4th International Forest Entomology and Pathology Symposium (ENFITO 2022)

12-14 May, 2022 Trabzon, TURKEY

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Abstract Book

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Alien Invasive Species, Quarantine Measures and Current Situation in Turkey

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Abstract

Although invasive species have found on the quarantine list of many countries, the range of they are increasing and cause economical harmful in invasion of area. There is a great increase in the number of invasive species detected in agriculture, forests, parks, gardens, and settlements in many parts of the world. Some species can adapt in a new area and their population increases rapidly due to their ecological tolerance and biological characteristic. There are habitats where the invasive species can adapt in addition to the native species that threaten the forests in Turkey. Foreign species are more important than native species. It is not known how foreign invasive species will behave. In Turkey, which has many protected area and significant plant area, determination of biological outbreaks and of their distribution by monitoring, and taking precaution play the important role. In the last five decades in Turkey, several biotic elements including insects and fungi transported from other countries and even other continents have caused and still cause significant level of damage. Since Turkey is like a bridge between Asia and Europe with respect to international trade, the risk of transmission of foreign invasive species. Increased importation of plant and wood materials in recent years has resulted in an increase in the foreign invasive species in Turkey. It is very difficult to control the population of invasive species at harmless level and stabilize it when they spread. This paper present information about foreign invasive species that were transmitted to the forests in Turkey. Alien invasive species were evaluated according to the EPPO list and literature. In the last 50 years, forests in Turkey have been affected by foreign invasive species such as *Dendroctonus micans, Ips typographus, Ips amitinus, Ips cembrae, Ips duplicatus, Ophelimus maskelli, Leptocybe invasa, Leptoglossus occidentalis, Cydalima perspectalis, Ricania japonica Corythucha arcuata, Corythucha ciliata, Hyphantria cunea, Rhynchophorus ferrugineus, Anoplophora chinensis* and *Dryocosmus kuriphilus*. In addition to the native species that threaten forests, foreign invasive species are of greater importance. It is not known what course of any foreign origin species that may infect our forests will follow. Turkish biodiversity is quite high compared with the biodiversity of other countries in the temperate zone. For this reason, the potential distribution areas of species can be determined by obtained information about the distribution of species and found whether they are present on different hosts and can be taken precaution. Both the quarantine legislation and the organization must be complete. It is a fact that there are important shortcomings in forestry quarantine. It is also important that (1) to eliminate the infrastructure deficiencies of the forest administration, (2) updating the legislation largely on agricultural quarantine, (3) inspectors who will carry out the forestry quarantine are selected, trained, and assigned in this regard.

Keywords: *Invasive alien species, insect, forest, Turkey.*

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Entomopathogens in the Control of Forest Pests

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Abstract

In the world, a significant part of terrestrial species live either in forests or depending on forests. All beings in the forest ecosystem, from a huge tree to a microorganism that cannot be seen with the naked eye, are indispensable and important parts of forests. Forests are one of the most important elements of the earth in terms of protecting biological diversity, cleaning the air, regulating the water regime, controlling climate change, preventing erosion, ensuring environmental and atmospheric cycles and meeting the basic needs of humanity. Sustainable forest management foresees the biological diversity, productivity, self-renewal ability and life energy of forests at local, national and global levels, and the potential to fulfill their ecological, economic and social functions against all kinds of threats and dangers. However, various abiotic and biotic factors cause problems in this process from time to time and cause disruptions in the management of the process. Recent evaluations pointing out that an average of nine million hectares of forest areas are being destroyed annually from the world's forests reveal that harmful insects are the leading cause of this. Insects threaten forests seriously by multiplying in a short time due to their high reproductive energies. Conditions such as climatic changes, commercial transportation and cross-border movements of insects cause the spread of invasive species between neighboring and sometimes even distant countries. All these reveal the importance of combating forest pests in order to ensure sustainability in forests. There are various approaches in which different methods are applied separately or together in the fight against forest pests. The use of biological control methods and agents are the leading environmentalist, effective and reliable approaches. Microorganisms (viruses, bacteria, fungi and nematodes) are the biological factors that have shined in recent years in the fight against agricultural and forest pests. Local microorganisms isolated from pests, with determined biological and ecological properties, with extremely high efficacy values, are developed as biopesticides and used safely in the control of pests. The presence of many pests depending on different ecological conditions in our country ensures that the entomopathogenic fauna of our country is also rich. Advantages such as being environmentally friendly, highly adaptable to ecological conditions, easy to produce and apply, narrow host distribution and not being effective in highly organized organisms make these biopesticides promising and attractive.

Keywords: *Forest pests, biological control, entomopathogenic microorganisms*

ORAL PRESENTATIONS

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The Determination to Catching Capacity of Fheromone Trap Types Using in The Brutian Pine Forests of Antalya and Isparta Forestry Regional Directorates [*Orthtomicus erosus* (Woll.) Case]

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Abstract

This study was aim to determining amount of pest and natural enemy insects as proportional, nontarget insect species and preference of pest and natural enemy insect species to pheromone trap types. The Mediterranean Bark Beetle (*Orthotomicus erosus* Wollaston) that cause important damage in Antalya and Isparta Regional Forestry Directorate and has commercial pheromone, was studied. Treatment were made in stands where intense damage occur within the boundries Antalya and Isparta Regional Forestry Directorate. Trial areas were selected on three different altitudes. Theyshon type and Scnadinav type funnel traps were used. According to the statistical analysis, Theyshon type pheromone traps in all three trial sites were found to catch more target insects than funnel traps in terms of number of insects. The results of t-test were found to be statistically significant. Theyshon traps were found to catch more target species (*O. erosus*) and fewer predators (predator insects) than funnel traps. *O. erosus* collection amount of Theyson traps was 13.3 times more than funnel traps. Funnel traps at all test sites have more predator insects than Theyshon traps. The predator ratio of 6% in the funnel trap was determined as 0.2% in the Theyshon trap. In the three experimental areas that were studied on pheromone traps, 25 predator species were detected on *O. erosus*. Among them, *Temnochila caerulea, Thanasimus formicarius, Aulonium ruficorne, Cylister elongatus* and *Rhizophagus (Eurhizophagus) depressus* were determined as the most effective predators.

Keywords: *Orthotomicus erosus, Pheromone, Pheromone trap types, Predators, Non-target species*

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P450 genes in forest insect pests and parasitoid species

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Abstract

The coevolution resulting from the arms race between plants and herbivorous insects leads to develop highly effective tools for competitive success. Plants developed different mechanisms to reduce insect attack while insects enhanced several strategies to overcome plant defense barriers. For instance, the highly specialized detoxification mechanisms as one of the remarkable tools that developed in herbivorous insects, provides the ability to develop resistance against human-made insecticides. On the other hand, most of the predatory and parasitoid species were free from the natural selection implemented by plant toxins, hence they did not need detoxification as strong as herbivores do, and they became more sensitive to insecticides than herbivores. P450 genes code the enzymes which have several functions like metabolizing and detoxifying plant toxins (adaptation to the host plant) and insecticides (resistance). In the present study, we identified P450 gene family evolution in the forest insect pest species *Agrilus planipennis*, *Anoplophora glapripennis*, *Cinera cedri*, *Dendroctonus ponderosae*, *Thaumetopoea pityocampa*, and the egg parasitoid *Trichogramma brassicae*. Protein data belonging to these species were retrieved from NCBI. Insect genes were searched against PFAM. P450 gene clustering and analysis of gene evolution were performed using OrthoFinder and CAFÉ, respectively. We found that the number of genes encoding P450 family varied greatly among the species. We detected the highest number of P450 genes in *A. glapripennis* (166), followed by *A. planipennis* (109), *D. ponderosae* (137), *C. cedri* (95), *T. pityocampa* (79) and *T. brassicae* (55), and these genes were clustered into 81 orthogroups and the highest number of species-specific P450 genes was in *A. planipennis* (17). According to our results, insect species examined share the core P450 family which clustered together. This result reflects that these clusters are conserved among insect orders during long co-evolution with host plants' P450 inhibitors. Gene family evolution analysis showed that the highest number of gene gain occurred in the coleopterans, *A. glapripennis* (53), *D. ponderosae* (45), *A. planipennis* (29), and the lowest number of gene gain was in the hymenopteran *T. brassicae* (11). *A. glapripennis* has a wider host range from different plant genera compared to other species studied, which suggests that *A. glapripennis* P450 gene duplications may have been a result of intensive need for detoxifying a greater variety of plant toxins which might force gene duplications in this species to a greater extent. On the other hand, *T. brassicae*, an egg parasitoid, might not need detoxification mechanisms like other species. These results suggest that detoxification mechanism is a primary evolutionary force underlying duplications of insect P450 genes.

Keywords: *Cytochrome P450, CYP gene family, gene evolution, insecticide resistance.*

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Use of DNA Barcodes to identify invasive *Spodoptera frugiperda* (Noctuidae: Lepidoptera) species in Pakistan

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Abstract

Spodoptera frugiperda (Noctuidae: Lepidoptera) is the most damaging agricultural pest which has invaded Asian countries in recent years. The current investigation confirms the occurrence of fall armyworm in Pakistan and discusses its phylogenetic relationship with *S. litura* and *S. exigua*. The cytochrome c oxidase subunit I (COI) gene, ‘‘a universal barcoding region’’ of FAW having 650 bp, was isolated using specific primers. Maximum likelihood phylogenetic analysis of *S. frugiperda*, *S. exigua*, *S. litura,* and many others revealed significant variations among the sequences. *S. frugiperda* showed intraspecific disparities with reference to different geographical locations. Multiple sequence alignment presented similarities and differences found between the barcodes of the three pest species. The study proves the utility of the COI barcoding region for the identification and discusses phylogenetic interrelations existing between the pest species.

Keywords: *Fall armyworm, Destructive, Molecular methods, Phylogenetic analysis, Multiple sequence alignment*

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Development of novel Betabaculovirus as a biological insecticide, and efficacy of Fall Webworm larvae

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Abstract

Studies on the isolation of granulovirus from Hyphantria cunea in the world date back to very old years and no information about its formulation was found in the literature searches. It is thought that researching the potential of this detected local virus to be used effectively in biological control and thus the development of the virus as a pesticide will provide important contributions to the literature and the use of the virus as a biological control material. Betabaculovirus, Hyphantria cunea granulovirus (HycuGV) was isolated from the infected H. cunea larvae and was characterized previous study. In this study, it was aimed to the local betabaculovirus isolate to development of oil formulation and to efficacy of H. cunea larvae. The oil formulation was prepared by mixing the pathogen suspension with sunflower oil and some adjuvants such as surfactant, solvent, emulsifier. One-year (old) and freshly (new) prepared oil formulations containing HycuGV (1 □ 109 OBs / ml) were studied on H. cunea 3rd instar larvae. Five different amounts (60, 80, 100, 120 and 140 □l) of the old and new formulations were used to test the effectiveness of formulations on larvae. LC50 values of old and new oil formulations were calculated as 90,932 □l (76,675-107,841) and 80,297 □l (67,2-95,946), respectively. The influence of the temperature and UV of viral inclusion body on virulence against H. cunea was evaluated for oil-based formulations of HycuGV under laboratory conditions. The viral formulations were transferred in tubes and maintained at 28 °C, 35 °C, 42 °C and 60 °C and UV radiation for one, three and five hours. The use of the product in pest control will give the opportunity to compete with the world in this field. All these data will enable the initiation of studies on the development of viral biological control preparations in our country.

