Book of abstracts

Plant Health in Sustainable Agriculture: Hot Spots and Solution Perspectives

Novi Sad, Serbia
6th-8th September, 2022

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HARMONIZATION AND INNOVATION IN PHD STUDY PROGRAMS FOR PLANT HEALTH IN SUSTAINABLE AGRICULTURE (HARISA)

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Harmonization and Innovation in PhD Study Programs for Plant Health in Sustainable Agriculture (HarISA)

Final conference

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Plant Health in Sustainable Agriculture: Hot Spots and Solution Perspectives

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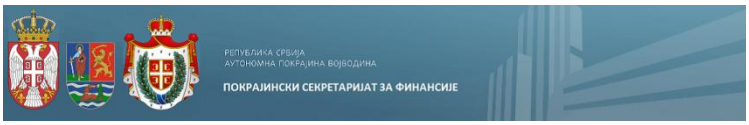

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Subgroup 1 - Diagnosis in plant health and IPM

Integrated management of *Alternaria dauci* in carrots

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Abstract: *Alternaria dauci* is responsible for Alternaria Leaf Blight (ALB), the worldwide major foliar disease in carrot production. The disease commonly occurs when carrots are cultivated during moderate temperatures and the leaves are exposed to prolonged periods of wetness. Severe epidemics have been reported to reduce yields by 40-60%. Under high disease pressure, no single control measure is sufficient to manage the disease adequately. The disease management relies on the combination of the application of synthetic Plant Protection Products (PPPs) with the use of partial resistant varieties. In this direction, several biological and synthetic PPPs were evaluated against Alternaria leaf blight in carrots in two greenhouse experiments. Based on the greenhouse pathogenicity assays the most efficient PPPs were selected for the development of 15 IPM modules. The efficacy of these IPM modules were evaluated under field conditions adding two reference IPM modules that included only fungicides and three treatments using different bio-PPPs. For every pathogenicity trial an intermediate disease resistant variety and a susceptible one were used that were inoculated with a spore suspension of *Alternaria dauci*. All tested IPM modules and bio-PPP treatments were able to control ALB in the field. Efficiency seems to depend on the genotype, while higher protection was observed with the partial resistant genotype.

Keywords: *Alternaria dauci*, integrated management, plant resistance, carrot

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Subgroup 1 - Diagnosis in plant health and IPM

Detection of pear leaf blister moth using an automatic pest monitoring system

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Abstract: Pear leaf blister moth (Lepidoptera: Lionetiidae) is an economically dangerous insect in apple orchards worldwide. During the growing season, the moth develops several generations that cause damage directly to the leaves. The larvae live inside the leaves and feed on the mesophyll tissue, causing defoliation of the leaves and later affecting bud differentiation. In more severe infestations, fruit organoleptic characteristics may also be affected. In the context of precision agriculture, the introduction of new technologies and early detection of pests through the use of automated monitoring systems for economically important apple pests can improve pest control and reduce damage to apple crops. The objective of this study is to develop an automatic monitoring system based on pear leaf blister moth detection using an RGB camera. During a period of 11 weeks, a series of 250 images were taken, and 4150 moths were annotated in the images. A convolutional neural network was trained based on 90% of the annotated images. The results showed that the analytical model trained in this way was able to identify the pear leaf blister moth with 70% accuracy, which was verified using the remaining 10% of the captured images. These preliminary results show that the system can contribute to more accurate and early detection of pests, but still needs to be improved with a larger training data set.

