군 내에서 날개무늬가 비슷한 경우가 있어 동정에 어려움이 많은 그룹 중 하나이다. 또한, 이 들은 산림 지역, 초지 및 물가 등 다양한 환경에 서식하며, 생활 습성에 따라 일부는 임업 및 농업에 피해가 큰 해충으로 알려져 있는 중요한 경제곤충 그룹이라 할 수 있다. 본 연구는 이와 같이 분류동정이 어려운 줄수염나방아과 곤충을 대상으로 야외채집조사, 표본제작, 생식기 해부검경 및 DNA 바코드 등을 수행하여 최종적으로 분류학적 동정지침서를 작성하고자 수행되었다. 연구결과 19속 63종으로 정리되었다. 본 연구를 통해 확보된 DNA바코드 데이터는 정확한 바코드를 활용한 진단 및 동정 연구 등에 활용되고, 이들의 분포정보 구축, 형태적 특징 및 분자분석 연구의 기초데이터 확보를 통한 관련 분야 활성화 등에도 기여할 수 있을 것으로 기대된다.

검색어: DNA barcode, reproductive system, Herminiinae, Erebidae, Korea

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First record of the coprophagous beetle genus *Stenotothorax* Schmidt (Scarabaeidae: Aphodiinae) in Korea

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The genus *Stenotothorax* is reported for the first time in the Korean Peninsula. While working on Korean Aphodiinae, we identified *Stenotothorax hibernalis* (Nakane & Tsukamoto) from the Goseong-gun, Gangwon Province. This species was found in the northern region of South Korea. A key to Aphodiini genera in Korea, habitus photographs, and illustrations of diagnostic characters are provided to facilitate identification.

Key words: *Stenotothorax*, Aphodiinae, coprophagous beetle, taxonomy

P103

Lepidopterous insect fauna of Chungju and Eumseong, Chungcheongbuk-do, Korea

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본 조사는 제5차 전국자연환경조사의 일환으로 육상곤충류의 분포현황을 알아보기 위해 수행되었다. 조사도엽은 충북 음성군(장호원, 생극 도엽) 및 충주시(동량, 앙성 도엽) 등지에서 각각 2개 도엽씩 구분하여 최소 2계절 이상 포함되도록 2023년 4월부터 7월까지 총 24회(도엽당 4회)의 채집·조사를 실시하였다. 조사방법으로는 포충망을 이용한 쓸어잡기, 채어잡기 및 현장확인 등을 통해 기본조사를 수행하였으며, 트랩 조사방법으로는 버킷라이트트랩을 사용하였다. 현지조사를 통해 채집된 곤충은 건조표본으로 제작하여 종 수준까지 분류 및 동정 작업을 수행하여 총 157과 932종 5,235개체의 육상곤충류가 채집·조사되었다. 2017년 수행된 선행조사에서는 62과 235종의 육상곤충류가 확인되었으며 선행 조사 결과와 금번 현지 조사종을 종합하면, 충청북도 음성군 및 충주시의 나비목은 총 44과 984종으로 정리되었다. 이 중 91과 697종이 금번 현지조사에서 새롭게 확인된 종이었다.

검색어: 2023년 전국자연환경조사, 육상곤충류, 버킷라이트트랩

P104

Monitoring of the genus *Grapholita* (Lepidoptera: Tortricidae) in Korea

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The genus *Grapholita* Treitschke, 1829 is a complex group belonging to the tribe Grapholitini of the subfamiliy Olethreutinae, due to their similar characteristics among the species. The genus comprises about 150 described species worldwide. The majority of described species occur in the Holarctic region. To date, eight species of *Grapholita* have been reported from Korea. The genus contains several notorious pests such as *G. dimorpha* Komai and *G. molesta* (Busck). Among them, *G. inopinata* has been doubtful in distribution.

This study aim to optimize species specific sex pheromone composition/amount and establish the distribution of the pest species of the genus *Grapholita* in Korea.

Key words: Lepidoptera, distribution, *Grapholita*, Korea

P105

Taxonomic study of *Trichophysetis* (Crambidae, Lepidoptera) in Korea

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The genus *Trichophysetis* is one of the taxa that has recently undergone frequent changes in its taxonomic position. Only four species have been recorded in Korea, including synonymized Hendecasis species. Recent studies on the taxonomic classification of *Trichophysetis* have not addressed any species inhabiting Korea. Therefore, it is necessary to conduct a renewed morphological analysis of Korean species. In this study, we compare and analyze four Korean *Trichophysetis* species with one newly recorded species.

Key words: Glaphyriinae, morphology, wings, key, Amur

P106

The sugarcane looper, collected from Byeonsanbando National Park, Korea

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Mocis frugalis (Fabricius, 1775), the sugarcane looper, was collected in Byeonsanbando National Park in South Korea for the first time. This species is known as a major crop pest, especially to sugarcane at tropical and subtropical regions. Due to climate change and the subtropicalization of the southern part of the Korean Peninsula, some tropical and subtropical crops are cultivated in Korea, including sugarcane. Besides, *Oryza sativa* L. and *Zea mays* L., which of main crops in Korea, are known as host plants of *M. frugalis* in the Oriental region. Even if unclear of domestic settlement, precision monitoring will be necessary.

Key words: sugarcane looper, insect pest, invasion, Jeollabuk-do

P107

A new silkworm variety, NuriGeumJam, producing yellow sericin cocoons

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연구에서는'누리금잠'이라 명명된 새로운 누에 신품종을 개발하였으며, 이는 황색 고치와 세리신 고치를 생산하는 두 개의 기존 계통, 잠311과 D751의 교배를 통해 육성되었습니다. 이 신품종은 첫 교배 실험을 거친 2019년 봄부터 2021년 봄까지 총 4차례의 생산력 평가를 진행했으며, 이어진 2022년 봄부터 2023년 가을까지 4차례에 걸친 지역 적응성 평가를 통해 2023년 가을에 새로운 품종으로 공식 인정받았습니다. '누리금잠'은 봄과 가을 시즌에 각각 평균 부화율 86.9%, 89.6%를 기록하였고, 유충의 평균 성장 기간은 봄에는 21일과 12시간, 가을에는 19일과 22시간으로 나타났습니다. 세리신 고치의 평균 생산성은 봄에 79.17%, 가을에 74.9%였으며, 수확된 세리신의 평균 중량은 누에고치 250개를 기준으로 봄에 6g, 가을에는 7.7g으로 측정되었습니다.

이와 같은 결과는'누리금잠'이 높은 부화율과 우수한 세리신 생산성을 갖추고 있음을 시사합니다. 이는 세리신 기반 제품의 생산 효율성을 증가시킬 뿐만 아니라, 양잠산업의 경제적 가치를 상승시키는 데 기여할 수 있을 것으로 생각됩니다.

검색어: 누에, 세리신, 색견, 신품종

P108

A tentative mechanism for the pupal chamber construction of the Japanese pine sawyer, *Monochamus alternatus* Hope (Coleoptera: Cerambycidae) in pine trees

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The Japanese pine sawyer (JPS), *Monochamus alternatus* Hope, is an important vector of the pine wood nematode, *Bursaphelenchus xylophilus* (Steiner and Buhrer), which causes pine wilt disease. JPS selects a characteristic life cycle of a four- or five-instar pathway, which indicates the number of instars before pupation. In this study, we investigated the potential presence of a three-instar pathway and sought to determine the minimum larval age required for JPS to construct a pupal chamber. The results showed that no third instars made pupal chambers, suggesting that there is no three-instar pathway. The initiation time of digging the tunnel to make the pupal chamber ranged widely from Julian date 274 (30 September) to 332 (27 November). This timing became an average age stage of 4.8 instar, which equals an 80% completion of the fourth instar. Thus, the minimum larval age at which JPS constructs the tunnel to pupate the next year is estimated to be late in the fourth larval instar. Further, we discuss the diapause ecology in relation to the larval development of JPS in different thermal environments. Tentatively, we suggest that the regulation of diapause induction in JPS involves a dual process of reaching a critical developmental stage and stimulus (tentatively a cold temperature). This hypothesis will be helpful for future studies of diapause mechanisms and the selection of the instar-pathway in JPS and related species.