Keywords: *Formulation, Hyphantria cunea Granulovirus, Biotest, Efficacy*

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Selection of some local entomopathogenic fungus for the biological control of *Anoplophora chinensis* (Coleoptera: Cerambycidae)

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Abstract

Anoplophora chinensis (Coleoptera: Cerambycidae) commonly known as the citrus longnorned beetle, is a highly invasive, destructive, and polyphagous pest. International trade plays an important role in the spread of this pest on the earth. It causes damages on more than 100 species of trees and shrubs. *A. chinensis* is native to Asia and occurs primarily in China, Korea, and Japan, began to appear in Europe in the 2000s. The pest was detected in Şile for the first time in Turkey in 2014, then it was detected in Bartın, and finally in 2016 in Trabzon, where it caused a huge problems. In this study, to control this pest with biological agents 10 local entomopathogenic fungal isolates from our culture collection including *Metarhizium anisopliae*, *Beauveria bassiana*, *Lecanicillium muscarium* and *Isaria fumosorosea* were tested against adults of *A. chinensis* at 1×10^8 conidia/mL concentration. According to the results of screening tests, while mortality of KTU-51 (4-Güm-A, *M. anisopliae*) and KTU-21 (117, *M. anisopliae*) reached 100% and 90% on the pest at 12th day, respectively; KTU-2 (Ardeşen, *M. anisopliae*) and Ya1 (*I. fumosorosea*) yielded approximately 70% mortality rates. It was determined that HP-4 (*B. bassiana*), which produced 60% mortality 12 days after infection, had a 100% mortality effect on the pest on the 15th day of application. Therefore, KTU-51 (the most effective of strains belonging to the genus *Baeuveria*) and Hp-4 (the most effective of strains belonging to the genus *Metarhizium*) were selected for dose-response ($1 \times 10^{5\text{-}9}$ conidia/mL) mortality tests against adults of the pest. Based on probit analysis, the LC_{50} values of isolates KTU-51 and Hp-4 was calculated as $3{,}4 \times 10^5$ conidia/mL and $2{,}6 \times 10^6$ conidia/mL against *A. chinensis* adults, respectively. Consequently, both isolates appears to be promising candidates for further investigations as biocontrol agents against *A. chinensis.*

Keywords: *Anoplophora chinensis, entomopathogenic fungi, Metarhizium, Biological Control*

This research was supported by The General Directorate of Agricultural Research and Policy (TAGEM-20/AR-GE/-12).

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Cynips quercus in the Western Palearctic: the role of Turkey between Asia and Europe

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Abstract

Recent studies have addressed the eastern populations as origin of diversity and the source for many European taxa. Here we use DNA sequence data of an oak gall wasp species, *Cynips quercus*, widely distributed in the western Palearctic from Europe to Iran to answer the following questions: i) Do the eastern *C. quercus* populations have higher genetic diversity than the European populations?, ii) Are the eastern populations source for the European populations?, iii) What is the possible date of divergence between the Asian and European populations? In an attempt to answer these questions, we analysed 88 cytochrome b sequences representing Iran, Turkey, Hungary, and Spain. Out of 108 polymorphic sites we used 78 parsimony informative characters and detected that the highest genetic diversity was in Turkey followed by Iran, Hungary, and Spain, respectively. Pairwise comparisons indicated that Iran was most diverged from Spain, Hungary, respectively, and as expected Turkey was least differentiated from Iranian samples. Similarly, gene flow was highest between Turkey and Hungary, and between Turkey and Iran. Expectedly, the least amount of genetic exchange was between Iran and Spain. Phylogenetic analysis grouped all the Turkish samples with the Iranian samples, and Spain with Hungary formed the second clade structure. Likewise, network analysis revealed that the western Turkish samples were separated from eastern sequences, and all of the eastern Turkish sequences were clustered with the Iranian samples meanwhile a western Turkish lineage provided source to Hungary and then to Spain eventually forming separate haplogroups. Estimated date of divergence of the Turkish haplotypes from the Iranian lineage was around 4,87 million years and about 3 million years ago Hungarian and Spanish lineages have diverged from each other. Our current analyses overall suggest that each of the studied localities are with relatively high genetic diversity which is not unexpected for all of the four studied sites since each played significant role as a distinct glacial refugium in the past. Correspondingly, it seems that Turkey played a key role as a bridge between Asian and European populations of *C. quercus* through providing genetic source for Europe.

Keywords: *oak gall wasp, Turkey, Iran, Hungary, Spain.*

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Contributions of *Andricus tomentosus* to the Turkish Gallwasp Diversity

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Abstract

Andricus tomentosus is a common parasitic oak gallwasp species in the Palearctic region forming its bell-shaped asexual generation galls on white oak species. Despite its widespread distribution in Turkey little is known about the species. In this study, we aimed to reveal genetic diversity of the species and tried draw some conclusions about its contribution to the Turkish diversity and explain the current geographic distribution of the existing variation. Thus, we collected 240 asexual generation galls from 19 localities throughout the distribution range of *A. tomentosus* from Turkey to rear adults. After isolating total DNA, we amplified mitochondrial DNA cytochrome b gene and nuclear ITS2 region to assess genetic diversity and population genetic structure of the species. Alignment of DNA sequences generated 47 mitochondrial haplotypes and 28 nuclear alleles revealing intermediate to high level of genetic variation for both studied regions. Some of the eastern Turkish populations displayed higher diversity as compared to the central and western localities. Population demographic analysis indicated that several eastern populations expanded in the past suggesting an eastern origin of the species. Nonetheless, overall demographic analyses and high haplotype/allele versus low nucleotide diversity implied that *A. tomentosus* populations might have undergone a series of expansion and retraction events in the past, which were correlated with the paleoclimatic and paleoenvironmental changes. Further, phylogenetic inferences suggest that *A. tomentosus* populations are divided into two well-divergent groups as eastern and western Turkish clades. The presence of two major clade structure offered that the mountains of Anatolia were the main driver of the lineage formation in *A. tomentosus*.

Keywords: *oak gall wasp, Turkey, Iran, Hungary, Spain.*

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Impacts of *Ips typographus* (L.) Outbreaks on Soil Organic Carbon Stocks of Oriental Spruce

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Abstract

Forests are major components of the carbon cycle. Tree killing disturbances such as forest fire and bark beetle outbreaks can have a major influence on forest carbon cycles and stocks. Last three decades, the disturbance by bark beetle outbreaks is reported to be increased dramatically by global warming due to the direct link between insect population success and seasonal temperature. Among the bark beetle species, *Ips typographus* is the most destructive species of the genus Ips, and probably the most serious pest on spruce in Europe and also in Turkey. Although large forest *Ips typographus* outbreaks in Oriental spruce (*Picea orientalis*) forests have been reported in Turkey, no studies to date have assessed the impact of this disturbance on SOC stocks of spruce forests. Our main objective was to contribute to the understanding of the impacts of *Ips typographus* outbreaks on SOC stocks of Oriental spruce forests. Soil samples of three depths (0 to15 cm, 15 to 35 cm and 35 to 65 cm) were collected from highly damaged (HD) with high tree mortality, (2) moderately damaged (MD) with low tree mortality and (3) control stands (Control) with uninfested trees on north (N) and south (S) aspects, and at top and bottom slope position on each aspect. The results showed that total SOC stocks in Oriental spruce stands were significantly reduced by the severity of insect damage. The control stands on both N and S aspects had the highest SOC stocks (133.2 and 131.0 Mg C ha^{-1} respectively), followed by the MD (119.1 and 139.9 Mg C ha^{-1} respectively) and the HD stands had the lowest SOC stocks (77.3 and 118.7 Mg C ha^{-1} respectively). Total SOC stocks of the control, MD and HD stands were found to be lower at the top slope position than at the bottom slope position on both N and S aspect. However, higher differences in total SOC stocks between the top and bottom slope positions were more clearly seen for the HD or MD stands on S aspect compared to the control stands and N aspect. It is concluded that changes in canopy cover, litterfall, litter chemistry, forest floor litter, decomposition rates, and microclimate factors due to insect damage could be responsible for the variation in SOC stocks of Oriental spruce stands. And so, the impacts of natural disturbance on forest SOC stocks should be considered in estimating total SOC stocks of forests.

Keywords: *Forest disturbances, SOC stocks, Ips typographus, Oriental spruce, Turkey*

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Effects of Chestnut Gall Wasp (*Dryocosmus kuriphilus* Yasumatsu) on Leaf Litter Decomposition Rates of Anatolian Chestnut (*Castanea sativa*)

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Abstract

The chestnut gall wasp *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae) is considered one of the most serious threats to chestnut trees and fruit production in the world. Previous studies have reported that the gall wasps can reduce shoot elongation, fruit production, and cause twig dieback. In addition, they cause variations in the photosynthesis, number and morphology of tree leaves, amount of leaf fall and canopy closure of chestnut stands. However, no studies to date have studied the effects of all those variations on other components (leaf litter chemistry and decomposition, soil properties and nutrient cycling) of the chestnut forest ecosystem. We therefore set up a study to investigate the effects of chestnut gall wasp on leaf litter chemistry and decomposition rates of chestnut stands in Yalova, Türkiye using the litterbag technique in the field. Chestnut leaf samples were collected from highly infested sites (HIS) with severely galled leaves, (2) moderately infested sites (MIS) with slightly galled leaves and (3) control sites (CLS) with no galled leaves. The collected leaf samples from the HIS, MIS and CLS morphologically differed from each other. The leaves from the HIS were smaller and lighter than the leaves from the MIS and CLS. All leaf samples were initially analysed for C, N, ADF, lignin and cellulose concentrations. The litterbags used for the field experiment were 20 cm x 20 cm with a mesh size of 1 mm to allow for inclusion of mesofaunal but exclusion of macrofaunal decomposers. The litterbags were filled with about 5 g of air-dried chestnut leaves and fixed to the ground of the corresponding sites (HIS, MIS and CLS) on three altitudes (220 m, 340 m and 490 m) on North aspect in 2021. Five litterbags of each leaf category will be harvested in April 2022 (after 6 months later) from each corresponding site, and the results of the first sampling will be presented in the 4th International Forest Entomology and Pathology Symposium in Trabzon.

Keywords: *Dryocosmus kuriphilus, Leaf litter decomposition, Litter quality, Altitude, Canopy closure*

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Microbial control of *Leptoglossus occidentalis* (Heteroptera: Coreidae) using entomopathogenic fungi

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Abstract

Forests provide important ecosystem services as well as economic and social benefits but are threatened by insects. *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae), the western conifer seed bug, is a good example of forest pest. The pest which is polyphagous is considered a major pest of conifer seed orchards and increasing populations of *L. occidentalis* have led to an important decrease in pine nut production in Mediterranean countries. Chemical control has been the most widely used strategy for managing this pest. However, there is a concern about the use of insecticides due to their negative effects on human health, the environment as well as on beneficial organisms. In this study, to determine the eco-friendly and effective microbial control agent, we assessed the pathogenicity of twelve indigenous isolates of four entomopathogenic fungi, *Beauveria bassiana*, *Isaria fumosorosea*, *Metarhizium brunneum* and *M. flavoviride* on adults of *L. occidentalis* under laboratory conditions. Fungal suspensions at 10^7 conidia/ml concentration were applied by hand-sprayer and insects were observed 10 days. Bioassays were conducted in a rearing cage in the laboratory at 20 ± 2°C and 70 ± 10% relative humidity with a natural photoperiod. All the isolates were pathogenic to the seed bug, but pathogenicity varied significantly among the isolates. While As-2 and As-18 isolates caused 90% mortality, KTU-24 caused only 16% mortality at the end of experiment. The median lethal times of As-2 and As-18 isolates which had the highest mortality were estimated as 5.83 and 2.73 days, respectively by probit analysis. Therefore, concentration response experiment was performed using five different concentrations (from 10^7 to 10^3) of As-18 isolates and median lethal concentration were estimated as 7.61×10^3 conidia/ml. In addition, conidia transmission ability between treated and untreated adults was determined for As18 isolate. But horizontal transmission of conidia between the insects was not observed. Our study showed that *M. flavoviride* As-18 isolate has the potential as a microbial control agent of *L. occidentalis.* However, field experiment is needed to determine how effective the As-18 isolate would be in controlling *L. occidentalis* populations.