Keywords: *Leucoptera malifoliella* (Costa 1836), apple production, artificial neural network, precision agriculture

Subgroup 1 - Diagnosis in plant health and IPM

Geometric morphometrics techniques - a tool for evaluation of box tree moth *Cydalima perspectalis* invasiveness

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Abstract: Morphological variation can affect the ability of species to disperse and adapt to new areas. Geometric morphometric methods are valuable tools for assessing the extent of phenotypic changes influenced by genetic variation. Such methods were used in this study to determine the morphological variability of the box tree moth *Cydalima perspectalis*, Walker from Croatia and to assess its invasive character. Box tree moth is an invasive species that spreads rapidly, has high reproductive potential, and is highly adaptable. A cross-site analysis was conducted, and the dataset was partitioned by geographic area, with intraspecific variation found independently between northern and southern populations. Results indicate that wing shape is influenced by agroecological factors, with forewings being more plastic than hindwings. Northern populations have broader wings, while southern populations have more elongate wings. Wing characteristics of box tree moth are of great importance in assessing their spread, especially given their high invasive potential. Using this innovative and effective, yet simple and inexpensive method, we can detect differences in wing shape and size and use these differences as biomarkers of variation between and within populations. These results suggest that geometric morphometric methods can be used to study the biological adaptation of box tree moth in native and newly invaded areas.

Keywords: box tree moth, landmarks, adaptation, wings, geometric morphometrics, invasiveness

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Subgroup 1 - Diagnosis in plant health and IPM

IKOPROTECTA - Agricultural composted products as plant protection and growth regulators

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Abstract: Composts are natural products known for their beneficial properties in plant nutrition by enriching the soil with organic matter and nutrients. Composts contain high microbe populations, that are mainly non-pathogenic and a number of studies have highlighted their capacity to suppress or control a variety of plant diseases. The aim of this study was to assess the biopotential of two composted products (Ikorganic), based on disease assessments in greenhouse and in *vitro* experiments. The fungi, yeasts and bacteria that were isolated from the composted products, were evaluated on their ability to inhibit the growth of phytopathogenic fungi and bacteria such as *Verticillium dahliae*, *Botrytis cinerea* and *Pseudomonas syringae* pv tomato. The antagonistic activity of the isolates was investigated, *in vitro*, by employing dual culture technique and several of efficient antagonistic bacterial isolates were identified. Subsequently, the efficiency of the composted products concerning the plant growth promotion and the reduction of disease severity against the above-mentioned pathogens, was evaluated and demonstrated in greenhouse, on tomato plants and on tomato fruits and strawberries. The results of the *in vitro* experiments as well as the comparative study of the two different composted products regarding their ability to control both foliar and soil-borne plant diseases will be presented.

Keywords: composts, plant protection, biological control, plant growth promotion

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Subgroup 2 - Sustainable use of pesticides

Watermelon anthracnose disease in Serbia - importance and management

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Abstract: Watermelon (*Citrullus lanatus* (Thunb.) Matsum. et Nakai) is one of the most important cucurbit crop worldwide. Watermelon is generally grown in open-fields, where the environmental conditions are favorable for disease development. Anthracnose, caused by the fungal pathogen *Colletotrichum orbiculare* (Berk. et Mont.) Arx (syn. *C. lagenarium* (Pass.) Ellis et Halst.), is a destructive foliage disease in watermelon production. In warm, humid climates around the world, the fungus affects watermelon and many other cucurbits, and it can leads to severe crop losses. The disease significantly reduces the total amount of yield and fruit quality by infecting above-ground organs like fruits, leaves, and stems. Due to that reason, effective control of *C. orbiculare* has to be done. It can be achieved using all preventive measures, whereas the use of fungicides has a major importance. However, management of anthracnose is very difficult because there are no registered fungicides in the Serbian pesticide market for chemical control of *C. orbiculare*. Considering that the watermelon is a "minor crop", the registration of plant protection products is not profitable for agrochemical industry. Based on the results of morphological, pathogenic and molecular characterization, all isolates used in this study were determined as *C. orbiculare.* Using the *in vitro* and *in vivo* methods, the sensitivity of *C. orbiculare* isolates to different fungicides were established in laboratory.

Keywords: *Colletotrichum orbiculare*, watermelon, anthracnose, fungicides, sensitivity.