Key words: Vector of pine wilt disease, Diapause ecology, Entrance hole, Mandible length, Life cycle

P109

A prediction model for the adult emergence of *Delia antiqua* (Diptera: Anthomyiidae) from overwintered pupae and its field validation

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고자리꽃파리는 양파 및 마늘 등 백합과 *Allium* 속에 속하는 농작물에 중요한 해충으로 전 세계적으로 온대지역에서 경제적 해충으로 취급하고 있다. 본 연구에서는 기존 자료를 바탕으로 월동번데기의 성충으로 우화모델를 작성하고 포장 실측자료와 비교하여 평가하였다. 월동번데기 발육모형으로 선형과 비선형모형을 작성하고 발육기간 분포모형과 결합하여 예찰모형을 작성하였다. 비선형발육모형 작성시 3-매개변수 락틴모형 적용뿐만 아니라 4-매개변수 모형의 마지막 변수 값을 선형모형의 절편값으로 대체하여 저온에서 선형성이 강화도록 변형시켰다. 성충우화 50% 예측에서 일일평균온도를 이용하는 경우 적산온도 모형을 비롯하여 발육률 적산모형(선형식 및 비선형식) 모두 실측치와 큰 차이가 있었다. 시간별온도를 입력값으로 한 경우 3-매개변수 모형을 제외한 사인곡선 적산온도 모형, 선형 발육률 적산모형, 4-매개변수 비선형 발육률 적산모형의 평균편차는 3일과 차이가 없었다. 최종적으로 선형모형 및 4-매개변수 비선형모형을 바탕으로 시간별온도자료를 이용한 발육률 적산모형은 선발하였다. 그 결과 선형 발육률 적산모형이 두 포장적합 집단(1984, 1987)에서 실측일과 편차가 3일과 차이가 없었다. 비선형 발육률 적산모형은 1984년 적합은 0.8일 편차로 정확하였으나 1987년 집단에서 평균편차가 6.5일로 다소 증가하였다.

검색어: 고자리꽃파리, 발생예측모형, 적산온도, 우화모형, 시간별온도

P110

Growth period by temperature of *Rhopalosiphum nymphaeae* (Hemiptera: Aphididae) occurring on medicinal crop *Alisma plantago-aquatica* L. subsp. *orientale* (Sam.) Juz.

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질경이택사(*Alisma plantago-aquatica* L. subsp. *orientale* (Sam.) Juz.)는 습지에서 자라는 여러해살이 풀로 질경이택사는 덩이줄기를 약용으로 사용하며, 이뇨작용, 고혈압, 고지혈증 등에 효과가 있다. 국내에서는 전남 순천에서 주로 재배되고 있으며, 8월 중・하순에 벼를 수확하고 같은 논에 후작으로 육묘한 택사를 이모작으로 심어 소득을 올리고 있다. 2022년 8월 전남 순천에서 재배중인 질경이택사에 진딧물이 발생하였으며 수생식물에 주로 발생하는 연테두리진딧물로 확인되었다. 연테두리진딧물(*Rhopalosiphum nymphaeae*)은 노린재목 진딧물과에 속하는 곤충으로 몸체는 황색, 황갈색 또는 적갈색을 띄고, 알로 월동하고, 질경이택사, 연꽃, 수련 등의 수생식물로 이주하여 흡즙가해한다. 연테두리진딧물을 5개 온도(15.0, 20.0, 25.0, 30.0, 35.0℃), 65±5%, 16L:8D의 조건에서 발육기간을 조사하였다. 약충의 발육기간은 각각 10.8, 8.2, 5.5, 4.7일이었고, 35℃에서는 발육하지 못하였다. 성충의 생존기간은 각각 29.2, 28.2, 17.2, 8.6일이었고, 35℃에서는 발육하지 못하였다.

Key words: *Rhopalosiphum nymphaeae*, *Alisma plantago-aquuatica*, Growth period, Survival period

P111

Potential distribution in South Korea of three quarantine mealybug species (Hemiptera: Pseudococcidae): here's what CLIMEX says

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Dysmicoccus brevipes (Cockerell), *Dysmicoccus neobrevipes* Beardsley and *Pseudococcus longispinus* (Targioni-Tozzetti) are widely-distributed pests that feeds on many economically important hosts, particularly tropical fruits and ornamentals. The potential distribution of these mealybug pests into South Korea remains a primary concern because of their high incidence in interceptions screened during inspection. Hence, these species prompted a modelling effort to assess their potential risk of introduction. Potential risk maps were developed for these pests with the CLIMEX model based on occurrence records under environmental data. The potential distribution of these pests in South Korea in the 2020s, 2050s and 2090s was projected based on the RCP 8.5 climate change scenario. Results show that *D. brevipes*, *D. neobrevipes* and *P. longispinus* have little potential for invasion in the exterior environment of South Korea due to high cold stress in the 2020s. However, for *D. brevipes* and *P. longispinus*, 3 and 86 locations in Jejudo, were predicted to be marginally suitable for this pest under future climate factors, respectively. In that respect, the results of these model predictions could be used to prepare a risk-based surveying program that improves the probability of detecting early *D. brevipe*, *D. neobrevipes* and *P. longispinus* populations.

Key words: Climate change, pink pineapple mealybug, grey pineapple mealybug, long-tailed mealybug, risk prediction

P112

Report on the Survey Results of Terrestrial Insects in Muju-gun, Jeollabuk-do

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Insects, constituting a classification group with exceptionally high diversity, account for over half of all known species on Earth and over 80% of the animal kingdom, holding potential for diverse genetic resources. Therefore, this study aimed to assess the distribution of terrestrial insects in major surveyed areas, focusing on firefly habitats in Muju-gun and key locations such as Ilsadae, Pahoe, Sushimdae, and Naedori Riverside Park in Muju-gun, to acquire fundamental data for the exploration and management of natural resources.

As result of survey, Total 12 order, 104 family, 314 species of insect has been confirmed.

Key words: Muju-gun, terrestrial insects, biodiversity.

P113

Seasonal adult occurrence of three pest moths in Iksan, Korea

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최근들어 평균 온도가 평년보다 높게 경과함에 따라 노지 작물에 발생이 많은 파밤나방, 담배거세미나방, 담배나방의 발생소장을 2023년 전북 익산의 노지 고추포장에서 성페로몬트랩을 이용하여 조사하였다. 파밤나방은 4월 중순부터 채집되기 시작하였으나 채집량은 적었고 6월 중순, 7월 중순, 9월 상순, 9월 하순에 발생최성기를 보였다. 담배거세미나방은 5월 중순부터 채집되기 시작하여 6월 상순, 7월 상순, 8월 상순, 9월 상순, 11월 상순에 발생최성기를 보였으며 8월 하순이후 발생량이 많은 경향이었다. 담배나방은 5월 상순부터 발생하기 시작하여 6월 중순, 8월 상순, 9월 상순에 발생최성기를 보였으며 10월부터는 채집량이 적은 경향이었다.

검색어: 성페로몬트랩, 파밤나방, 담배거세미나방, 담배나방, 발생소장

P114

Effect of temperature on the development of *Autographa nigrisigna* (Lepidoptera: Nictuidae)

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상추는 수요가 연중 지속됨에 따라 재배면적과 생산량이 증가하고 있는데, 주로 생식으로 이용되며 수확간격이 짧아 해충 다발생시 약제방제가 어려운 작물이다. 최근 검은무늬밤나방이 약제방제가 소홀한 포장에서 잎을 광포식하여 빠른 시간내에 직접적인 피해를 주고 있다. 본 연구에서는 검은무늬밤나방의 온도별 발육특성을 구명하여 방제를 위한 기초자료로 이용하고자 한다. 검은무늬밤나방은 시설재배 상추에 발생한 유충을 채집하여 실내 사육 후 항온조건(15, 20, 25, 30℃)에서 발육단계별 발육기간을 조사하였다. 온도가 높아짐에 따라 각 태별 발육기간은 짧아지는 경향이었으며, 유충은 보통 4회 탈피하였다. 25℃에서 알기간은 2.5일, 유충기간 10.0일, 전용기간 1.0일, 번데기기간 7.0일로 알에서 성충까지의 발육기간은 20.5일 이었다.

검색어: 상추, 검은무늬밤나방, 온도, 발육기간

P115

Estimate occurrence period of the brown planthopper, *Nilaparvata lugens* using a temperature-dependent developmental model

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최근 이상기후 및 기후변화로 인해 농작물 병해충 발생이 증가하고 발생양상 또한 다양해지고 있으며, 국제 무역 및 해외 여행객 증가로 인한 외래 병해충 유입 위험성이 높아지고 있는 추세이다. 특히 대표적인 비래해충 중의 하나인 벼멸구(*Nilaparvata lugens* Stål, 1854)의 발생 범위, 출현율 및 빈도수가 꾸준히 증가하여 피해를 호소하는 농가들이 많아진 반면, 이들에 대한 대응책은 피해발생의 불규칙성, 이전 자료의 부족 및 불명확성으로 인해 미비한 실정이다. 본 연구에서는 이러한 문제를 대비해 벼멸구의 온도발육모형을 이용하여, 기상자료, NCPMS와 더불어 연발생 횟수와 분포 가능 범위 및 발생 시기를 예측하였다. 또한, 벼멸구의 발생량이 많았던 충남 예산, 경남 사천, 진주의 최초발생일, 최초비래일, 최고발생일, 발생최성일 기준으로 각각 발육영점온도 및 유효적산온도를 적용하여 세대별 발생시기를 예측하였다. 최초발생일과 최초비래일은 예산 7월 9일, 7월 16일, 사천 7월 2일, 7월 19일, 진주 7월 26일, 7월 26일로 나타났으며, 최초발생일과 최초비래일 사이를 초발생일로 적용하면 다음세대 발생이 실제 조사한 지역별 최고발생일인 예산 9월 7일, 사천 8월 9일, 진주 8월 8일과 근접한 시기로 추정되어 효과적임을 알 수 있었다.