Keywords: *the western conifer seed bug, microbial control, entomopathogenic fungi, virulence*

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An overview of Staphylinidae (Coleoptera) and Fungi Interactions and Scientific Studies in Turkey

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Abstract

The aim of this study is to examine the biological relationships of the Staphylinidae family, which is one of the families with the most species in the Coleoptera order, and fungi, and to evaluate the studies on this subject in the World and Turkey and to reveal the deficiencies and the studies that need to be done.
In this study, studies on Staphylinid and fungal relationships and the studies that have been done so far in the World and Turkey on this subject have been examined, and conclusions have been drawn about the deficiencies and the studies that need to be done. Donisthorpe (1935) is the first author to list the proper names of fungi with which insects are related. Benick (1952) and Höfler (1960) provided information on the Staphylinidae genera associated with fungi. Graves (1960), discussed the relationships of some Staphylinidae species and fungi. Lipkow (1997) explained in detail the fungal relationships with species belonging to the genus *Oxyporus* (Staphylinidae: Oxyporinae). Klimaszewski and Peck (1987) studied the succession of insect fauna (Coleoptera) in the fungus *Polyporellus squamosus*. Staphylinidae species have been extensively covered in this publication. Relationships with fungi were also examined by Leschen (1994), who compared the ecological and behavioral correlates between mycophagous Coleoptera in hard persistent fungi versus soft transient fungi. Hanley and Godrich (1995) examined in detail the relationships of Oxyporinae with fungi. Henneberg (2004) did a thesis on the relationship and biology of fungi and insects. Lipkow and Betz (2005) reviewed on the relationships between Staphylinidae and fungi and described adaptations to the mouthparts of tissue and spore-feeding forms. Schigel (2012) reviewed about the relationship of staphylinids with fungi. Klimazewski et al. (2013) in order to understand their trophic relationships in forest ecosystems, the intestinal contents of Staphylinids were analyzed and their relationship with fungi was revealed. Weithmann et al. (2020) has given a list of Staphylinidae species that are related to the fungus in their work. Apart from these, many studies have mentioned the relationship of Staphylinids with fungi. There is currently no study conducted in Turkey regarding this important relationship between staphylinids and fungi. When the studies carried out in Turkey are examined, it has not been possible to go beyond the faunistic studies. When we look at the studies conducted in Turkey, Assing (2007, 2009, 2011) stated that he collected Staphylinidae species from fungi Abacigil et al. (2013) reported that samples were collected from mushrooms from Kaz Mountains. Sert et al. (2013) identified a species from the genus *Liogluta* and a new species from the genus *Gyrophaena* (*Gyrophaena cagatay* Sert et al. 2013) from Mount Hasan. Sert et al. (2021) identified 23 Staphylinidae species which are related with fungi. Apart from these studies, there is no study that examines the relationship between fungi and Staphylinidae in detail, both faunistic, systematically and ecologically. We prepared our project in order to eliminate this deficiency and will presented it to TÜBİTAK (The Scientific and Technological Research Council of Turkey). In case this planned project is realized, an important step will be taken to fill the gap in such an important issue in our country.

Keywords: *Staphylinidae, Fungi, Systematic, Biological Interactions, Turkey*

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Antioxidative defense responses and chemical composition of *Pinus sylvestris* L. and *Pinus nigra* L. as attacked by *Thaumetopoea wilkinsoni* Tams, 1926 (Lepidoptera: Notodontidae)

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Abstract

Disruption of ecological balance increases the frequency and intensity of insect outbreaks in various forest species. *Pinus* species, used in traditional medicine and are an important industrial plant, suffer severe ecological and economic losses with the invasion of insects. Many taxa that have the ability to create biotic stress factors prefer the foods present in coniferous species. Of these taxa, insects are the most important organisms that conifers must contend with to survive. *Thaumetopoea wilkinsoni* Tams, 1926 (Lepidoptera: Notodontidae) is essential insect species threatening pine species. Due to the damage caused by *T. wilkinsoni*, a biotic stress factor, the changes occur in the ecological and physiological parameters of *Pinus* species, which also try to cope with abiotic stress. Because of changing ecological conditions, there is a growing interest in biotic-abiotic stress interaction in plants. The changes in ecological and physiological characteristics that occurred in *Pinus sylvestris* and *P. nigra* depending on the plant-insect relationship were determined in this study. The changes in fresh-dry weights, % water contents, chlorophyll a, b, total chlorophyll contents, the total protein contents, malondialdehyde amounts, and superoxide dismutase, catalase, ascorbate peroxidase activities in leaf samples of the pine processionary moth invaded and non-invaded *P. sylvestris* and *P. nigra* species were compared in the study. It was found that the fresh-dry weights, % water contents, chlorophyll a, b, total chlorophyll contents of the moth invaded individuals of both species were significantly decreased compared to the non-invaded individuals; additionally, the total protein contents, malondialdehyde amounts, and superoxide dismutase, catalase, and ascorbate peroxidase activities were determined to be significantly increased. The remarkable increase in monoterpenoids and sesquiterpenoids in invaded *P. sylvestris* and a remarkable increase in monoterpenes in *P. nigra* reveal that both species can develop defense against the herbivorous insect by using secondary metabolites. The increase in different secondary metabolites even in these two species against herbivore attack suggests that plants can use their secondary metabolite defense power in different ways.

Keywords: *Pinus, Pine processionary moth, Ecological parameters, Antioxidant enzymes, Secondary metabolites.*

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Highly Effective *Beauveria bassiana* (Ascomycota: Hypocreales) Against *Pristiphora abietina* (Hymenoptera: Tenthredinidae)

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Abstract

Outbreaks of lesser spruce sawfly, *Pristiphora abietina* (Christ) (Hymenoptera: Tenthredinidae) is one of the most important pests of forest trees. In this study, using morphological and molecular techniques thirteen fungal strains (Pa1-13) from the larvae of *P. abietina* were identified as *Lecanicillium muscarium* (Petch.) Zare and Gams, *Beauveria bassiana* sensu lato, and *Beauveria pseudobassiana* and tested their efficacy against the pest under laboratory and semi-field conditions. A laboratory screening test at 10^6 conidia ml^{-1} showed that all isolates caused 59-100% mortality after 14 days. Further experiments were performed with the three most effective isolates, all belonging to *B. bassiana*. For these isolates, an increase in conidia dose increased (from 1×10^4 to 1×10^8 conidia/ml) pest mortality. In addition, the ability of horizontal transmission in the pest population was shown. All three isolates (Pa4, Pa5, and Pa6) were effective in killing *P. abietina* on spruce under semi-field conditions. Pa4 (*B. bassiana*) yielded the highest mortality and mycosis with 100% in screening tests and caused the highest mortality of the pest in the field experiments. With these results, Pa4 isolate was used to develop biopesticides. While the mass production of Pa4 (*B. bassiana*) was carried out with liquid-state fermentation. The Pa4 isolate was formulated in oil, and the product was named as Pa4-OD. The insecticidal testing of the developed formulation Pa4-OD on *P. abietina*, which is the pest, is continuing. As a result, the oil-based mycoinsecticide developed in this study can make more profits by using fungal-based biopesticides for these pests.

Keywords: *Beauveria bassiana, liquid-state fermentation, oil-based mycoinsecticide, Pristiphora abietina*

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Life cycle of *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Coreidae) in Isparta and Burdur Province

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Abstract

Western conifer seed bug, *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Coreidae) was described in 1910 from western North American fauna and spread to eastern and Central America after the World War II. It was first recorded from Europe (Italy) in 1999 and rapidly spread all over the continent. It feeds mainly on the lipid and protein storage in seeds of coniferous trees, including economically important stone pines, and eventually cause seed loss. It was first recorded in 2009 in Turkey from İstanbul and Edirne, and it was found in 40 provinces afterwards. It is suspected to be partly responsible of the dramatic decrease in pine nut yield observed in recent years in Bergama, İzmir where is on of the most important pine nut production spots in Turkey. In the present study, we focused on the life cycle of *L. occidentalis* between 2016 and 2021 in Burdur and Isparta provinces. For this purpose, we observed the development of the populations of the species in *Pinus brutia, P. nigra* and *P. sylvestris* forests, and recorded the developmental stage of the pest along with coordinates, time, and host tree of the observation. Consequently, we detected two separate generations per year in the region. We found the first adults after overwintering in mid-May. Overwintering occurred after mid-October. First generation occurred between mid-May and late June, whereas second generation occurred between early August and mid-September. First nymphal instar of the first generation was seen after the third week of May, second nymphal instar after the second week of June, third nymphal instar after the fourth week of June, fourth instar after the first week July, and fifth instar after the third week of July. First nymphal instar of the second generation was seen after the second week of August; and we found all instars simultaneously until October. In order to estimate possible number of generations of *L. occidentalis* in 2021 in Isparta province, the cumulative degree-day method was used. For this purpose, developmental temperature thresholds and needs calculated were gathered from the relevant literature. Additionally, minimum and maximum daily temperatures for the year 2022 were collected from 15 meteorological stations in the region. As a result, the number of generations was estimated as 0.7, 0.7, 1.3, 1.4, 1.6, 1.7, 1.7, 2.0, 2.0, 2.1, 2.2, 2.2, 2.3, 2.5, and 2.8 for Yenişarbademli-Dedegöl Hill, Gölcük National Park, Şuhut-Karaadilli, Yalvaç-Çetince, Yenişarbademli, Sütçüler-Ayvalıpınar, Şarkikaraağaç-Kızıldağ National Park, Gönen, Ağlasun-Yumrutaş, Eğirdir-Barla, Gelendost, Isparta Süleyman Demirel Airport, Eğirdir, Senirkent, and Sütçüler, respectively. These results suggest the maximum number of generations that *L. occidentalis* could make in 2021 in Isparta province was three. The present study is significant contribution to the understanding the phenology of the Western conifer seed bug in Burdur and Isparta, Turkey. This information is crucial to the efficient planning of population management efforts against the pest.

Keywords: *Life history, The western conifer seed bug, invasive alien pest.*

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Damage of *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Coreidae) in pine nuts in İzmir-Bergama

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Abstract

Stone pine (*Pinus pinea* L.) is an economically important species both in Turkey and Europe. Pine nut has a significant market value worldwide. In Turkey, it mainly occurs in Western Anatolia, along with a limited distribution in Antalya, Kahramanmaraş and Trabzon provinces. A Mediterranean basin-wide decrease in pine nut yields has been reported since 2012. One of the regions where pine nut production is concentrated in Turkey is Bergama, İzmir. Studies in this region focusing on the environmental factors that may potentially impact the pine nut yield could not obtain robust results so far. One of the possible factors that may cause pine nut yield decrease is the western conifer seed bug, *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Coreidae), which feeds on the seed of coniferous trees. It was first reported from Turkey in 2009 from İstanbul and Edirne provinces. It rapidly expanded its range and reached to Bergama region in early 2010s. The present study focuses on the possible impact of *L. occidentalis* on pine nut production in 2021 in Kozak, Bergama. In order to determine the damage of *L. occidentalis* feeding on pine nuts, we studied on 15 stone pine individuals in the study area. On 10 June 2021, we closed one mature cone (three years-old) on each tree by using a metal net with a mesh size of 1 mm to protect the cones from insect attack. We also determined and marked one mature cone per tree and left the cone uncovered. We collected 30 cones (15 covered/15 uncovered) on 10 November 2021 and transferred to the laboratory where we stored them in an incubator at 50ºC to open the cones and reach the seed. Once the cones were opened, we collected, counted and weighed the shelled seeds. We screened the seeds under a x-ray scanning system (Siemens Mammomat Inspiration) with a 1 cm processing height and 32 kV - 50 mAs values. After counting the seeds that could not develop, we conducted a float test to identify the health status of the seeds and we broke all the seed shells to reach the nuts. We weighed the nuts of each cone and classified them according to the level of damage (heavy, medium, light). As a result, we found that the number of the healthy seeds and weight without shell was significantly higher in closed cones. Number of immature seeds along with heavy and medium damage ratio was higher in open cones. According to the float test, 48% of the open cones and 17% of the closed cones were unhealthy. We also confirmed that x-ray screening is an efficient method for detecting damage in seeds. We concluded that *L. occidentalis* is one of the main factors contributing to seed loss in Bergama region.