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Subgroup 2 - Sustainable use of pesticides

Pesticide residue analysis of plant samples

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Abstract: Plant protection products are widely used in agricultural production to control pests, increase yield, improve quality, and extend the shelf life of produce. Although their properties are usually valuable, these very properties can have negative effects when pesticide residues are released into the environment. The presence of pesticide residues, their metabolites or degradation products in the environment is a significant risk factor. Therefore, out of concern for public health, maximum residue limits (MRLs) were established by Regulation (EC) No. 396/2005. MRLs are legally permissible upper limits for pesticide residues in or on food or animal feed based on good agricultural practice (GAP) and the lowest exposure necessary to protect vulnerable consumers. Residue analysis provides a measure of the nature and extent of chemical contamination in the environment and its persistence. With the increasing focus on food safety, accurately determining pesticide residues in food has become an important issue. The most common analytical techniques for the detection of pesticide residues are gas chromatography-mass spectrometry (GC-MS) for volatile compounds and liquid chromatography-mass spectrometry (LC-MS) for non-volatile, thermally unstable, and polar compounds without derivative. The combination of chromatography and MS is become one of the most powerful tools for screening, confirmation, and quantification of complicated organic contaminants. The authors will present the advantages of each method as an important procedure for determining the safety of using certain pesticides.

Keywords: analytical chemistry, detection, food safety, pesticides, residues.

Subgroup 2 - Sustainable use of pesticides

Overview of automatic monitoring systems for apple pests

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Abstract: Apple (*Malus domestica* Borkh.) is one of the world's highest-yielding fruit crops. In addition to codling moth (*Cydia pomonella* L.), which is considered the most important apple pest, other lepidopterans, fruit flies, and true bug species also threaten production, affecting fruit quality and preventing its commercialization. Early detection and monitoring of pests is critical to preventing damage from pests. Due to new climatic conditions, the phenology of pests changes frequently and it is very difficult to predict their occurrence. Therefore, there is an increasing need to develop and use new smart technologies for pest monitoring (smart traps, sensors, etc.). Such methods can greatly facilitate site-specific management and consequently reduce the use of pesticides and their residues. The aim of this work is to provide an overview of methods for automatic monitoring of economically important apple pests in order to improve sustainable pest management in apple production.

Keywords: apple production, smart traps, site-specific management

Subgroup 2 - Sustainable use of pesticides

Olive tree endophytes: a new source of bioactivity in plant protection

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Abstract: The agri-food sector is facing unprecedented challenges, which necessitate innovative approaches and methods in order to be addressed. Among them, climate change, the emerging food crisis due to the recent war, and plant protection issues threaten the supply of the world's population with sufficient quantities of food. However, the application of traditional farming models and research based on conventional methodologies and approaches are not sufficient to solve the aforementioned issues. Therefore, here, a new source of bioactivity for applications in plant protection, olive tree endophytes, was assessed. Endophytes can be used in plant protection *per se*, or their bioactive metabolites could be potentially developed as pesticides. In this context, a holistic approach was applied for the isolation of olive tree endophytes and the assessment of their bioactivity. The developed pipeline resulted in the isolation of a large number of fungal and bacterial endophytes. Following the bioactivity assessment, a bacterial isolate exhibited superior antifungal activity against the devastating *Colletotrichum acutatum* species complex. Such bioactivity was largely attributed to the production of lipopeptides, whose toxicity was further assessed to target and non-target organisms and their plant-primming capacity was assessed *in planta* to olive tree applying metabolomics. The results were promising towards the further development of the bacterium as a plant protection agent, and the established pipeline could be used in the R&D of endophytic microorganism-based pesticides, that could, at least partially, substitute conventional pesticides.