검색어: 벼멸구, 비래해충, 온도발육모형, 유효적산온도, 초발생일

P116

Occurrence of three Noctuid moths in July and September (2020-2023)

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국내 농작물에 크게 피해를 주고 있는 파밤나방, 담배거세미나방과 담배나방에 대하여 2020년부터 4년 동안 7월과 9월에 전국 7개 지역의 발생 추이를 조사하였다. 조사지역은 경기도 안성, 충청북도 청주, 강원도 횡성, 경상북도 김천과 안동, 경상남도 창녕, 전라북도 김제를 포함하고 있다. 각 해충의 포획 마릿수는 2021년과 2022년도에 크게 다르지 않았으며, 지역 간 해충 발생 수준도 비슷하였다. 2021년도와 2022년도와 비교해서 2023년도에 담배거세미나방과 파밤나방은 각각 119% 및 70% 증가했지만, 담배나방은 23% 감소하였다. 전체적으로 지역별 발생 시기 및 발생량이 매년 차이를 보이는 것은 기후 등 환경변화의 영향이 가장 큰 것으로 사료 된다. 전체 해충 포획수는 파밤나방이 가장 많고, 담배나방의 수가 가장 적었다. 전년 대비 담배거세미나방과 파밤나방의 경우 중부지역이 남부에 비해 더 많이 발생하였다. 9월에 더 많이 포획되어 전년과 유사한 경향을 보였으며, 최근 3년 동안 9월 발생 밀도가 가장 높았다. 담배나방은 전년에 비해 발생량이 급감하였으며, 안성지역을 제외한 대부분 지역에서 감소하였다.

검색어: 파밤나방, 담배나방, 담배거세미 나방, 모니터링

P117

Effects of fluctuating temperature on the population parameters and growth of *Myzus persicae* (Sulzer) (Hemiptera: Aphididae)

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We investigated the effects of fluctuating temperature on development and fertility of *M. persicae* at different temperature conditions, 10, 15, 20, 25, 28, and 30±5℃, respectively. In this study, we collected detailed data on development periods, and fertility of *M. persicae* at six different temperatures. We analyzed the life table parameters of *M. persicae* using age-stage, two-sex life table program. The intrinsic and finite rate of increase were the highest at 25±5℃. The fertiltiy was the highest at 20±5℃.

Key words: *Myzus persicae,* Life table parameter, Population growth, Temperature

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P118

Community structure and Biodiversity of Rice field spiders in Korea

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Spiders play an important role in regulating insect pests in the agricultural ecosystem. The community structure and biodiversity of rice field spiders were surveyed in 5 areas (Anseong, Nonsan, Imsil, Namwon, and Gurye) from 20 May to 30 September, 2021. A total of 5,525 spiders collected were identified as 64 species of 17 families. Species richness and abundance were high in Lycosidae, Tetragnathidae and Linyphiidae. The similarity of rice field spider communities among regions was about 72% and was divided into three groups: the middle inland area, the southern mountainous area, and the southern inland area. Species diversity averaged as 2.55±0.06. On the seasonaliy of The boidiversity tended to increase toward the latter half of cultivation.

Key words: biodiversity, community, rice field, seasonality, spiders

P119

Population dynamics of Soybean insect pests in climate change scenario

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The moth species and bugs are highly polyphagous that feed on a wide range of field and vegetables crops, including soybean in Korea. The monitoring study was conducted in soybean fields in Southern area Miryang from 2021-2023. Commercial funnel and rocket traps housing species-specific baiting with pheromone were used for monitoring of moth species *(Spodoptera frugiperda, Spodoptera litura, Agrotis ipsilon, Helicoverpa armigera, Ostrinia furncalis*, *Spodoptera exigua*, and *Mythimna separata*) and bean bugs (*Riptortus pedestris*), respectively. The higher number of Spodoptera species (*S. litura* and *S. exigua*) were captured in August to September with several seasonal population peaks. The higher number of *R. pedestris* was captured in July to September. Climatic components were found as critical and influential factors in the population dynamics of moth species and bean bug. The population information of this study can be used to understand the spring emergence along with number of generations, and integrated into management programs of moths and bugs.

Key words: Monitoring, seasonal peaks, spring emergence, generations, management

P120

Selection of pine sawyer, *Monochamus salturius* aerial sparying control agent with low honeybee toxicity

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최근 소나무재선충병 항공방제를 위해 살포한 네오니코티노이드계 농약이 꿀벌 폐사에 영향을 미친다는 우려와 이슈가 제기됨에 따라 산림청은 소나무재선충병 항공방제를 중지하고 해당 약제들을 방제용 약종 결정에서 제외시켰다. 본 연구에서는 북방수염하늘소의 항공방제를 위해 꿀벌 독성이 낮은 살충제를 선발하여 살충효과를 조사하고 향후 방제 약제로 활용하고자 한다.

꿀벌 독성이 낮은 살충제를 선발하기 위해 The Pestcide Manual Nineteenth Edition(BCPC)에서 살충제 원제 231종을 대상으로 꿀벌에 대한 접촉독성이 100㎍/bee 이상인 원제 중에서 테트라닐리프롤 액상수화제, 아피도피로펜 미탁제, 플로니카미드 입상수용제, 플루벤디아마이드 액상수화제, 피메트로진 입상수화제 5개의 약종을 선발하였다. 선발한 약제 5종을 소나무재선충병의 매개충인 북방수염하늘소에 직접 분무하고 시간경과별 살충효과를 조사한 결과, 피메트로진 입상수화제에서 분무 후 1일차에 약 53.3%의 가장 높은 방제율을 나타냈으며, 3일차에는 86.7%, 5일차에는 100%로 매우 효과적인 살충효과를 나타냈다.

검색어: 소나무재선충병 방제, 살충제, 북방수염하늘소, 꿀벌 독성

P121

Regional release effect of *Neodryinus typhlocybae* (Hymenoptera: Dryinidae) for controlling *Metcalfa pruinosa* (Hemiptera: Flatidae)

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M. pruinosa has been found on 98 families and 345 species of plants, indicating a wide host range. Since its first report in a persimmon orchard in Gimhae in 2009, it had spread to 126 municipalities over 12,429 ha. Because of powerful dispersal ability, it's difficult to control with insecticides. Therefore, it is necessary to reduce the population density through the release of *M. pruinosa*'s natural enemy, *N. typhlocybae. N. typhlocybae* females prey on or externally parasitize the nymphs of *M. pruinosa*. This natural enemy was introduced from Italy in 2017 through an international cooperative project between National Institute of Agricultural Sciences and University of Padova for controlling the sporadic pest, *Metcalfa pruinosa*. This study reported the results of mass rearing *N. typhlocybae* indoors and releasing them outdoors from 2020 to 2023 in 21 regions nationwide, showing an average parasitism rate of 27.3% and an average production of 7.9 cocoons per host, suggesting the possibility of their establishment in Korea.

Key words: *Neodryinus typhlocybae, Metcalfa pruinosa*, Natural enemy, Regional release

P122

Parasitic fly species(Diptera: Tachinidae) on the third generation of *Hyphantria cunea* and the difference in parasitic rates by disturbance

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본 연구는 서식 환경에 따라 구분된 3화기 미국흰불나방(*Hyphantria cunea* Drury)을 숙주로 하는 기생파리의 종과 기생률의 차이를 확인했다. 조사 기간은 2023년 10월 24일부터 29일까지로, 방제를 실시한 서천군 국립생태원과 방제를 실시하지 않은 군산시 근린공원에서 숙주인 미국흰불나방의 유충을 채집하였다. 유충은 기주식물인 수국을 급여하여 실내 개별 사육하였다. 각 조사지에서 미국흰불나방의 기주식물은 국립생태원에서 8종, 근린공원에서 6종이 확인되었다. 총 숙주 380마리 중 기생파리는 106개체로 총 27.9%의 기생률을 보였고(유충 92개체, 미동정 알 14개체), 기생률은 근린공원이(39.6%) 국립생태원(12.5%)보다 더 높았다. 성충의 우화율은 63.0%로, 동정 결과 4속 92개체가 나타났다. 전체 종과 가장 많은 개체가 확인된 *Exorista japonica* (Townsend, 1909)의 조사지에 따른 유충 생존율과 성충 우화율은 모두 근린공원이 더 높은 것으로 확인 되었다. 조사결과 E. japonica가 미국흰불나방의 생물적 방제제로 유효할 것이라 판단되며, 근린공원에서의 더 높은 기생파리 유충 생존율과 성충 우화율을 통해 인간에 의한 교란이 적은 환경에서 기생파리를 이용한 미국흰불나방 방제가 더 효과적일 것이라고 고려된다. 또한 숙주의 생존율과 기생파리의 우화율을 비교한 결과 해충 방제가 이뤄지지 않는 환경에서 천적 개체군이 유지될 가능성이 더 높다고 사료 된다.