Keywords: *Damage, Pinus pinea, The western conifer seed bug, invasive alien species.*

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Managing bark beetle outbreaks in protected areas: Experiences and suggestions

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Abstract

Bark beetles that cause landscape level outbreaks and kill millions of trees are one of the most devastating pests in forest ecosystems. The mountain pine beetle, *Dendroctonus ponderosae* Hopkins and European spruce bark beetle, *Ips typographus* L. have killed millions of trees across western Canada and Eurasia, respectively. The outbreaks of *I. typographus* in protected areas besides the outbreaks in productive forests are remarkable and important. During the outbreaks in the Bavarian Forest National Park in Germany, Šumava National Park in Czech Republic, Tatra National park in Poland and Slovakia and Hatila Valley National Park in Turkey thousands of hectares of spruce forests have been damaged by *I. typographus*. There are approximately 4000 national parks in the world. National parks preserve extraordinary areas of wilderness, conserve biodiversity and contribute carbon storage. Conservation of biodiversity is complex due to the wide-ranging effects of any change in a region's ecosystem such as climate warming. Climate warming increases the reproduction of bark beetles and expand the distribution range of some pests in latitude and elevation. *Ips typographus* outbreaks have caused rapid diebacks in spruce forests in its distribution range in Eurasia. National park areas are also affected by these outbreaks. Besides the strong ecological effects on succession, carbon cycling and fuel dynamics in affected productive forests, outbreaks have significant socioeconomic impacts in national parks. Productive forests are strongly managed by conducting sanitation fellings and/or clear-cuts to suppress *I. typographus* attacks. These management activities have also been applied in national parks. There is debate how to respond *I. typographus* outbreaks in national parks. Managing affected stands with sanitation fellings and/or clear-cuts and plant, or non-interference with natural processes are being discussed. Today, we have more than 30 years of knowledge about the results of different management approaches in national parks. Not only the investigations conducted in European protected areas, but also the results reported from North America provide evidence that biodiversity increases along the edges of gaps produced by *I. typographus* outbreaks. The diversity and species density of insects including pollinators and also endangered beetles is higher at the edges and gap interiors. Further, the spontaneously developed stands that are not managed in accordance with the non-interference approach in Bavarian Forest National Park in Germany have the similar densities and dimensions of trees as the stands adjacent to them in Šumava National Park in Czech Republic that are clear-cut and planted again. In Hatila Valley National Park, spruce trees that were infested by *I. typographus* following windfalls are being managed by sanitation fellings at irregular intervals since early 2000s. Windfalls are also removed by salvage loggings. The amount of sanitation fellings reached about 50,000 m^3 in some years. In this study, management of *I. typographus* in Hatila Valley National Park is discussed and analyzed comparatively with the management of national parks from Europe, and suggestions are made.

Keywords: *Hatila Valley National Park, Ips typographus, natural processes, biological diversity*

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Identification of *Halyomorpha halys*' Host Plants and Population Level in Batumi-Georgia

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Abstract

Halyomorpha halys (Stål 1855) (Brown Marmorated Stink Bug) is an invasive and economically important agricultural and ornamental insect pest nowadays established in much country in the world. It was first observed in the Republic of Georgia in 2015 and spread to almost all of Georgia. Millions of dollars of economic losses have occurred as a result of the damage done in hazelnut production areas in Georgia. This research provides information about the distribution, population level and host plants of BMSB in the Batumi region of Georgia. Field observations were conducted by utilization of sticky traps baited with pheromone lures. The host plants on which *H. halys* were fed were determined by making investigations in the area. In order to determine the rate of pest distribution, pheromone traps were placed on the following plants: Greencape - tangerine plant, Makhinjauri – orange plant, Urekhi - nut bush, Airport settlement- corn plot, Kakhaberi - nut bush, Makhvilauri - Kiwi plant, Sarpi - Kiwi plant and apple plant. The pheromone traps with PHEROCON® pheromones remained suspended in May-October 2021 and were regularly checked every week. As a result of the controls, during the study period (22 weeks), a total of 3240 *H. halys* adolescents fell to a pheromone trap. It has been determined that the population density of *H.halys* is much higher in Makhvilauri and Green Cape, relatively less in Makhinjauri and Urekhi, and low in Kakhaberi, Sarpi and Airport settlements. In addition, in the study area up to 70 plant species are list for host of *H.halys*. The important hosts; fruit trees and bushes such as, kiwi, hazelnut, fig, cherry, plum, apple, pear, tangerine, persimmon, mulberry, persimmon and grape; leguminous field crops such as common bean; corn; forest trees such as maple and willow; as well as ornamental trees and shrubs such as butterfly bush and honeysuckle; vegetables such as paprika, tomato and pepper.

Keywords: *BMSB, Distribution, Pherome Traps, Host Plants*

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First record of *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae) in Artvin and planning first trials of biological control

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Abstract

The chestnut gall wasp, *Dryocosmus kuriphilus* is an invasive species that is native to China. Out of its original distribution, this alien invasive cynipid causes devastating damages to chestnuts (*Castanea* spp.) in Asia, United States and in Europe since mid-twentieth century. In addition to lack of natural enemies at the newly infested areas that ease establishment, *D. kuriphilus* is prone to fast population growth and fast spreading. It is accepted as one of the most important pests of chestnuts worldwide. It induces galls on the newly growing shoots that inhibit development of the shoot, flowering and fruiting. Galling by *D. kuriphilus* has caused up to 80% yield losses in Europe. Higher amounts of galls cause overall decline in chestnut tree health. Chestnut forests are among the most important natural resources in terms of the functions they provide. In addition to provide raw wood material, these forests are important due to their non-wood products and contribution to honey production. There are 262,045 hectares of natural chestnut forests in Turkey. Artvin has the third largest chestnut forests area in Turkey that is 27,520 hectares. *D. kuriphilus* was detected in Artvin for the first time at İdliyet location of Taşlıca Forest Division (sub-district no. 19-20) at June 2021. In the field observations made in the surrounding forests after the detection of the gall wasp, it was determined that *D. kuriphilus* has infested entire Taşlıca Forest Division and also it was individually present at Baş Hatila and Arıpınar locations of the Hatila Valley National Park. In October 2020, it was stated that *D. kuriphilus* was found individually in chestnut forests in Adjara (Georgia), by contacting colleagues from Adjara and Artvin Regional Directorate of Forestry (J. Abuladze - Y. Aksu personal communication). Upon this information, field surveys have been conducted to check the neighbouring Camili Forest Division stands with Adjara. Field surveys revealed that these neighbouring stands at the Turkish part have not been infested by *D. kuriphilus*. Damage level alters as a function of the time elapsed between the pest arrival, detection and biological control occurrence. Ecological and economical losses will increase in the elapsed time. Following the parasitoid release program in Italy that was first performed in 2005, Chinese parasitoid *Torymus sinensis* Kamijo (Hymenoptera: Torymidae) is being released to control *D. kuriphilus* in Europe. *T. sinensis* is mentioned as host specific and phenologically well-synchronized with its prey *D. kuriphilus*. After the detection of *D. kuriphilus* in Artvin, control measures have been planned. A unit has been established for rearing *T. sinensis* as a part of Biological Control Laboratory of Artvin Regional Directorate of Forestry. A total of 1000 individuals of *T. sinensis* will be reared and released at the infested sites in 2022. Time of release will be fixed in accordance with the formation of the galls in the forest. Dispersal of the gall wasp and establishment of the parasitoid will be surveyed throughout vegetation periods of 2022 and 2023. No galls will be collected from Artvin for two years to secure the establishment of *T. sinensis* in the infested areas.

Keywords: *chestnut gall wasp, classical biological control, parasitoid release.*

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Rove beetles (Coleoptera: Staphylinidae): Underestimated bioindicators of land-use and human effect on terrestrial ecosystems

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Abstract

Nowadays, land-use and effect of human act plays an important role in sustainable management of natural resources. Changes in natural habitats due to these effects can be determined by detecting alterations in the communities of various bioindicator groups. The family Staphylinidae (Coleoptera), is one of the most speciose animal groups in the world. They occur in a wide variety of habitats, found in almost every terrestrial ecosystem and form an important part of the soil fauna. Most of the staphylinids are generalist predators and feed on various soil arthropods. They are found in moist habitats, riverbanks, leaf/forest litter and decomposing animal matter. Furthermore, they almost occupy all natural, semi-natural and man-made habitats, which making them a potential bioindicator in terrestrial ecosystems as indicators of the environmental status and anthropogenic influence. In order to be able to use them as bioindicators, the community structure and species diversity should be determined. They can be collected by different kind of traps or taking soil quadrat sampling. While pitfall traps usually used for sampling, carrion-bait traps could also be used as they are attracted to fly larvae feeding on carrion. In forests, sifting could be a good alternative for sampling either from leaf/forest litter or mushrooms. In this study the bioindication potential of Staphylinidae in terrestrial ecosystems was reviewed. Species composition, abundance and species richness are various parameters of species diversity in a given area and often used and compared in studies as they are indicators of organism's response to ecological changes. In several studies examining staphylinid communities in forest habitats, these parameters have been used to analyze the differences between community structure of specific taxon, depending on forest type, age and managing degree. Similarly, as in forest habitats, these parameters could also be used in determination of the effect of land-use in agricultural settlements. As a result, it could be concluded that, staphylinids can be used as bioindicators of natural status of the environment and human effect on different habitats. They're widely distributed in almost every habitat and species composition of a given habitat is affected by several factors depending on habitat type, species diversity and the degree of influence. On the other hand, indicator species determination should be made cautiously because widely distributed species have fewer specific preferences and have more ability to adapt changed conditions.

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Saproxylic Elateridae (Coleoptera) Species in Inner Western Anatolian Region of Turkey

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Abstract

The family Elateridae is one of the biggest families of the order Coleoptera. It has been stated in various sources that the number of species in the family varies between 6,000 and 10,000. In Turkey, there are 8 subfamilies, 65 genera, and 493 species belonging to the Elateridae. Adults are usually found on flowers or vegetation, beneath tree bark or stones, and in decaying woods, saprophagous, phytophagous, or predators. Larvae are found in a variety of habitats including soil, debris, and rotting wood (Lawrence et al., 2000). The larvae of many species are destructive agricultural pests, which feed on newly planted seeds and the roots of various plants, such as beans, cotton, potatoes, corn, beet, carrot, onion, alfalfa, clover, various fruits, and cereals (Kabalak and Özbek, 2018). The main aim of this study is to exhibit the saproxylic Elateridae fauna of the Inner Western Anatolian region of Turkey (Afyonkarahisar, North of Denizli, Kütahya, and Uşak provinces). This study has been carried out in the scope of the Tübitak project titled “Researches on the Family Elateridae (Coleoptera) in Inner Western Anatolian Section of Turkey”. In the scope of this study, specimens were collected from decaying trees (*Pinus brutia*, *Salix* spp., *Populus* spp., and several fruit trees), and pheromone traps in 2019 and 2021. A number of collected specimens, collecting months, collecting altitudes, and temperatures of collecting localities of species were recorded and evaluated. Photographs of collecting methods were taken during field studies. Collected specimens are preserved as dried samples in the collections, examined morphologically and their species were determined. As a result of morphological examinations, 17 species were diagnosed from the genera *Agrypnus*, *Ampedus*, *Calais*, *Cardiophorus*, *Ischnodes*, *Lacon*, *Melanotus,* and *Prosternon*. Photographs of species were taken both in field studies and in the laboratory. Some ecological properties and zoogeographical distributions of these species are given, compare, and discussed.