Keywords: fungicides, metabolomics, natural products

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Subgroup 2 - Sustainable use of pesticides

Current status of *Erysiphe necator* populations sensitivity to fungicides in Serbia

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Abstract: The grapevine production in Serbia takes place on approximately 21000 hectares, with an annual total production of about 160000 tons. One of the most important pathogen in grapevine cultivation is *Erysiphe necator,* the causal agent of powdery mildew. If chemical protection is not carried out properly, the pathogen may cause significant losses in the yield and quality of the grapes. Systemic fungicides are prevalently used to control *E. necator.* Due to their very specific mode of action and continuous application, the risk of resistance development is increased. The results about this topic in Serbia are scarce, so the aim of this study was to investigate the efficacy of different fungicides and determine the sensitivity status of *E.necator* populations. The trials were conducted on four locations from 2019 to 2021. Completely randomized block system with four replications was used. Commercial formulations of the fungicides from different groups (QoI, SDHI, DMI fungicides, spiroketal-amines, aryl-phenyl ketones, aza-naphtalenes, phenyl-acetamide) were tested. During each experimental year, two assessments were done on the bunches and one on the leaves. The incidence and severity of powdery mildew in the control plots were significant especially during 2019 and 2020. A drop in the efficacy of QoI fungicides and DMI fungicides was observed. Evidently reduced efficacy of aryl-phenyl-ketones was observed on two localities. A lower sensitivity of the population to quinoxyfen was determined, but no cross resistance between aza-naphtalenes was detected. In two experimental sites, the efficacy of boscalid was low, while the other SDHI fungicides showed very high efficacy in all experimental sites. Depending on the site, the efficacy of spiroxamine and cyflufenamide was moderately high to very high. The results obtained in this study indicate that there has been a shift in the sensitivity of *E.necator* populations to certain groups of fungicides in Serbia.

Keywords: powdery mildew, grapevine, sensitivity, fungicides, efficacy

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Subgroup 2 - Sustainable use of pesticides

Influence of different spraying technical factors on leaf surface coverage in vineyard

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Abstract: The research was carried out with a Nobili octopus radial sprayer. The influence of the main technical spraying factors (nozzle type, operating speed and spraying rate) on the coverage of the treated surface, the average droplet diameter, the number of drops/cm^2 and liquid drift was investigated. The speed of the sprayer is adjusted to 6 and 8 km/h, and the spraying rate to 250 l/ha, 300 l/ha and 350 l/ha for the vineyard. Blue (TR 8003), yellow (TR 8002) and green (TR 80015) Lechler nozzles are used. The research is set up as a three-factorial field experiment with 18 treatments in 4 replication, both for the type of spreader and for the different type of vineyard plots. For each treatment, 60 water-sensitive pieces of paper were placed on the tree/vine, which were processed using computer image analysis and the ImageJ computer program. In addition to the main characteristics of the research, the index of the leaf area and density, speed and flow of the air current, working pressure, direction of the nozzles are determined, and the weather conditions are monitored during the research. Before the actual research, the sprayers are tested according to the European standard EN 13790. By reducing the ISO number of the nozzle, increasing the speed of the sprayer and increasing the spray rate, the coverage of the treated surface, the number of droplets/cm^2 and liquid entrainment increases while average droplet diameter decreases. The best relationship between the coverage of the treated surface and the liquid drift in the vineyard is achieved with the coverage of the treated surface of 60.33% and the liquid drift of 17.41% (green nozzle, working speed of 6 km/h, spraying norm of 350 l/ha and working pressure of 11.02 bar).