검색어: 미국흰불나방, 기생파리, 기생, 화학적 방제, 기생률

P123

Detection and frequency of nematode infestations in Chinese Ginger during quarantine

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식물기생선충은 식물에 기생하여 식물의 생장을 저하시키거나 심할 경우 식물의 고사를 일으키는 주요 병원체의 하나이다. 이들 선충은 수입 식물을 통해 국내로 유입될 수 있으며, 이로 인해 식물의 생장이 저하되거나 식물이 죽는 등의 실제적 피해를 야기할 수 있다. 생강은 한국의 대표 음식인 김치를 비롯한 다양한 요리와 음료, 전통약재 등에 사용되는 중요한 식약재료이며, 그 가치와 수요가 매우 높다. 최근 10년(2014-2023년) 동안 종구로써 사용되는 재식용 생강의 수입량은 총 31,740톤이었는데, 수입 생강 원산지의 대부분은 중국으로써 최근 10년간 수입량의 99.99%를 차지했다. 동기간 검역처분 내역은 합격 수량이 1,090건(27,637톤), 폐기 수량은 222건(4,102톤)이었다. 폐기 처분을 받는 주용 원인을 분석해보면, 관리급 선충 검출이 139건, 종구에 흙이 부착된 경우가 26건 등이었다. 앞으로도 농림축산검역본부는 수입 재식용 생강에 대한 실험실정밀검역을 통해 우리나라의 농업과 자연환경에 위해를 가할 수 있는 식물기생선충의 차단을 위해 최선의 노력을 다하고자 한다.

검색어: 식물검역, 관리해충, 폐기

P124

Control effect of *Frankliniella occidentalis* using eco-friendly agricultural materials package in a pepper greenhouse

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To control western flower thrips (*Frankliniella occidentalis*), a significant pest of peppers, the control effects of eco-friendly agricultural materials were tested when treated alone and in combination. The control effects of yellow sticky roll traps installed on the stem, predatory natural enemy (*Hypoaspis miles*) inoculated on the stem, and plant extracts (50% custard apple seed oil + 10% cinnamon extract) sprayed on the foliage were 45.3%, 36.6%, and 50.2%, respectively, when treated individually. Meanwhile, when three eco-friendly agricultural materials were comprehensively applied, the control effect was maintained between 62.4% and 80.9% compared to untreated conditions during the pepper harvesting season. These methods can be utilized for the eco-friendly control of western flower thrips in pepper greenhouses.

Key words: Pepper, western flower thrips, natural enemy, sticky roll trap, plant extract

P125

Ovicidal effect of plant extract mixture against seven major insect pests

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The ovicidal effect of plant extract mixture (5% cinnamon extract + 10% citronella oil + 30% citrus oil + 10% derris extract + 20% neem extract + 25% penetrating surfactant) against several major insect pests was tested using the spraying method. In the case of stink bugs, eggs tended to die during hatching. When treated with a plant extract mixture (500-times solution), mortality for *Halyomorpha halys*, *Riptortus clavatus*, *Eurydema dominulus*, *Trialeurodes vaprarorium*, *Bemisia tabaci*, *Spodoptera exigua*, and *Agrotis ipsilon* reached as high as 100%. Therefore, it is believed that industrialization will be feasible in the future.

Key words: plant extract mixture, ovicidal effect, stink bug, whitefly, moth

P126

Impact of release densities on parasitism efficiency of larval parasitoids, *Exorista japonica* and *Meteorus pulchricornis*

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노지 나방류 해충인 담배거세미나방 방제를 위한 유충기생성 천적 2종인 긴등기생파리와 예쁜가는배고치벌의 방사조건을 확립하고자 콩 재배포장에서 방사거리 및 방사밀도별 기생율을 조사하였다. 긴등기생파리는 방사 후 24시간 이내 방사지점으로부터 10m까지 이동하여 나방류 유충을 기생하였으며, 예쁜가는배고치벌도 방사지점으로부터 15m에서도 기주유충에 산란하여 고치가 형성된 것이 확인되었다. 긴등기생파리는 면적당 방사밀도가 높아질수록 기생율이 증가했으며, ㎡당 0.15마리(천적:해충=1:5) 방사했을 때 평균기생율 63.1%로 나타났다. 예쁜가는배고치벌은 긴등기생파리와 같은 방사밀도에서 평균기생율 47.8%로 확인되었으나, 방사밀도에 따른 기생율 차이는 없었다.

Key words: 적정방사밀도, 방사비율, 방사간격

P127

Establishment of soybean banker plant system for aphid parasitoid, *Binodoxys communis* (Hymenoptera, Braconidae)

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We established a soybean banker plant system and evaluated the biological control effects of aphid control in bell pepper greenhouses. The soybean banker plant was *B.communis* breeding system and developed as an alternative aphid control agent to the most common Barley banker(Barley-Colemani). After inoculating approximately 50 soybean aphids(*Aphis glycines*, aphid starter population) on 2 week old soybean seedling pot after sowing and then releasing aphid parasitoids, an average of 348.7 parasitic wasps per a soybean banker plant could be produced without additional host aphid inoculation. Common recommendation for installation in the greenhouses are about 2 soybean banker plants per 330㎡ before or immediately after planting. If the number of aphids per stem is fewer than three on 2 weeks after installation of the banker plant, additional supplementation of 20~30 aphids is necessary to maintain this system for one month. When one soybean banker plant was installed per 120㎡, the aphid control effect was about 60% on the 21st day after installation.

Key words: Aphid parasitoid, Soybean aphid, Cotton aphid

P128

Orientation bioassay for chemical synthesis aggregation pheromone of Scotinophara lurida using 4 choice olfactometer

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먹노린재 합성집합페로몬 후보물질 12종에 대한 유인력을 평가하였다. 페로몬 방출기는 4구 후각계(Olfacomter)를 사용하였고 4개의 진공관에 각각 후보물질을 투입 후 진공 유압 방식으로 방출하여 포집기에 유인되는 먹노린재의 개채수를 측정하는 방법으로 검정하였다. 4구 후각계 페로몬 평가 방법은 기존 Y-관 후각계의 문제점인 양방향 선택성과 공간 한정성을 개선하여 평가의 정확성을 향상시켰다. 유인력 평가 결과 12종의 유인제 후보물질 중 Trans-2-Decenal이 먹노린재 실험개체에 대하여 100% 유인력을 보였다. 또한, 선별된 Trans-2-Decenal의 먹노린재 유인력에 대한 유효농도 시험을 진행 한 결과, 50%의 농도에서 유인력이 가장 높았다. 본 연구를 통해서 선별된 Trans-2 Decenal은 기존의 노린재과에 대한 페로몬 트랩에 비해 먹노린재에 대한 유인 효과가 높을 것으로 사료되었다. 이에 따라, Trans-2 Decenal을 기반으로 한 페로몬 트랩이 상용화된다면 추후의 먹노린재 방제 효과가 높아질 것으로 기대된다.

검색어: 먹노린재, 집합페로몬, 4 Choice Olfactometer, Trans-2-Decenal

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

P129

Control effect of several insecticides on adults of the black rice bug, *Scotinophara lurida* (Hemiptera: Pentatomidae)

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효과적인 먹노린재 방제 방법을 제시하고자 벼에 등록되어 있는 살충제 10종에 대해 접촉독성과 잔효독성 특성을 충체분무법과 기주분무법으로 각각 실내에서 검정하였다. 그리고 논의 담수 여부에 따른 방제 효과는 작용기작이 다른 4종의 약제를 이용하여 실내 벼 포트 망사검정과 야외 논 포장 망사검정을 통해 비교하였다. 그 결과, 5종의 살충제는 충체분무법과 기주분무법 모두 살충률 100%의 높은 살충활성을 보였으나, 일부 살충제는 충체분무법 대비 기주분무법에서 살충률이 다소 낮았다. 한편, 약제 살포 5일 후 담수한 벼 포트의 살충률은 93.3% 이상, 배수한 포트는 96.7% 이상으로 높은 방제 효과를 나타냈으며, 논 포장에서도 약제 살포 7일 후 담수 시 97.8%이상, 배수 시 98.9% 이상으로 나타났다. 이러한 결과로부터 대부분의 먹노린재 방제용 살충제는 높은 접촉독성과 잔효독성을 모두 갖고 있으나 일부는 잔효독성이 낮아 충체에 충분히 묻어야 높은 방제 효과가 기대되었다. 또한 살충제 살포 시 논의 담수 여부는 방제 효과에 크게 영향이 없을 것으로 보였다.