Keywords: *Elateridae, saproxylic species, fauna, Inner Western Anatolian region.*

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Niche Modelling Study on Six Elateridae (Coleoptera) Species in Turkey

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Abstract

The main purpose of this study is to make Ecological Niche Models (ENM) for *Athous haemorrhoidalis*, *Cardiophorus nigratissimus*, *Drasterius bimaculatus*, *Nothodes parvulus*, *Peripontius omissus* and *Peripontius terminatus* species within the scope of Tübitak project 118Z772 carried out in the Inner Western Anatolia region. Within the scope of ENM, models for current, 2050, and 2070 years were created using MaxEnt 3.4.1 (Phillips et al. 2006; Elith et al. 2011) software. 4 RCPs (representative concentration pathways; RCP2.6, RCP4.5, RCP6, and RCP8.5') defined in the Intergovernmental Panel on Climate Change 5 (IPCC) were used to identify suitable future habitats for species distribution.19 bioclimatic variables used in the models were obtained from the Worldclim database (Hijmans et al. 2005; www.worldclim.org) at 30 arcsec (~1km) resolution. During the model preparation phase, geographic information system (GIS) operations were performed with ArcGIS 10.6 software. Presence data for *Athous haemorrhoidalis*, *Cardiophorus nigratissimus*, *Drasterius bimaculatus*, *Nothodes parvulus*, *Peripontius omissus,* and *Peripontius terminatus* were obtained from species identified from field studies, as well as in the Global Biodiversity Information Facility (GBIF) database (GBIF.org (2021)) and samples from literature. (Kabalak & Sert, 2011; Kabalak & Sert, 2013; Sert & Kabalak, 2011; Kabalak & Sert, 2021). ENMs were created using MaxEnt in the SDMtoolbox application and the spatial jackknife (Spatial jackknifing) option (Radosavljevic and Anderson, 2014). It is necessary to evaluate whether the generated ENMs differ from a random estimate. Area Under the Curve (AUC) was preferred for the validation of models (Fielding & Bell, 1997). AUC value greater than 0.5 indicates that the model result is different from a random estimate.AUCs value is 0.65 for *Athous haemorrhoidalis*, 0.73 for *Cardiophorus nigratissimus*, 0.72 for *Drasterius bimaculatus*, 0.78 for *Nothodes parvulus*, 0.77 for *Peripontius omissus* and 0.85 for *Peripontius terminatus*. While *Cardiophorus nigratissimus* is xerophilic species, *Athous haemorrhoidalis*, *Drasterius bimaculatus*, *Nothodes parvulus*, *Peripontius omissus*, and *Peripontius terminatus,* prefer humid habitats. As a result of ENM, we can state that suitable habitats of all examined species could decrease in future estimations.

Keywords: *Ecological Niche Modelling, Elateridae, Inner Western Anatolian region.*

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Studies carried out in the laboratory of biological control against forest pests in Trabzon

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Abstract

The great spruce bark beetle, *Dendroctonus micans* (Kugelann) (Coleoptera: Curculionidae), has been a potential threat to Turkey and the entire Eurasian spruce forests for many years. Within the scope of biological, mechanical, and biotechnical control of forest pests, three laboratories were established under the Regional Directorate of Forestry in Trabzon, namely Maçka (1998), Torul and Trabzon (2001). The production of *Rhizophagus grandis* (Gyllenhal) (Coleoptera: Monotomidae), the predator of *D. micans* that damages the spruce forests in the region, began in 1998 and continued in all laboratories from the time of their establishment. As a result of the studies in these laboratories, with the increase of the success rate in the control and the natural balance against *D. micans*, the laboratories were merged, Trabzon being the center. Our laboratory, which is under the Regional Directorate of Forestry in Trabzon, continues to serve as one of the laboratories established within the framework scope of biological control of forest pests in Turkey. The laboratory houses many areas such as reproduction, diagnosis, projects, and training to strengthen the activities carried out and build the capacity to control forest pests through biological control. *R. grandis*, which is a predator against *D. micans* in biological control in the laboratory, was integrated into a new system in 2020. *Torymus sinensis* Kamijo (Hymenoptera: Torymidae) parasitoid against *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae) was produced and released on infected trees in forest areas. The laboratory, which has made many innovations in the production phases of these beneficial insects, has supplemented the classical production methods with modern methods that allow us to perform studies of higher quality, increase labor productivity and save time. On the other hand, control of other pests with pheromone traps and bird nests continues. In our laboratory, where molecular and microbiological studies are also carried out, morphological and molecular species diagnoses of entomopathogenic fungi that have a lethal effect on forest pests are performed. When we evaluate our projects, we continue to work on the control of entomopathogenic fungi and the spread and increasing losses of mistletoe in collaboration with the Eastern Black Sea Forestry Research Institute and the Karadeniz Technical University.

Keywords: *Dendroctonus micans, Dryocosmus kuriphilus, Rhizophagus grandis, Torymus sinensis*

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Short-term effects of fire on arthropod community in a *Pinus brutia* Ten. forest

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Abstract

The high temperature and low humidity conditions that emerged in the summer of 2021 caused “megafires” that affected large areas in Turkey. One of these large fires occurred in Marmaris region, Muğla Province, and it caused the destruction of 11.543 hectares of land, partially or entirely. Right after the fire, a short-term study was performed to detect arthropod groups that were active in recently burned areas. Sampling was performed with pit-fall traps in eight sites burned in different fire severity. The study sites were grouped into four fire severity categories; high, medium-high, medium-low, and low. At each site, three pit-fall traps were placed along a transect at 5 m intervals. Sampling was carried out for two months immediately after the fire. During sampling, insects observed in the sites were recorded, and burned trees were examined for potential wood-boring beetle activation. In total, 4437 individuals belonging to four arthropod classes, Arachnida, Chilopoda, Diplopoda, and Insecta, were caught. Insects were represented by the Coleoptera, Dermaptera, Blattodea, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Neuroptera, Orthoptera, and Thysanura orders in all sites. Total activity was the highest in high-severity burned sites than other sites. Moreover, the highest arthropod activity was observed immediately after the fire and decreased in the second month, especially due to the high activity of ants in recently burned areas. Ants (Hymenoptera: Formicidae) constituted 75% of the total number of individuals in the first month and %77 in the second. Although there was no evidence of the colonization of wood-boring beetles in the traps and during observations on burned trees, *Aradus cinnamomeus* (pine bark bug), a species considered a pest on pines, was determined in the traps. Contrary to the expected decrease in the number of individuals due to the mortality effect and the acute habitat change depending on fire, the high activation of the arthropods shows the importance of early studies in understanding the effects of fire and role of arthropods on post-fire ecosystem process.

Keywords: *Turkish red pine, direct effect of fire, arthropods.*

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Monitoring of Forest Pest Insect Through Remote Sensing Time Series Analysis: Example Of Tahtakopru Province

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Abstract

Several biotic and abiotic factors threaten forest health in Turkey that has around 22.9 million ha of forest area. Insect pests are the main destructive biological threats for Turkish forests. Pine, beech and spruce forests stand out as forests under the threat of insect epidemics. In addition, boxwood and chestnut trees are also forest trees in danger of insect epidemics. Bark beetles (*Dendroctonus micans, Ips spp.*), pine processionary moth (*Thaumetopoea pityocampa*), chestnut gall vasp (*Dryocosmus kuriphilus*) and the box tree moth (*Cydalima perspectalis*) are the most serious forest pests in Turkey in the last decade. Integrated Pest Management (IPM) strategies with the ecological aspects are the main perspective to improve pest control strategies against forest pests. First step for this is to monitor the damage level of forest pests over time. The advanced techniques like remote sensing has become important tools for forest health monitoring. Moreover, with rapid development of technology, remote sensing applications introduces new approaches for monitoring and determining the damage levels of forest pests. In the early stage of damage, stressed tree leaves do not cause any colour change in the visible spectrum. Therefore, early detection of damage becomes difficult. In this study, it is aimed to detect and monitor forest pests early by performing time series analysis of plant indices and monitoring the spectral changes in the Google Earth Engine (GEE) platform. For this purpose, Tahtakopru (Inegol) location was chosen as the study area. The epidemic (2019), pre-epidemic (2018) and post-epidemic (2020) summer and autumn periods were monitored for beech trees infected by the red-tailed beech caterpillar (Calliteara pudibunda). For monitoring, time series analysis and Random Forest (RF) classification were performed using Sentinel-2 satellite data and 9 different plant indices: NDVI, SAVI, TVI, RVI, NPCRI, EVI, GNDVI, NDWI, RDI. As a result of the analysis, it was determined that the insect epidemic started in October 2018. When the classification results were compared, it was seen that the best result belonged to the 2019 summer-autumn period with an overall accuracy of 86.16% and a kappa value of 0.7864. When the 2018-2020 period was followed, it was determined that the overall accuracy value was 80.58% and the kappa value was 0.70. Finally, the change analysis was made on the GEE for the time of the epidemic and after, and the amount of damage caused by the insect epidemic was determined as 373 hectares.

Keywords: *Forest Monitoring, Time Series Analysis, Pest Insect, Remote Sensing, Google Earth Engine*

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The Saproxylic Insect Diversity of Koycegiz and Fethiye (Mugla) Anatolian Sweetgum Forests

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Abstract

Liquidambar orientalis Miller (Altingiaceae) (Anatolian sweetgum tree), an endemic species of Turkey, is an important element in floristic richness. Although the species is common in Muğla, it also occurs in Southwest Anatolia. Old, hollow or dead individuals of this species are important to the basic requirements of many insects, providing nutrition and shelter to saproxylic insects in particular. In this work, saproxylic Coleoptera associated with *L. orientalis* were collected and identified, revealing the contribution of this tree species to insect diversity. The study was carried out in selected old (d age; 36,0-51,9 cm diameter at breast height) Anatolian sweetgum forests in Köyceğiz and Fethiye. Köyceğiz area is within the borders of Beyobası Forest Sub-District Directorate Kavakarası village; Fethiye area is within the borders of Ömer Eşen and Küçük Kargı Nature Park. In order to sample insects, five trees were selected in both areas and two trap types (Window trap and Pitfall trap) were used, a total of ten. Traps were installed on March 12, 2021 and checked once a month for six months (April-September). In addition to the traps, standing and fallen dead trees were examined in both areas and 22 individual insects collected. In addition, on July 22, 2021, 23 saproxylic insects, mostly Cerambycidae and Elateridae, were obtained using the light trap method in the Fethiye area. Insects were taken to the laboratory and the non-saproxylic insects separated; others were identified to the family level. At the end of the sampling periods, 1302 individuals, representing 112 species in 33 families were obtained. A total of 1219 of them were collected with window type traps and 38 of them with pitfall traps. The traps set in Köyceğiz yielded 767 individuals, whereas 535 individuals were obtained from the traps set in Fethiye. Curculionidae (555), Anobiidae (325) and Tenebrionidae (104) were the most commonly found families, whereas Corylophidae (1), Monotomidae (1), Mycetophagidae (1) and Phalacridae (1) had the least number of individuals. The highest number of species were from Anobiidae (16), Elateridae (15), Curculionidae (8) and Staphylinidae (8). Anthribidae, Bostrichidae, Corylophidae, Cryptophagidae, Endomycidae, Eucridae, Lucanidae, Malachiidae, Monotomidae, Mycetophagidae, Oedemeridae, Phalacridae, Pyrochroidae and Scirtidae were each represented by a single species. Based on these data, it is clear that saproxylic insect fauna is diverse in Anatolian sweetgum forests, where old trees are abundant.

Keywords: *Liquidambar orientalis, Dead Tree, Saproxylic Insect, Muğla*

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New Record of Gall midge of Dogwood, *Craneiobia corni* (Giraud, 1863) (Diptera: Cecidomyiidae) in Türkiye

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Abstract

Gall midges, Cecidomyiidae family contain the most species-rich group of gall inducers insects. The family includes 6.203 species and 736 genera (with fossil) in the World. So far from Türkiye, 118 species were reported. The larvae of most gall midges feed within plant different tissue such as flowers, buds, branches, and shoots, causing abnormal plant growths called galls. During the study carried out to determine the gall insect species in the Eastern Mediterranean Region of Türkiye between 2016 and 2021, galls and larvae of *Craneiobia corni* (Giraud, 1863) were found on the leaves of *Cornus sanguinea* subsp. *cilicica* Wangerin) D. F. Chamb. (Cornaceae). *C. corni* is a new record for the gall midges (Cecidomyiidae) fauna of Turkey. The species is widespread in Adana (Pozantı), Mersin (Çamlıyayla), and Niğde (Ulukışla-Alihoca vil.). *C. sanguinea* subsp. *cilicica* was recorded the host plant for *C. corni* in the field. Although Türkiye is a large country with various plant communities, a few researchers have carried out systematic faunal investigations. Systematic faunal investigation of the Cecidomyiidae fauna of Türkiye will contribute to the production of new information.