검색어: 먹노린재, 살충제, 접촉독성, 잔효독성, 담수, 방제 효과

P130

Initial Exploration of Nematicide-Based Control for Plant-Parasitic Nematodes

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This study evaluates the efficacy of two nematicides in controlling plant-parasitic nematodes, surrogate of the exotic invasive species(EIS) *Pratylenchus penetrans*, to mitigate the introduction and spread of EIS. The indoor bioassay experiments involved immersing *Syngonium podophyllum* and *Philodendron spp*. in nematicides at concentrations of 0.4 and 5.0 ml/L for periods of 10 minutes and 1 hour. The results indicated no phytotoxic effects on the host plants at any tested concentration or duration, and a 100% mortality rate of *P. penetrans* was achieved under the specified conditions. Future research should build on these findings by focusing on plants infested with *P. penetrans.*

Key words: *Pratylenchus penetrans*, immersion, nematicides, *Syngonium podophyllum, Philodendron spp*.

P131

Efficacy of phosphine and low temperature treatment on *Drosophila suzukii*

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Drosophila suzukii (Matsumura) (Diptera: Drosophilidae) is found in many regions, including Asia and Europe. Unlike other vinegar flies, *D. suzukii* uses its serrated ovipositor to pierce the pericarp of healthy fruits and lay eggs, causing severe damage. In order to develop a disinfect method of *D. suzukii* during the quarantine process, low-temperature and phosphine(PH_3) fumigation treatment at five different concentration conditions were performed. In the experiment, eggs, early larvae, late larvae, and pupae were used. As a result of low temperature treatment, eggs, early larvae, and late larvae were 100% controlled on the 4^{th} day, and pupae were at 6th day. As a result of PH_3 treatment, in order to achieve 100% mortality rate, eggs needed to be treated at 0.5mg/L, early larvae at 0.4mg/L, late larvae at 0.3mg/L, and pupae were not controlled even when treated at 0.5mg/L, the highest concentration of the experiment. Although additional experiments are required for PH_3 treatment of pupae, it is believed that it can be used to design the combined treatment method of low-temperature and PH_3 fumigation under the same experimental conditions.

Key words: *Drosophila suzukii,* PH_3, low temperature

P132

Mortality of *Ceratitis capitata* (Diptera:Tephritidae) and phytotoxicity of dragon fruits by combined treatment of ethyl formate, phosphine and low-temperature

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Mediterranean fruit fly(Ceratitis capitata) is an important plant quarantine pest globally. Although C. capitata is not existed in Korea, securing a proper treatment method is important to prepare the fruit fly invasion. In this study, mortality of C. capitata and phytotoxicity of dragon fruits by combined treatment of ethyl formate, phosphine and low-temperature have been evaluated as a preliminary study to establish a treatment standard of C. capitata. As a result, 3rd instar larva of C. capitata was the most tolerant growth stage to low temperature and fumigants. For phytotoxicity test, treatment dosage was set to EF 15mg/L+ PH3 0.7 mg/L, which showed 100% mortality to 3rd instar larva of C. capitata. After treatment of EF+PH3+low temperature to dragon fruit, phytotoxicity was not observed, however, quality of fruit was rapidly decreased as storage time was elongated. To maintain the fruit quality, decrease of low temperature storage period is required.

Key words: Medieterranean fruit fly, dragon fruit, fumigant, low temperature

P133

Investigation of phosphine resistance of stored-product insects collected from Rice Processing Complex (RPC) in Korea, 2021-2023

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Phosphine is a common pesticide used to control grain pests in Rice Processing Complex(RPC). However, increasing use of aluminum phosphide caused the occurrence of phosphine resistance pests. In this study, phosphine resistance pests collected at RPC in 2021-2023 was investigated with FAO No. 16 test and Dihydrolipomaide dehydrogenase(DLD) test the occurrence of phosphine resistance in Korea. Test pests were collected in investigated the 42 region. As a result of the FAO No. 16 test, all sample were phosphine sensitive, and Jincheon had the lowest mortality rate of 48%. In the DLD test, 18 regions showed weak resistance, with Eumseong being the most resistant at 30%. It is required to inspect the RPC and other grain storage continuously to inhibit the widespread of resistant pest.

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

P134

Insect repellent effects of multilayer films with adhesives containing natural plant extracted anti-insect materials

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가공식품 비닐포장을 천공하여 소비자 클레임을 유발하는 저장해충 피해를 저감화하는 허들방충포장 개발을 위해 천공성 저장해충(화랑곡나방, 수시렁이 유충)을 대상으로 천공을 방해하는 점착제와 유인을 억제하는 천연식물 추출 방충물질을 적용한 다층필름을 제작하여 방충효과를 검증하였다. 연구에 사용된 다층필름은 기존 열 경화성 접착제, 수용성 점착제, 천연식물 추출 방충물질을 혼합한 점착제, 탄닌을 혼합한 점착제를 1급지(OPP 20μ) 필름과 2급지(LLDP 50μ) 필름 사이에 도포하여 제작 후 각 다층필름으로 파우치포장을 제작하여 NO CHOICE TEST를 수행하여 방충 효과를 분석하였다. 천연식물 추출 방충물질 함유 점착제 적용 다층필름으로 제작된 파우치 포장은 모든 부위에서 화랑곡나방, 수시렁이 유충의 유인을 통계적으로 유의하게 억제하는 것으로 분석되었고 다층필름 제작시 사용한 점착제는 천공성 해충의 천공행동을 억제할 수 있을 것으로 판단되어 식품 유형에 따라 천공성 해충 오염이 우려되는 제품의 포장에는 적합할 것으로 조사되었다.

검색어: 허들방충포장, 다층필름, 천공성 저장해충, 소비자클레임, 천연방충성분

P135

Improved model for the time of upward-movement to reset the control period of overwintered *Cacopsylla jukyungi* in southern region of Korea

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Cacopsylla jukyungi, a significant pest affecting pear trees, typically overwinters beneath the rough bark of pear trees before ascending to laying eggs in February. The optimal time for control is between overwintered adults climb trees and laying eggs. Analyzed temperature data from 2009 to 2013 and 2021 to 2022, the predicted period of upward-movement using the basic model was compared with the date when actual upward-movement was observed. As a result, in the southern region, the actual upward-movement date was faster than the predicted time of the basic model, and the egg laying period was same or faster than the actual upward-movement date in 2021 to 2022. Improved models were proposed through comparative analysis of the accumulated daily maximum temperature and the cumulative number of days for each daily maximum temperature. In addition, taking into account the earlier spawning season, it is proposed that the optimal control period be improved.

Key words: pear pest, *C. jukyung*i, improved model

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Investigation the Role of Flies as Vector in the Spread of Lumpy Skin Disease Virus During Outbreak in the Republic of Korea

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전 세계적으로 가축의 경제적·사회적 피해가 큰 럼피스킨은 매개체(흡혈곤충: 침파리, 모기, 진드기 등)에 의한 기계적 전파가 된다고 알려져 있다. 본 연구는 2023년 10월 국내 최초로 발생한 럼피스킨의 전파 매개체의 역할을 조사하고자 하였다. 럼피스킨 의심 또는 확진 농장에서 채집된 매개체를 대상으로 형태학적, 분자 유전학적 검사를 실시하였고, 매개체 종 동정, 럼피스킨 바이러스 검출 유무와 유전학적 특징을 조사하였다. 그 결과 럼피스킨 바이러스가 검출된 매개체는 집파리와 침파리였으며, 럼피스킨 바이러스의 계통학적 분류를 통해 주변국에서 유행하는 백신유래 야외주와 유사함을 확인하였다. 백신유래 야외주는 중국, 러시아, 몽골 등에 다발하는 럼피스킨 바이러스로 인접국에 주로 발생되었다. 국내 럼피스킨은 역학적으로 주변 발생국의 매개체에 의해 국내 유입되었을 가능성이 크며, 국내 전파는 물류·인적 이동 등에 의한 확산일 것으로 추정되었다. 결과적으로, 국내 럼피스킨은 파리가 농장간 전파의 주요 요인이었을 가능성이 높다. 향후, 국내 럼피스킨 재발생과 전파를 효과적으로 차단하여 농가 피해를 최소화하기 위해 지속적인 매개체 분포·서식 조사와 더불어 방제, 매체 전파능 연구를 강화해야 할 것이다.

검색어: 럼피스킨, 럼피스킨 바이러스, 침파리, 집파리

P137

Plasticity in ovariole number is mediated by complex interactions between temperature and nutrient balance in *Drosophila melanogaster*

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The number of ovariole is an important fitness-related trait in *Drosophila melanogaster* flies, because it determines the number of eggs that can be potentially produced by females. Ovariole number is also a highly plastic trait, which is profoundly affected by a number of environmental factors, such as temperature and nutrition, experienced during larval development. While multiple studies have examined the separate effects of rearing temperature and nutrition on ovariole numbers in *D. melanogaster*, few studies have explored how the combination of these two environmental factors affects the phenotypic expression of this plastic trait. In this study, we recorded ovariole number and its correlated life-history traits from *D. melanogaster* flies reared under one of nine larval rearing conditions where three temperatures (18, 23, 28°C) were fully combined with three dietary protein:carbohydrate ratios (P:C= 1:8, 1:2, 2:1). Preadult survivorship was reduced at the lowest P:C ratio (1:8), but was unaffected by temperature. *D. melanogaster* flies reared in cooler environments developed into larger individuals. The extent of such temperature effect on body size was consistent across diet, as indicated by non-significant interaction between temperature and diet. In manner opposite to body size, the number of ovarioles tend to decrease in response to decreasing temperature. Importantly, as evidenced by a significant interaction between temperature and diet for this trait, this negative effect of rearing temperature on ovariole number was observed in *D. melanogaster* flies reared at two low P:C ratios (1:16 and 1:2) but not at high P:C ratio (2:1). If reared on a protein-enriched diet (P:C=2:1), *D. melanogaster* flies attained a high number of ovarioles (35−40) that was not statistically distinguishable across the temperature regime. Our results indicate that high protein intake can buffer the negative effect of cool temperature on ovariole development.

Key words: Development, Nutrition, Ovariole, Temperature, *Drosophila melanogaster*

P138

Not Presented

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Effects of macronutrient balance on larval life-history traits in the two sibling species of *Drosophila*: *D. melanogaster* and *D. simulans*

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The two sibling species of fruit fly, *Drosophila melanogaster* and *D. simulans* (Diptera: Drosophilidae), have long been used as the key model organisms in ecological and evolutionary research. While numerous studies have investigated the thermal responses of these two species, no study has yet systematically compared their response to dietary macronutrient balance. To fill this knowledge gap, we compared how various life-history traits expressed during larval development would response to an array of dietary ratio of protein to carbohydrate (P:C ratio) in these two sibling species. Largely consistent with previous studies, *D. melanogaster* took longer to complete their larval development and were much larger at adult emergence than *D. simulans*. For both species, an increase in dietary P:C ratio resulted in improved larval survivorship and faster development. However, the two species showed qualitatively different response to dietary P:C ratio when body mass at adult eclosion was concerned. The body mass of *D. melanogaster* peaked at an optimal P:C ratio of 1:4, but decreased as the P:C ratio either increased or decreased from this optimum. In marked contrast, the body mass of *D. simulans* was insensitive to dietary P:C ratio.

Key words: Carbohydrate, *Drosophila*, Life-history trait, Nutrient, Protein, Sibling species

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Geographical characteristics of *Culex tritaeniorhynchus* and *Culex orientalis* microbiome in Korea

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Mosquitoes, the primary vectors of arboviruses, harbor a diverse microbiome that plays a crucial role in their development, immunity, and vector competence, tThe composition of the mosquito microbiome is heavily influenced by the environment and habitats, Therefore, identifying the relationship between the habitat and the mosquito's microbial community can improve the overall understanding of mosquito biology, However, the microbiome profiles of *Culex tritaeniorhynchus* and *Culex orientalis*, known as transmission vectors of the Japanese encephalitis virus, are poorly understood. Using 16s rRNA Illumina sequencing, we hereby investigated the microbial profiles in these two mosquito species collected in several areas in Korea. Thirty-six prevalent bacterial familes were identified from these mosquito species. the microbial composition variation were primarily influenced by the mosquito collecting sites. Moreover, species biomakers were identified by utilizing the regional specificity of the mosquito microbiome. Based on the microbiome profiles representing high similarity, *Culex orientalis* may share an ecological niche with *Culex tritaeniorhynchus*.

Key words: mosquito, microbiome, *Culex tritaeniorhynchus, Culex orientalis*

P141

miRNA-Target mRNA Interactions Reveal Novel Insights into Detoxification Mechanisms in *Spodoptera frugiperda*

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Spodoptera frugiperda, commonly known as the fall armyworm (FAW), is a major pest across the globe due to its broad host range and distribution worldwide. We investigated the function of microRNAs (miRNAs) in the detoxification of insecticides, with a specific focus on its susceptibility to chlorantraniliprole which is widely utilized insecticide for its management. miRNAs are small non-coding RNA molecules, crucial for post-transcriptional regulation of gene expression. This study aims to elucidate the impact of these miRNAs on the expression of cytochrome P450 genes, which play a significant role in conferring insecticide resistance. We identified notable changes in the abundance of two specific miRNAs, sfr-miR-10465-5p and sfr-miR-10476-5p through RNA sequencing, after chlorantraniliprole exposure. These miRNAs exhibited significantly high expression in the fat body tissue, while showing relatively lower expression in the head, midgut, and malpighian tubules. Further analysis suggested that these miRNAs might target specific cytochrome P450 genes, like CYP4C1 and CYP4C21, which are known to play a role in insecticide resistance development. Experimentation with miRNA mimics through microinjection revealed a notable increase in the survival rates of *S. frugiperda* larvae when subjected to chlorantraniliprole exposure, with a significant reduction in CYP4C1 and CYP4C21 gene expression levels. This suggests a direct connection between the miRNAs and the increased tolerance of *Spodoptera* larvae to the insecticide. Our research presents the complex function of miRNAs in gene expression regulation related to insecticide resistance, offering valuable insights into the molecular mechanisms of chlorantraniliprole resistance in *S. frugiperda*. These findings pave the way for further investigations into miRNA roles and their potential in managing pesticide resistance in agricultural pests.

Key words: miRNAs, *Spodoptera frugiperda*, chlorantraniliprole, cytochrome P450, insecticide resistance

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Mitochondrial COI-based population genetic analysis of the cicada, *Cryptotympana atrata* (Cicadidae: Hemiptera), which is a climate-sensitive indicator species in South Korea

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The blackish cicada, *Cryptotympana atrata* Fabricius, 1775 (Hemiptera: Cicadidae) was originally distributed mainly in the southernmost remote island, Jeju and rarely throughout low lands in South Korea, but has been explosively increased at the urban areas, where annual temperature is higher. In this study, we sequenced a partial mitochondrial COI from a total of 171 individuals collected throughout 12 localities in South Korea. The haplotype found with the highest frequency in Jeju island shares only with two inland localities in southern region with a low frequency, whereas the haplotype found with the highest frequency throughout inland localities was not found in Jeju island. These results showed that Jeju population, southern region, and other inland populations form somewhat different genetic groups.

Key words: blackish cicada, climate sensitive species, climate change, COI, Korean peninsula

P143

Expression profiles and phylogenetic properties of venom gland-specific viruses in some Aculeate bees and wasps

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To identify viruses and compare their abundance levels in the venom glands of hymenopteran species, we conducted venom gland-specific transcriptome assemblies and analyses of 22 Aculeate bees and wasps and identified the RNA genomes of picornaviruses. Additionally, we investigated the expression patterns of viruses in the venom glands over time following capture. Honeybee-infecting viruses, including black queen cell virus (BQCV), deformed wing virus (DWV), and Israeli acute paralysis virus (IAPV), were highly expressed in the venom glands of Apis mellifera and social wasps. This finding suggests that the venoms of bees and wasps likely contain these viruses, which can be transmitted horizontally between species through their stinger usage. A. mellifera exhibited an increasing pattern of abundance levels for BQCV, DWV, IAPV, and Triatovirus, while the social wasp *Vespa crabro* showed increasing abundance levels of IAPV and Triatovirus over different capture periods. This suggests that the venom glands of honeybees and wasps may provide suitable conditions for active viral replication and may be an organ for virus accumulation and transmission. Some viral sequences clearly reflected the phylogeny of Aculeate species, implying host-specific virus evolution. On the other hand, other viruses exhibited unique evolutionary patterns of phylogeny, possibly caused by specific ecological interactions. Our study provides insights into the composition and evolutionary properties of viral genes in the venom glands of certain Aculeate bees and wasps, as well as the potential horizontal transmission of these viruses among bee and wasp species.