Keywords: *Gall midge, Craneiobia corni, Cornus sanguinea* subsp. *cilicica, New record, Türkiye.*

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The oak gall wasp, *Dryocosmus mikoi* Melika, Tavakoli, Stone & Azizkhani (Hymenoptera: Cynipidae): A new record from Türkiye, with its new host and inquilines species

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Abstract

Oak gall wasp, *Dryocosmus mikoi* Melika, Tavakoli, Stone & Azizkhani 2006 is a member of Cynipidae Family (Hymenoptera). It was first described from Iran in 2006. Until recently, it was thought to be part of Iranian endemism. Also, it was reported from Israel in 2018. Only its sexual generation is known. Its larvae form an almond-shaped and solid gall (=tuber), which is between two veins areas in the leaf of the *Quercus* sp. The study was conducted in natural oak communities in the Eastern Mediterranean Region of Türkiye between 2019 and 2021. *Dryocosmus mikoi* was determined on *Quercus trojana* subsp. *trojana* in Adana (Pozantı), on *Q. brantii* Lindl in Gaziantep (Yavuzeli), on *Q. ithaburensis* subsp. *macrolepis* (Kotschy) Hedge & Yalt. Mersin (Gülnar) and on *Q libani* G. Olivier and on *Q. trojana* subsp. *trojana* in Niğde (Ulukışla). *D.mikoi* is the first record from Türkiye. In addition, *Q. trojana* subsp. *trojana*, a new host oak was recorded for *D.mikoi.* Also, two different inquiline Cynipidae and a Cecidomyiidae (Diptera) specimens were reared from the galls of *D.mikoi*. It is known Türkiye represents a major center of diversity of oak cynipids. Therefore, a detailed investigation of the cynipidae fauna of Türkiye will contribute to the production of new information.

Keywords: *Dryocosmus mikoi, Oak Gall wasp, Inquilines species, Cecidomyiidae, New Record, Türkiye.*

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The aphid species (Hemiptera: Aphidoidea) detected on forest trees in Mugla province

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Abstract

Aphids are a group of insects belonging to the order Hemiptera. Aphids are feeding on plants and carry plant viruses. Approximately 6000 aphids species are known all over the world and the aphid fauna of Turkey is represented by 612 species. Mugla is an important place in terms of forest area in Turkey. Insect and plant viruses also damage plants and prevent their growth and development. This study was conducted in Mugla province from March 2020 to December 2021. In this study, 31 aphid species were determined that cause damage on forest trees. During the study *Cinara (Cinara) brauni, Cinara (Cinara) intermedia, Cinara (Cinara) maghrebica, Cinara (Schizolachnus) orientalis, Cinara (Schizolachnus) pineti, Cinara (Cinara) pinihabitans, Cinara (Cinara) watanabei, Eulachnus cembrae, Eulachnus nigricola, Eulachnus pumilae, Eulachnus tauricus* and *Eulachnus tuberculostemmatus* on *Pinus* spp., *Cinara* (*Cinara*) *cedri* on *Cedrus* spp., *Diphyllaphis* (*Diphyllaphis*) *mordvilkoi*, *Kurisakia querciphila*, *Lachnus crassicornis, Lachnus roboris, Lachnus swirskii, Lachnus tuatayae, Phylloxera glabra, Thelaxes californica, Thelaxes suberi, Thelaxes valtadorosi, Thoracaphis flava* and *Tuberculatus* (*Tuberculoides*) *pallescens* on *Quercus* spp., *Chaitophorus indicus*, *Chaitophorus melanosiphon*, *Chaitophorus populeti*, *Chaitophorus populialbae* and *Pemphigus* (*Pemphiginus*) *vesicarius* on *Populus* spp., *Tiliaphis shinjii* on *Tilia* spp. were determined. *Kurisakia querciphila* has been identified as a new record and the number of Turkish aphid fauna increased to 613. The forest areas are going to destruction by various reasons such as climate change, fires, and grazing, so it is important to specify of biodiversity of forest areas to improve efficient management strategy for conservation processes. This study aimed to provide detailed information about the aphid species that are determined on forest trees in Mugla province.

Keywords: Aphid, Forest trees, *Kurisakia querciphila,* Mugla, Turkey

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The effect of fire-related variables on beetle community in a *Pinus brutia* forest

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Abstract

Fire is a very important and unique ecological force for the Mediterranean ecosystem. Fires affect the faunistic communities through direct mortality and by causing changes in habitat structure. Fire-related variables as much as fire itself may cause significant changes in plant species diversity and vegetation structure during the recovery process and these changes affect the structure and dynamics of animal communities that use the area as habitat. This study was performed to investigate the effects of post-fire management treatments, pre-fire vegetation age and fire severity on the structure of beetle communities after one of the largest fires of Turkey occurred in Antalya province, the Serik-Taşağıl location in 2008. Within the scope of the study, non-treated and subsoiling-seedling planting treatments in crown fire areas, non-treated and seed spreading-thinning treatments in surface fire areas were evaluated. Beetle samples were collected between May and November 2018 using pit-fall traps. Sampling was carried out in grids consisting of 9 pit traps with a distance of 5 m in each sampling site. In both treatment comparisons, beetle abundance and species richness values were higher in the non-treated area compared to other areas. As a result of the comparison of mature and young areas in terms of pre-fire vegetation age, it was found that beetle abundance and species richness values were higher in the mature area. In the evaluations for the comparison of the crown and surface fires, the abundance and species richness values of the area destroyed by crown fire were higher than surface fire. Beetles as an important bio-indicator group give very important cues about diversity and ecosystem process of the area. According to the results, non-treated areas in both young and mature stands supported more species and individuals of beetles. It is important to realize practices that support diversity as well as forest regeneration while making decisions about applications to be carried out in the areas after the fire.

Keywords: *Turkish red pine, Coleoptera, plantation, species diversity.*

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Some contributions to the aphid (Hemiptera: Aphidoidea) and host plant composition of Antalya province in Turkey

Özhan Şenol[1], Gazi Görür[1], Gizem Başer[1], Hayal Akyıldırım Beğen.[2], Bengisu Venhar Akçay[1]*

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Abstract

Aphids are significant pests due to phloem sap-sucking and vectors of harmful plant viruses. Aphids depend upon host plants to sustain their lives and they are one of the most important insect groups that harm by feeding on cultivated plants, ornamental plants and naturally grown herbaceous and woody plants in the areas they spread. Nearly 6000 aphid species have been identified. Up to date, nearly 612 aphid species are known for Turkish aphid fauna. This study conducted in Antalya province from March 2020 to December 2021. Antalya province has higher forested area and located in the Mediterranean Region in Turkey. There is a higher floristic endemism, 500 of 700 endemic plant species determined at the Taurus Mountains placed in Antalya province. Specimens were mounted according to Martins (1983) and identification process of aphid species were identified based on Blackman & Eastop (2022). The voucher specimen are deposited in entomology laboratory of Niğde Omer Halisdemir University. During the field study 1108 specimen collected from 131 different localities. However, 131 aphid species were detected belonging to 50 genera on 101 different host plant species and *Aphis* (*Aphis*) *roripae* (Palmer, 1938) was new addition for aphid fauna of Turkey. This study aimed to make contribution to aphid and host plant composition of Antalya province. These findings were preliminary results of the study, so it is expected to more aphid species and infected host plant species should be identified at the end of the identification and field studies.

Keywords: *Antalya, Aphidoidea, Turkey, host plant, Hemiptera*

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Saproxylic Beetles Detected in Oak Forests of Different Ages in Mersin/Gulnar Region

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Abstract

For many years, the oak forests in the Eastern Mediterranean basin in Turkey have been hosting different species, especially fungi, insects, and birds. However, oak forest areas are constantly destroyed due to different land-use patterns. With this destruction, fauna habitats are damaged, especially habitats of some saproxylic beetle species on the IUCN list. Developing practical and applicable management plans, studies aiming to reveal the habitat structure and define the relationships between species that depend on it for these habitats, which need to be protected, requires. This study was carried out to determine saproxylic beetle diversity in oak forests. For this purpose, total of 45 window-type traps, five for each, on 9 sample areas were set in young, medium, and old oak forests in the Gülnar district of Mersin province in 2017. Beetles were collected from the traps for five months, between June and October. Regarding the data obtained, the preference and diversity of saproxylic beetles in different age groups of oak forests are evaluated. In the study, 13240 saproxylic beetles belonging to 44 families of the order Coleoptera, were determined. The highest number of individuals was respectively the families Dermestidae (2354 individuals), Elateridae (2325 individuals), and Curculionidae (1531 individuals). The highest number of individuals by age group; are 806 individuals from Elateridae in the young-aged area, 1073 individuals in the middle-aged area, and 586 individuals in the old area are from Dermestidae. Considering the distribution of saproxylic beetles falling into the traps by months, it was seen that the highest number of individuals was in June and the least in September. Old oaks are valuable habitats with the results of this study and the evaluation of literature and Turkey's position is an important hot spot in terms of biodiversity. It is also understood that more studies should be done on protecting old oak areas and the biodiversity in Turkey.

Keywords: *Oak Forest, Protection, Saproxylic beetle, Mersin*

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The biological characteristics of *Ips typographus* in Adjara spruce forests

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Abstract

The environmental and economic damage caused by the negative impact of the spruce bark beetle is enormous all over the world. Georgian spruce forests are no exception. Therefore, a detailed study of the biological characteristics of the pest, taking into account the ecological factors of a particular region, is very important, even in order to properly plan the pest control mechanisms. Studies on the growth and development of a separate phase of the bark-eating typographer (egg, larva, pupa, and adult) were carried out in laboratory and field conditions by the methods adopted in the practice of international forestry. Studies In the Adjara forest have shown that mass reproduction of pests is promoted by high fertility of pests, rapid development, high generation rate, biotic factors, resistance to climatic factors, improper agricultural measures, forest frequency reduction, and so on. In winter, 80% of the pest is collected in the snow cover from the root collar to the height of the stem up to 2 m, and a small number of it is found above the snow cover. The pest population is found in the soil layer 6-8 cm deep and in the fallen tree bark (where thousands of insects gather at the same time) at a distance of 2.5-3.0 m from the trunk of a woody tree, which is the best possibility in fighting with a chemical method (insecticides); The egg stage of the pest lasts 10-20 days in different environments, the worm - 20-30 days, and the shell - 7-15 days. It takes about 35-65 days for the new generation to fully develop. At a temperature of 0°C, the growth and development of the pest in all its phases (larva, pupa, a not fully grown beetles) is very slow, but. As the temperature increases, their growth rate increases; Spruce bark beetle moves very slowly at 0°C, although flight and adverse effects are not observed, while constant flight and strong activity occur at 20-25 ° C; The egg stage of the pest lasts 10-20 days in different environments, the larva - 20-30 days, and the pupa - 7-15 days. It takes about 35-65 days for the new generation to fully develop. In different environments of the study area, adult male beetles reach 5.5 mm in length, while females reach 5.9 mm; Timely and correct forestry complex measures are needed to reduce the pest to a minimum.