Key words: bee virus, aculeata, solitary hunting wasp, social wasp, honeybee, bumblebee

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Pollination activities of *Apis mellifera* and *Apis cerana* in strawberry greenhouse

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시설재배 딸기의 화분매개에 꿀벌 사용이 보편화되어있지만 동양종(*A. cerana*) 꿀벌의 화분매개효과 연구는 미비한 실정이다. 따라서 본 연구는 딸기에서 동양종 꿀벌의 화분매개자로 가능성을 평가하기 위하여 비닐하우스 딸기에서 서양종 꿀벌과 화분매개행동 특성을 비교하였다. 향후 봉군 수명과 착과된 딸기의 기형과율품질을 평가 할 예정이다. 서양종과 동양종 꿀벌은 10시 이후부터 활동량이 증가하고, 13시에 방화활동이 가장 활발하였으며 이후부터 감소하는 일주행동 패턴을 보였다. 서양종과 동양종 꿀벌 활동성은 모두 온도, 조도, 자외선과 정의 상관관계를 나타냈으며 상대습도와는 부의 상관을 보였다. 특히 서양종 꿀벌은 온도, 조도, 자외선이 같은 수준의 상관(r=0.7)을 보이는 것에 반해, 동양종 꿀벌의 경우 온도와 습도보다 광조건(조도, 자외선)에서 더 높은 상관계수(r > 0.9)가 나타났다. 서양종과 동양종 꿀벌의 방화특성을 조사한 결과 꽃에 머무는 시간은 서양종 꿀벌이 평균 6.9초, 동양종 꿀벌이 7.0초로 같은 수준이었으나(p>0.05), 꽃 간 이동시간은 동양종 꿀벌이 2.4초로 서양종꿀벌(3.1초)보다 20% 유의미하게 짧은 것으로 나타났다(p=0.011). 따라서 같은 시간에 동양종 꿀벌이 서양종 꿀벌보다 더 많은 꽃을 방문 할 수 있을 것으로 생각된다.

검색어: 화분매개벌, 동양종 꿀벌, 서양종 꿀벌, 일주행동 패턴, 시설재배 딸기

P145

Comparative analysis of reporting status about the Invasive Alien Species Report Center in 2022 and 2023

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외래생물 유입에 대응하기 위해 (환경부)국립생태원에서는 2019년부터 외래생물 신고센터를 운영하고 있으며, 민원 신고에 대한 신속한 대응과 국민 행동요령을 안내하고 있다. 외래생물 전체 신고 건수는 2022년 140건 중 곤충 88건, 2023년 645건 중 곤충 530건으로, 1년 만에 외래생물 전체 신고 건수는 505건, 곤충 신고 건수는 442건이 증가하였다. 2022년 전체 신고 중 붉은불개미(*Solenopsis Invicta*) 의심 신고 건수가 78건로 가장 많았으며, 그 중 노랑밑드리개미 12건 등 개미과가 49건으로 확인되었다. 2023년은 전체 민원 신고 중 외래흰개미류 의심 신고가 418건으로 가장 많았고, 붉은불개미 66건 순으로 많았다. 외래흰개미류 의심 신고의 경우 대부분이 국내에서 서식하는 흰개미(*Reticulitermes speratus kyushuensis*)로 190건, 붉은불개미의 경우 밑드리개미류(10건), 주름개미(8건), 권련침벌(8건) 등으로 확인되었다.

검색어: 외래생물, 외래곤충, 외래흰개미, *Reticulitermes speratus kyushuensis,* 신고센터

P146

Long-term storage and growth control of the yellow mealworm, *Tenebrio molitor* Linnaeus

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We introduce a method for preserving yellow mealwom (*Tenebrio molitor*) larvae for an extended period and show that a high percentage of larvae can survive in good health under low-temperature storage conditions combined with specific diapause termination conditions. When storing larvae for 140 days, the storage temperature can be varied based on our goals, giving us control over yellow mealworm production to meet specific demands. To produce adult beetles, storing larvae at 15 ℃ with wheat bran and ending diapause at 30 ℃ resulted in 90% pupation rate, with 60% becoming adults in 21 days. If our aim is larvae production, storing them at 10–12 ℃ with wheat bran and ending diapause at 25–30 ℃ allows the larvae to reach a suitable weight for processing. This approach ensures long-term storage of yellow mealworm larvae and provides a practical way to control their development, allowing efficient mass production tailored to market demands.

Key words: *Tenebrio molitor*, low-temperature storage, diapause termination temperature

P147

2023 IRA reports and case study for avocado fruit from Philippines

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Division of the risk management, APQA(Animal and Plant Quarantine Agency) is conducting the IRA(Import Risk Assessment) to prevent the introduction of pests when importing foreign agricultural products. In the 2023 IRA, 55 cases of 19 items from 23 countries was analyzed, and fresh avocado(variety: HASS) from the Philippines was concluded in September 2023 and can be imported in accordance with appropriate phytosanitary measures. The main issue in the IRA of fresh avocado fruits from the Philippines was whether HASS variety avocados were host plants of *Bactrocera dorsalis*. As a result of the risk analysis, *B. dorsalis* were included in the pest list that needs to be managed by special risk management. As a risk management for *B. dorsalis*, one trap using methyl-eugenol is installed per 20 ha once a week. After surveying, if the population is more than 2/trap/day, control measures such as adding traps and spraying pesticides are necessary. As equivalence, regionalization, and transparency have been strengthened with the recent entry into force of the mega FTA, a higher level of scientific basis is required. Accordingly, division of the risk management, APQA is working harder to improve its expertise, and we need your cooperation and attention of the IRAs.

Key words: Import risk assessment, quarantine, avocado, fruitfly

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Research on data collection and utilization for smart rearing of edible insects

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식용곤충은 미래식량 자원으로써 우수한 가치를 지니고 있어 해외에서는 사육자동화, IoT 및 AI 기술적용, 수직재배시스템 구축 등 많은 연구가 진행되고 있지만 국내에서는 대규모 사육농가나 곤충스마트팜 기술개발이 부족하여 이를 위한 AI/빅데이터 인프라 구축이 시급한 실정이다. 학습용 인공지능 데이터는 식용곤충으로 활용되고 있는 장수풍뎅이, 흰점박이꽃무지, 갈색거저리, 백강잠, 메뚜기, 풀무치의 생애 주기별 총 6종의 RGB 사진데이터와 분광이미지 데이터 408,000장을 구축하였으며 온도, 습도, CO_2, 암모니아, 조도, 수분 등 환경 데이터 200,000세트를 수집하였다. 수집된 데이터는 원시데이터 수집, 원천데이터 가공, 라벨링 데이터 결합, 가공데이터 검수 등을 통해 만들어졌으며 관련 데이터는 AI Hub(www.aihub.or.kr)에서 다운받을 수 있다. 확보된 식용곤충 6종의 데이터는 곤충 종별 성장단계, 환경 변수에 따른 최적의 사육환경 조성, 생산시기 예측, 스마트대량사육시스템 개발, 제품 가공시 추적이력제 도입, 식용곤충 스마트팜 기술 개발 및 연구 등 다양한 분야에 활용될 수 있을 것으로 예상된다.

검색어: 식용곤충, 기후변화, 질병, 스마트, 데이터

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Investigating the viability of silkworm seeds post extended low-temperature preservation

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누에씨는 매년 계대사육을 통해 자원을 보존하지만, 이 과정에서 잠종의 소실 및 혼합사고 등의 위험이 있어, 누에 유전자원의 효율적이고 안전한 장기보존법 개발이 필요한 상황이다. 본 연구에서는 2년 동안 저온에 보관된 누에 보급품종(백옥잠, 대황잠, 백황잠)과 누에 유전자원(n29, sa2, yang2)의 누에씨를 봄과 가을 사육기에 맞추어 점진법을 사용하여 부화를 유도하였다. 부화된 누에씨의 부화비율과 함께 전령 경과기간, 화용비율, 전견중 등의 사육 성적을 조사하였다. 2년간 저온 보관된 누에씨의 부화비율은 보급품종에서 87~88%, 유전자원에서는 71~75%로 나타났다. 화용비율은 보급품종에서 79~89%, 유전자원에서는 71~79%로 조사되었다. 품종 지정 시 사육 성적과 비교해 볼 때, 부화비율, 화용비율, 번데기 무게, 고치무게 모두 감소하는 경향을 보였다. 또한, 2년 동안 저온에 보관된 후의 누에씨 부화기간은 1년 동안 저온에 보관된 누에씨보다 1~2일 더 길었다.

검색어: 누에, 누에씨, 저온보존

P150

Effects of a sound insect-based animal assisted therapy program on depression in the elderly

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본 연구는 소리곤충을 활용한 동물매개치료 프로그램이 노인의 우울에 어떠한 영향을 미치는지 살펴보고자 하였다. 연구대상은 I시에 위치한 I치매안심센터에서 추천을 받은 우울 척도 검사에서 5점 이상을 받은 노인 20명이며, 실험집단과 통제집단 각 10명을 선정하였다. 프로그램은 2023년 6월부터 8월까지 주 1회, 회기당 50분씩 총 12회기를 실시하였다. 효과 검증을 위해 SPSS v.26을 활용하여 집단 간 동질성 검증(Mann-Whitney U test)을 하여 동질성이 입증이 된 후 각 집단의 사전과 사후에 노인 우울 척도 측정을 실시하고 비모수 윌콕슨 부호 순위 검정(Wilcoxon signed-rank test)으로 분석하였다. 그 결과, 실험집단의 우울 전체의 사전‧사후에 유의미한 차이가 나타났다($Z=-3.53$, $p<.05$). 그러나 통제집단의 우울 전체의 사전‧사후에는 유의미한 차이가 나타나지 않았다($Z=-1.06$, $p>.05$). 따라서 본 연구는 소리곤충을 활용한 동물매개치료 프로그램이 노인의 우울에 긍정적인 영향을 준 것으로 확인이 되었다. 이번 연구결과는 소리곤충을 활용한 정서 및 심리 치료에 대한 과학적 근거를 제시하여 관련 분야 활성화에 기여할 수 있을 것으로 기대된다.

검색어: 소리곤충, 노인, 우울

본 연구는 농촌진흥청 지역특화작목 기술개발(과제 번호 : PJ016956) 지원에 의하여 연구가 수행되었습니다.

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Effects of a sound insect counseling program on emotional expression in the elderly

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본 연구는 소리곤충 상담 프로그램이 노인의 정서표현에 도움을 주는지를 확인하고자 하였다. 연구대상은 남녀 구분 없이 만 65세 이상이며 정서표현 척도 검사에서 51점 이하, 의사소통에 문제가 없는 자로 실험집단 10명 통제집단 10명을 선정하였다. 프로그램은 2023년 7월부터 8월까지 주 2회, 회기당 50분씩 총 12회기를 실시하였다. 효과 검증을 위해 SPSS/WIN 26.0을 활용하여 집단 간 동질성 검증을 하고 입증이 된 후 실험집단과 통제집단의 사전과 사후에 노인 정서표현 척도 측정을 실시하고 분석하였다. 그 결과, 실험집단의 정서표현 전체의 사전 평균 56.25에서 사후평균 66.38로 유의미한 차이가 나타났다($Z=-3.41$, $p<.05$). 그러나 통제집단의 정서표현 전체의 사전평균 58.15에서 사후 평균 58.92로 유의미한 차이가 나타나지 않았다($Z=-0.43$, $p>.05$). 향후 본 연구결과를 기반으로 소리곤충을 활용한 노인의 정서표현 향상에 이점을 유도하는 소리곤충 활용 상담 프로그램으로 확대 적용할 수 있을 것으로 기대된다.

검색어: 소리곤충, 노인, 정서표현

본 연구는 농촌진흥청 지역특화작목 기술개발(과제 번호 : PJ016956) 지원에 의하여 연구가 수행되었습니다.

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Flight patterns of *Apis mellifera* and *Bombus terrestris* near their hives for image deep learning

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Bee traffic at the hive entrance can be used as an important indicator of foraging activity. We investigated patterns of honeybees and bumblebees near their hives as a basis for calculating bee traffic using the image deep learning. The flight pattern near the hive differed significantly according to bee at entering and leaving the hive. Honeybees mainly showed flight that changed flight direction more than once (69.5%), whereas bumblebees mainly performed straight flight (48.7%) or had a single turn (36.5%) in flight. When bees entered the hive, honeybees primarily showed one-turn or two-turn flight patterns(88.5%), and bumblebees showed a one-turn flight pattern (48.0%). In contrast, when leaving the hive, honeybees primarily showed a straight flight pattern (63.0%), and bumblebees primarily showed a straight or one-turn pattern (90.5%). There was a significant difference in flight speed according to the flight pattern. The speed of straight flight (0.89±0.47 m/s) was 1.5 to 2.1 times faster than flight where direction changed. Therefore, our results can help determine the capturing and recognizing the flying image of bees when calculating bee traffic by image deep learning.

Key words: Flight speed, deep leaening, *Apis mellifera*, *Bombus terrestris*

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The field application and test of insect pollinators in 5 fruit and vegetable crops

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국내 원예작물에서 화분매개곤충의 의존도는 해마다 증가하고 있다. 우리는 사과, 딸기 등 화분매개곤충의 의존도가 높은 주요 과수와 시설작물에 대하여 화분매개곤충의 사용기술을 개발하고 이를 현장에 적용하는 연구를 수행하고 있다. 2021년부터 2022년까지 딸기, 키위 등 5가지 주요 농작물에서 화분매개벌을 적용한 결과, 딸기에서 뒤영벌의 적용결과 기존 꿀벌과 통계적으로 같은 수준의 화분매개효과를 나타내었으며, 하우스에서 농약적용시 하우스 밖으로 벌통을 위치시키는 것이 방치보다 벌의 소실을 20% 더 감소시킬 수 있었다. 인공수분에 의존하고 있는 씨없는 수박에서 수분수 식재와 꿀벌을 이용함으로 기존 벌 방사보다 16% 착과율을 향상시킬 수 있었다. 시설고추에서 꿀벌과 뒤영벌의 혼합사용시 기존 꿀벌 방사보다 고추 수량이 10% 향상되었고, 토마토에서 660㎡당 뒤영벌의 봉군량을 1.5배 증가시 토마토 수량은 4.4% 향상되었다. 키위는 꿀벌로 기존의 인공수분을 충분히 대체할 수 있었고, 인건비가 60%이상 절감되었다. 또한 현재 시판중인 30종의 살충제와 27종의 살균제에 대하여 24시간내 반수치사를 보인 농약은 각각 살충제 6종와 살균제 4종 이었다. 이어서 2023년부터 참외, 멜론, 사과, 단감에 대한 현장적용연구가 진행되고 있다.

검색어: 화분매개, 꿀벌, 뒤영벌, 딸기, 수박, 키위

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Research on smart beekeeping data collection and utilization

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최근 기후변화 등으로 인한 꿀벌의 폐사가 증가하고 있으나 관련 데이터가 부족하여 이에 대한 연구가 어려움을 겪고 있어 학습용 인공지능 데이터를 구축하여 양봉 산업 발전에 기여하고자 한다. 학습용 데이터로 생애주기별 5단계(알, 애벌레, 번데기, 숫벌, 여왕벌), 종봉별 4가지(이탈리안, 카니올란, 한봉, 호박벌), 발생질병 1종(백묵병) 총 10가지 클래스를 데이터 수집장소 6곳(장성, 포천, 칠곡, 완주, 의령, 장흥)에서 학습용 데이터를 274,206장 구축하였다. 수집된 데이터는 원시데이터, 원천데이터 가공, 라벨링 데이터 결합, 가공데이터 검수 등을 통해 만들어졌으며 관측지에서 온습도, CO, CH_4, NH_3 등 환경데이터를 200,000건 확보하여 데이터 라벨링을 수행하였다. 데이터는 AI Hub(www.aihub.or.kr)에서 다운받을 수 있다. 확보된 데이터는 꿀벌의 생애 단계별, 종별, 건강상태별 이미지 데이터로 구성되어 있어 양봉 관리 자동화, 꿀벌 질병 예측, 양봉 기술 개발 및 연구 등 다양한 분야에 활용될 수 있을 것으로 예상된다.

검색어: 양봉, 기후변화, 질병, 스마트, 데이터

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

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곤충병원성 선충인 *Heterorhabditis. megidis*(큰형광병원선충)는 참나무 군락지(광주광역시 소재) 사양토에서 분리 동정되었고, 곤충병원성을 가지는 공생세균은 *Photorhabdus temperata*로 분리 동정되어 각각 GJ1-2로 명명하였다. *H. megidis* GJ1-2는 고구마(주황미) 큰 검정풍뎅이 *Holotrichia parallela*에 대한 방제 효과는 평택시(경기도 소재)와 논산시(충청북도 소재)의 노지 재배 사양토에서 관주처리 30일 후 각가 81.1%, 78.9%로 나타났으며, 인삼(재래종) 거세미나방 *Agrotis segetum*에 대한 방제 효과는 이천시(경기도 소재)와 청주시(충청북도 소재)의 비가림 재배(차광막 설치) 사양토에서 관주처리 14일 후 방제가는 각각 79.9%, 80,2%로 나타났다. *H. megidis* GJ1-2는 고구마(주황미)와 인삼(재래종)에서 약제 처리 후 3, 7, 14일 후 외관상 약해는 나타나지 않았다.

검색어: 곤충병원성 선충, 큰형광병원선충, 공생세균, 고구마 큰 검정풍뎅이, 인삼 거세미나방, 방제 효과