Keywords: *Spruce; Forest, Bark Beetle, Ips typographus, Biology.*

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Distribution and Control Studies of Citrus Long-horned Beetle, *Anoplophora chinensis* (Forster, 1771) in Trabzon

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Abstract

In this study, the expanding distribution area of an important alien invasive species, *Anoplophora chinensis*, in Trabzon province, and the control methods against the pest in 2017 to 2021 are given.
The pest was first detected on Japanese maples kept in Trabzon Metropolitan Municipality Atasu Facilities in 2016. Following the species determinations, the infected area was quarantined within 2 km along with the buffer zone. In order to emphasize the importance of the pest, importance was given to raising public awareness and training of technical personnel. As a result of the determination studies carried out in the hazelnut orchards around Esiroğlu Atasu Facilities, it was determined that 1082 decares of land were contaminated and risky in 2018. In 2018, chemical struggle started in partnership with the Provincial Directorate of Agriculture and Trabzon Metropolitan Municipality. The first spraying studies were carried out in 340 da hazelnut orchards in June, within a 10-day spraying period. In November 2018, 60 more areas were sprayed for the larval stage of the pest. As a result of the determination studies carried out in 2019, the contaminated area was determined as 1834 da and a buffer zone with a diameter of 2 km was created again. In 2019, spraying and eradication studies were carried out in 426 decares of land and 134,731 decares. Determination studies continued in 2020 and the contaminated area was determined as 3565 decares. In 2020, pesticides were applied in 760 da areas in Maçka District. In addition, eradication studies were carried out in 3266 da area, starting from the last month of 2020 and ending in 2021. During the eradication studies, 831,264,00 TL support payments were made to the producers in 2019 and 24,023,742,60 TL support payments in 2020. As a result of the ongoing detection studies in 2021, approximately 1323 decares of contamination were detected in the area.

Keywords: *Anoplophora chinensis, Hazelnut, Invasive species.*

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Damage Statistics in Forest of Turkey

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Abstract

The biotic and abiotic damages that occur in our country's forests significantly affect our forests. In this study, the current amount of damage in the tree volume caused by biotic and abiotic damage in our country forests and the current statistics of the control methods (Biological, Mechanical, Chemical and Biotechnical control) applied against biotic pests are given. In addition, records of pest control activities carried out regularly since 1941 in our country's forests are given. Efforts were made to control forest pests in an area of 15,703,193 ha from 1941 to 2022. Within the scope of biological control, according to the records kept since 1941, 1,940,540 bird nests were hung in our forests, 13,218 Red wood ant nests were transplanted and 16,403,736 predatory insects produced in laboratories were released into the forests. The General Directorate of Forestry has banned the use of toxic chemicals in forests since 2007 unless it is necessary to control harmful organisms. Thus, in the last 20 years, the area of chemical control has been reduced from 45.5% to 0.30%. According to ORBIS (Forest Information Systems) records, 2041 control projects were carried out in 2021. 851 of the projects are biological, 842 are biotechnical, 344 are mechanical and 4 are chemical control projects. İzmir (212), Kastamonu (172) and Adana (124) are the provinces with the highest number of projects. In 2021, 46 harmful organisms were tried to be controlled in 272,828.67 hectares of forest area. Pine processionary moth, *Thaumetopoea pityocampa/wilkinsoni*, (82.002 ha), Mediterranean pine engraver beetle, *Orthotomicus erosus*, (78.377 ha), Six-toothed bark beetle, *Ips sexdentatus* (51.758 ha) are the most combated pests in 2021. The combat ratio of these three pests in total combat is 78%. Across the country, 49,940 pheromone preparations were used in 23,833 pheromone traps in 2021. 89.784.580 harmful and 3.939.420 (4.39%) beneficial insects were caught in the pheromone traps. Between 2010-2021, 11,862,787 m3 and 3,407,215 m3 of wood properties were produced, respectively, as a result of abiotic and biotic origin damages. Existing pest control studies continue.

Keywords: *Abiotic Damage, Biotic Damage, Forest Damages, Forest Pests, Pest Control.*

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Studies of the biological control laboratories (Örnekköy laboratory case)

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Abstract

Örnekköy Biological Control Laboratory started to study in 2020 with the aim of mass rearing of different biological control agents of forest pests and diseasses. *Philosomia ricini* Donovan (Lep.; Saturniidae) had been chosen as laboratory host of *Ooencyrtus pityocampae* (Mercet) (Hym., Encyrtidae) mass rearing which is the most important egg parasitoit of the pine processionary caterpillar (*Thaumetopoea wilkinsoni* Tams. (Lep.; Thaumetopoeidae)) and the western conifer seed bug (*Leptoglossus occidentalis* Heidemann (Hem.; Coreidae)). The mass rearing of *Halyomorpha halys* (Stâl) (Hem.; Pentatomidae) as a different laboratory host of the same parasitoid had studied. On the other hand, *Ephestia* sp. (Lep., Pyralidae) had been chosen as laboratory host of *Trichogramma* sp. (Hym., Trichogrammatidae) which is the other egg parasitoid of the pine processionary caterpillar and the western conifer seed bug. In addition to these studies, the egg clusters of the pine processionary caterpillar had been collected from 11 different Forest Regional Directorates and 7 different Forest Management Diroctorates for determining of the parasitoid distribution. Also, determination of the effectiveness of pheromone lures of the another pest of the Turkish red pine stands O*rthotomius erosus* (Woll.) (Col., Curculionidae) had been studied. The hypovirulent application studies against chestnut branch cancer (*Cryponecteria parasitica*), that one of the important disease of the chestnut stands, has been started.

Keywords: *Spruce; Forest, Bark Beetle, Ips typographus, Biology.*

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Egg parasitoids of pine processionary moth (*Thaumetopoea pityocampa* (Denis & Schiffermuller, 1775) ve T. wilkinsoni (Tams, 1924) (Lepidoptera: Notodontidae) in Turkey

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Abstract

In this study, it was aimed to determine parasitism rate, distribution and abundance of the parasitoid species, their abundance according to altitude level and dynamic and period of parasitoid emergence before and after diapoz on pine processionary moth *T. pityocampa* (Denis & Schiffermüller, 1775) and *T. wilkinsoni* (Tams, 1924) (Lepidoptera: Notodontidae) egg batches that collected 11 city in the Mediterranean, Aegean and Marmara regions. For this purpose, a total of 1019 egg batches were collected from 31 red pine and a black pine area between 01.09.2015 and 15.03.2016 and study carried out between 2015-2018. Four parasitoid species were obtained on egg batches: *Barycapus servadeii* (Domenichini) (Hymenoptera: Eulophidae), *Ooencyrtus pityocampae* (Mercet, 1921) (Hymenoptera: Encyrtidae), *Anastatus bifasciatus* (Hymenoptera: Eupelmidae), and *Trichogramma embryophagum* (Hartig, 1838) (Hymenoptera: Trichogrammatidae). Parasitoid emergence was observed in 79,50% of the eggs. 51,48% of the parasitoids obtained from pine processionary moth eggs were *B. servadeii*, 47,27% *O. pityocampae*, 0,1% *A. bifasciatus*, and 1,1% *T. embryophagum*. *B. servadeii* and *O. pityocampae* were the most common and had the highest rates of parasitism. 18371 parasitoids were obtained from the 200458 eggs. The total parasitism rate of the eggs was %9,15. The percentage of parasitoid species in total eggs was *B. servadeii* 5,36%, *O. pityocampae* 4,33%, *A. bifasciatus* 0.001%, and *T. embryophagum* 0.07%. The emergence of parasitoids from the eggs started in September when the egg batches were collected and continued until June the last observation date. Accordingly, 92,27% of the total parasitoids occurred after the January and 88,60% were in April, May and June.

Keywords: *Egg batches, Parasitism rate, Parasitoid, Pine Processionary Moth.*

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Bark Beetles – Trap Trees

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Abstract

Bark beetles are normally secondary pests whose growth ability is more or less limited by the inadequate physiological state of the host. However, certain bark beetle species can multiply in large numbers when environmental conditions are favourable and can dry out trees in heavy infestations. Most bark beetles use weakened, recently dead or dying trees in forest areas as breeding material under normal endemic conditions. The factors that cause an insect species to be harmful are very diverse. Most of them are climatic factors and the most important stress factor is lack of water, namely drought. Climatic factors play a role, either by causing a state of stress that makes trees less resilient to attack by insects or by increasing the reproductive potential of insects. As a result, population density of certain bark beetles rises above the Economic Damage Level during the epidemic period. Storm-broken, overturned trunks, fungal or insect-damaged individuals, and trees exposed to prolonged drought provide favourable conditions for bark beetles to develop epidemics. Bark beetle species such as *Ips typographus*, *I. acuminatus*, *I. sexdentatus*, *Orthotomicus erosus*, *Pityokteines curvidens*, *Dendroctanus ponderosa*, *D. pseudotsugata*, *Scolytus ventralis* invade and kill healthy trees during the epidemic period. This ability has two bases. These are that these insects have an effective aggregation pheromone and/or carry large numbers of spores of several blue spot fungi that play an active role in the death of the tree. *Ips typographus* attacks healthy planted trees en masse during the epidemic. While the adult beetles open galleries in the living tree, they transmit the blue spot fungi, which inhibit the deadly resin discharge of the tree, into the sapwood. The attacked trees die as a result of the combined effect of insects and the *Ophiostoma* (*Ceratocystis*) *polonium* fungus that they bring with them and infect the trees. The basic approach to control with bark beetles such as *Ips typographus*, *I. sexdentatus*, which is a mass attack strategy, is to minimize attacks on healthy trees. Cutting down the infested trees, removing the trees that have been knocked down by the storm, and tracking and mass catching of these insects with pheromone traps are basic practices. However, it was observed that the mass capture efficiency of pheromone traps was very insufficient during the epidemic period. For this reason, the most effective control method to be followed against bark beetles during epidemic periods is the 'trap trees' method. However, there is no need to prepare a trap tree during the epidemic. The living trees under heavy attack are used as trap trees. For this purpose, in the epidemic areas, the trees in the position of trap trees, which are attacked by a large number of insects, must be determined, and must be cut. In addition, by stripping the bark of these trees, a large number of developing insects must be destroyed. Regular repetition of this application in every generation of the insect during the epidemic ensures a rapid decrease in insect density. Thus, the intensity and success of new attacks decreases significantly after each application, and the epidemic is brought under control. This practice is of vital importance in suppressing and preventing bark beetle epidemics, which have a mass attack strategy. In this study, similar studies carried out especially in the control of *Ips typographus* and *Ips sexdentatus* were taken as an example. Thus, the methods and principles of using the living trees under intense attack as trap trees for the control of bark beetles with a mass attack strategy and the success situation were evaluated.

Keywords: *Bark beetles, Mass attack strategy, Trap trees.*

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Impact of mistletoes on host growth and survival in Turkey

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Abstract

This paper reviews and evaluates the impact of mistletoes on host growth and survival in Turkey. The European mistletoe (Viscum album L.) is a hemi-parasitic plant growing on many tree species and is represented by four subspecies with different host species in Europe. Turkey is home to three subspecies of Viscum album L. found predominantly on coniferous and deciduous tree species. This pest is mainly found in pine and fir forests in Turkey. Mistletoe infection lead to substantial crown degradation by reducing the number of needles, needle length and width, and the longevity of needles on the infected branches. This reduction in foliage biomass results in a decrease in the chlorophyll content of infected trees. The significant reduction on photosynthetic capacity due to mistletoe infection leads to branch dieback, resulting in growth loss in host tree. Several studies have examined the impact of mistletoe infection on growth and development of their host in Turkey. The results of these studies indicated that radial growth losses reach up to 64% for severely infected trees. In addition, field observations indicated that severely infected trees become vulnerable to infection by other pathogenic agents such as insects, which often contribute to the death of host trees. To understand the effect of mistletoe on the health status and survival of hosts, it is necessary to further study the relationships between insects and mistletoe and their interactions with host species. The results can be valuable for the decision-makers managing mistletoe infected forests.

Keywords: *Viscum album L., mistletoe, growth loss, insect.*

POSTER PRESENTATIONS

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Isolation, Morphological Characterizations and Virulence of Entomopathogenic Fungus from *Dendroctonus micans* (Kug.) (Coleoptera: Curculionidae)

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Abstract

Dendroctonus micans (Coleoptera: Curculionidae) is an important bark pest that spreads to spruce forests in the world, causing the drying and death of many trees in the areas where it spreads. Entomopathogenic fungi (EPF) (18) isolated from *D. micans* were identified as genera *Metarhizium*, *Isaria*, *Lecanicillium*, and *Beauveria* as a morphological (infection form, colony morphology, spore form) characterizations. The EPF to determine their insecticidal activity were incubated that 25 ˚C for 4 weeks. Spore suspension added 10 ml of sterile %0,1 Tween 80 on the Petri and engraved with glass baguette and concentration prepared at 1 × 10^7 conidia/ml using the Neubauer hemocytometer. The spore suspension was applied to the larvae and adults of *D. micans* using the spraying method. In the study, ninety *D. micans* larvae and adults were used for each isolate. The experiments were conducted in three repetitions. Tween 80 (%0,1) was used for the control group. In the study, the pest was incubated for 15 days at 21 °C with a humidity of %60 using the inter-shell feeding method in plastic boxes. After application, the mortality rate of larvae varied between 82.5 % and 100 % OZM-1, OZM-2, OZM-4, OZM-8, OZM-22b and OZM-25b isolates had a 100 % mortality rate on day 7 and mycosis rates were 84.33, 96.66, 97.77, 90.0, 94.44, 88,88 %, respectively. The mortality rate in the control group was 10.33 %. The isolated OZM-4 (*Metarhizium sp.*) showed the highest mortality and mycosis rate. A conidial suspension (1 × 10^7 conidia/ml) of these fungi caused between 90 % and 100 % mortality in adults of *D. micans* within 7 days, and the mycosis rate of OZM-2, OZM-14, OZM-18, OZM-19 were determined as 80.0, 80.0, 80.0 % and 85 % respectively. Our results indicate that OZM-2 and OZM-4 isolates are promising biocontrol agents against various pests including *D. micans*.

Keywords: *Biocontrol, Bark beetle, D. micans, Entomopathogenic fungi*

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Using The Egg Parasitoid *Trichogramma denrolimi* Matsumura (Hymenoptera: Trichogrammatidae) Againts *Hyphantria cunea* (Drury) (Lepidoptera: Arctiidae) In Sakarya Province[a]

Hilal Tunca Cosic[1], Sefa Gizem Çankaya[2], Abidin Ağnar[2], Fatmagül Yurttaş[2], Damla Çaycı[1] Ayça İğde[1], Akın Emin[3], Özgür Toprak[3]*

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Abstract

The fall webworm, *Hyphantria cunea* (Drury) (Lepidoptera:Arctiidae), is an important and poyphyogous pest of several forest trees and agricultural crops. It has been observed that it causes significant damage to the ash trees around Sakarya Province. There are complex multitrophic relationships in the forest ecosystem. Therefore, chemical control is extremely harmful in the forest areas. Biological control is a suitable control method that can be used against forest pests. This study also includes the use of egg parasitoid *Trichogramma dendolimi* (Matsumura) (Hymenoptera:Trichogrammatidae) against the fall webworm. For this purpose, storage and rearing studies have been started on the host of the parasitoid, *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae). Rearing of parasitoid and host were performed under controlled conditions of 25 ±1°C, 65 ±5% R.H (relative humidity) and a photoperiod of 16 : 8 h (L : D = light : dark). *T. denrolimi* larvae, prepupae and pupae will store 7, 15, 20, 25, 35, and 45 days at 5, 10 and 15 ºC in a refrigerator. On the other hand, the rearing of *T. denrolimi* on *E. kuehniella* continues for a long time. More than 10.000 parasitoids are produced per day and a pre-release experiment was also carried out. After that, it will be focus on economic mass rearing of parasitoid with the completion of storage studies.

Keywords: *Trichogramma dendolimi, Hyphantria cunea, storage, rearing*

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The use of insecticide-effective parasitoid *Bracon hebetor* Say (Hymenoptera: Braconidae) against *Cydalima perspectalis* (Walker) (Lepidoptera: Crambidae)[a]

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Abstract

The Box Tree Moth, *Cydalima perspectalis* Walker (Lepidoptera Crambidae) is an extremely dangerous native pest, due to the rapid spread and aggressiveness with which attack the buxus plants. This insect pest has also caused significant damage on buxus plants in our country. Sustainable control strategies is very important with insect pest. Biological control, which is a sustainable control method, is one of the appropriate control methods for forest areas. Thus, this study also contains the use of idiobiont gregar larval parasitoid *Bracon hebetor Say (Hymenoptera: Braconidae)* against the *C. perspectalis.* This parasitoid has the ability to paralyze the host insect. *Bracon hebetor was reared* in the laboratory on its host *Ephestia kuehniella* Zeller *(Lepidoptera: Pyralidae).* Rearing of parasitoid and host were performed under controlled conditions of 25 ±1°C, 65 ±5% R.H (relative humidity) and a photoperiod of 16 : 8 h (L : D = light : dark). In this study, *B. hebetor* pupae and adult will store 7, 15, and 20 days at 6, 11 and 17 ºC in a refrigerator. On the other hand, rearing of *B. hebetor* on *E. kuehniella* continues more than one year. An effective and economical mass production model will be created with the conclusion of the storage studies. Additionnally, a small-scale release study is also planned this year.

Keywords: *Trichogramma dendolimi, Hyphantria cunea, storage, rearing*

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Gall forming aphid species that were determined from Antalya province of Turkey

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Abstract

About 6000 aphid species that belong to 510 genera have been identified worldwide. 612 Turkey distributed aphid species and 27 subspecies were determined so far. Aphids, which are phloem sap feeders, infest the herbaceous and woody plants. 10-20% of aphid species lead to gal formation on their host plant and nearly thirty-three aphid species cause gal formation among Turkey distributed aphid species. Galls supply a conserved microhabitat that contains high-quality of nutrient and also defends individuals from predators. Sites and shapes of gall are species-specific. It is possible that there is a positive correlation between selection and performance. The performance of galling aphids should be evaluated simply by means of a number of offspring in the maturing gall or dimension of gall. This study was conducted in Antalya province from March 2020 to December 2021. 120 gall-forming aphids were observed during the study and the mounted process was conducted based on Martin (1983). Identification processes were done according to Blackman and Eastop (2022) and voucher specimens are deposited in entomology laboratory of Department of Biotechnology, Ömer Halisdemir University. Nearly 19 gall-forming aphid species were determined on *Pistacia* sp., *Ulmus* sp., *Populus* sp. and *Malus* sp. host during the field study. This study aimed to find out how many gall-forming aphid species distribute in the Antalya province of Turkey and give information about the host plant and aphid composition in the study area.

Keywords: *Antalya, Aphidoidea, Turkey, Gall forming aphid, Hemiptera*

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First Rearing Egg Parasitoid *Ooencyrtus pityocampae* (Mercet) (Hymenoptera: Encyrtidae) on *Philosamia ricini* (Danovan) (Lepidoptera: Saturniidae) in Turkey[a]

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Abstract

Ooencyrtus pityocampae (Mercet) (Hymenoptera: Encyrtidae) is a polyphagous egg parasitoid that targets the insect pests of various heteropteran and lepidopteran families. *Leptoglosus occidentalis* (Heidemann) (Hemiptera: Coreidae) and *Thaumetopoea pityocampa* (Den. & Schiff.) (Lepidoptera: Thaumetopoeidae), which are among the hosts of the parasitoid, cause significant damage to the forests of our country. Biological control is one of the eco-friendly and effective control methods in forest areas. For this purpose, rearing studies of the parasitoid *O. pityocampae* were started in the İzmir Örnekköy Biological Control Laboratory. *Phylosamia ricini* Donovan (Lepidoptera: Saturniidae) has been chosen as a laboratory host. This host was obtained from the INRAE UEVT Antibes Biological Control Laboratory. Rearing of parasitoid and host were performed under controlled conditions of 25 ±1°C, 75 ±5% R.H (relative humidity) and a photoperiod of 16 : 8 h (L : D = light : dark). *P. ricini* larvae were fed every day with Ailanthus leaves. We were obtained over 3000 *Philosamia* eggs per day. For the first time, *O. pityocampae* was reared for more than ten generations on the eggs of *P. ricini* in our country. Our current studies are focused on mass rearing and release studies of the egg parasitoid *O. pityocampae*.

Keywords: *Ooencyrtus pityocampae, Philosamia ricini, first rearing.*

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Modern Approaches to the Laboratory Production of *Rhizophagus grandis* (Gyllenhal) (Coleoptera: Monotomidae)

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Abstract

Dendroctonus micans (Kugelann) (Coleoptera: Curculionidae, Scolytinae), which first invaded our country in 1966, has damaged thousands of trees in the forests of eastern spruce, *Picea orientalis* (L.), to date. As part of biological control, larvae and adults of *Rhizophagus grandis* (Gyllenhal) (Coleoptera: Rhizophagidae), which began production in 1985 and continue to be successfully produced, are fed to trees in areas damaged by *D. micans*. In this study, an attempt was made to increase production efficiency by supplementing the production method of *R. grandis* from larvae in the log under laboratory conditions with modern methods. For this purpose, the sterilization method of river sand, which was initially used for production, was changed. The sand, which had been boiled for days in cauldrons over the fire, was then sterilized in the oven at the appropriate temperature and time. The fact that the temperature in the new system was twice as high eliminated all microorganisms in the sand. The second change concerned the equipment that provides adequate temperature and humidity in the laboratory. Humidifiers and dehumidifiers were added to the air conditioners that regulate ambient levels, allowing for more accurate measurements. This method, which ensures that temperature and humidity levels are evenly distributed at every point in the laboratory, ensures that each log is incubated under the same conditions. As another innovation, it is planned to protect each of the production logs with tulle bags. In this way, the effect on the production of the number of males/females of the predator placed in the log channels will be made more visible. Again, covering each log with gauze facilitates the detection of a possible entomopathogen that occurs during production and reduces the risk of contamination of other logs by preventing the escape of infected insects from the log. In our study, another step was taken to open the logs channels. The milling work, which was previously done manually by workers, was taken to the next level with a new method. With this method, which increases the number of logs opened each day, the channels are opened easily and to the desired dimensions. Recent production studies have shown that these modern methods have a positive effect on labor output, time savings, and production efficiency.

Keywords: *Biological control, Dendroctonus micans, Modern method, Rhizophagus grandis*

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Biological Control of Chestnut Blight with Hypovirulent Isolates

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Abstract

Sweet-Anatolian Chestnut (*Castane sativa Mill*) is an important forest tree of our country, belonging to the Fagacea family. Our country has an important place in the world chestnut fruit production and this fruit is one of the strategic crops due to honey production as well as timber production. On the other hand, Chestnut Blight (*Cryphonectria parasitica*) is one of the most important diseases that cause yield loss and death as well in chestnuts which have a strategic importance. The disease leads to chestnut canker in the branches that they cannot be fed. 1-Tree branches with chestnut blight, bark samples are taken using 1 cm driller from reddish active cankers. 2-Bark samples are sterilised, cut and planted in the PDA (Potato Dextrose Agar) containing Methionine/Biotin. A single colony is obtained from the developing sample. It is incubated for 7 days in the dark and 5 days in light at 24° C. 3-Compliance groups are determined by matching with European ones (EU-12, EU-1). The transformation test is performed with the samples which determined compliance groups by combining hypovirulans. 4- If the transformation is successful, mass production is made by putting into paste to send for the applicators. Between 2020-2021, paste was prepared for 117 out of 281 samples (104 EU-12, 13 EU-1) that are from the Regional Directorates of Forestry in the laboratory of Bolu Regional Directorate of Forestry, and 41.6% success was achieved as a result of inoculation. Our main goal is to carry out molecular studies to increase the compliance groups for the development of hypovirulence in the field.

Keywords: *Crphonectria parasitica, biological control, chestnut blight, hypovirulence*