Key word: nozzles, sensors, vineyards, spraying norm, leaf surface

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Subgroup 2 - Sustainable use of pesticides

Systemic herbicides use in poplar plantations

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Abstract: The aim of this study was to determine the presence of weeds and to investigate the efficacy of the herbicides glyphosate (6 l/ha) and triclopyr (4 l/ha) in three-year-old poplar plantations. A field study was conducted in 2018 and 2019, at the Institute of Lowland Forestry and Environment "Kaćka forest". The experiment was established as a random block design with four replications. Herbicide efficacy and phytotoxicity were evaluated after 15 and 30 days. In 2018, the presence of 19 weed species was identified (*Amorpha fruticosa, Apera spica-venti, Apium graveolens*, *Asclepias syriaca, Avena fatua, Cirsium arvense*, *Convolvulus arvensis*, *Dactylis glomerata, Equisetum arvense, Galium lanceolatum, Geranium dissectum, Gleochoma hederacea, Ranunculus repens*, *Solidago gigantea*, *Solidago speciosa*, *Symphytum officinale, Trifolium campestre, Trifolium repens, Vicia villosa*), of which 84,21% belong to broad-leaved species and 15,79% to grass species. During 2019, the presence of 18 weed species was identified (*Amorpha fruticosa, Apera spica-venti, Asclepias syriaca, Avena fatua, Capsella bursa-pastoris, Dactylis glomerata, Daucus carota, Erigeron annus, Equisetum arvense, Galium lanceolatum, Gleochoma hederacea, Solidago gigantea*, *Solidago speciosa*, *Symphytum officinale, Trifolium campestre, Trifolium repens, Veronica hederifolia* and *Vicia villosa*), of which 83.33% belong to broad-leaved species and 16.67% to grass weeds. Results show that glyphosate had the best efficacy which was 94.34%, while the total efficacy of triclopyr was 85.53%. Herbicide phytotoxicity was not recorded in three-year poplar plantations. The high potency of controlling weeds showed that glyphosate and triclopyr can be recommended as an effective measure to control weeds in poplar plantations.

Keywords: weed vegetation, glyphosate, triclopyr, weed control, poplar

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Subgroup 2 - Sustainable use of pesticides

Significance of Appropriate Pesticide Application

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Abstract: In order to successfully protect cultivated plants from harmful organisms, it's necessary not only to choose an appropriate plant protection product and to use it in a timely manner, but also to properly apply it to the plant. Therefore, the appropriate choice of equipment for application, it's proper functioning have a significant impact on efficiency of the treatment. In accordance with the Directive of the European Parliament 2009/128 EC, frameworks on the sustainable use of plant protection products have been established. Inspection of pesticide application equipment includes checking the technical accuracy and functionality of the device as well as risk assessment for the operator and the environment. The standardization of this procedure in Europe was established in 2003 with the adoption of the European standard EN 13790, and by 2006 it's implementation became mandatory in 20 countries.

In Montenegro, during 2021, the Directorate for Food Safety, Veterinary and Phytosanitary Affairs implemented a national program of phytosanitary measures, which prescribed the inspection of equipment used for the application of plant protection products. The objective was to get an overview on condition of the equipment for pesticide application in Montenegro. Major irregularities were observed with most of the devices, such as malfunctioning of manometers and uneven flow of nozzles, which directly affects the uncontrolled application of pesticides. After testing of 20 devices for pesticide application, only one met the technical correctness. In further activities, it's planned to intensify the control of pesticide application equipment in order to achieve controlled use of pesticides.

Keywords: equipment, sustainable use of pesticides

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Subgroup 2 - Sustainable use of pesticides

Efficacy of different insecticides in the control of green peach aphid on nectarine

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Abstract: The efficacy of different insecticides in the control of green peach aphid (*Myzus persicae*) on nectarine at the the locality of Metković (Bogatić municipality) was examined conducting field trials in 2019 and 2020. The experiments was carried out according to the statistical model of completely randomized block design with four replications and standard EPPO method for evaluation of the efficacy of insecticides in the control of aphids in orchards. Insecticidal formulations were previously diluted with water and applied with a backpack sprayer "Solo". The efficacy of insecticides from the group of neonicotinoids (acetamiprid, imidacloprid, thiamethoxam), organophosphates (chlorpyrifos), pyrethroids (deltamethrin) and flonicamid were examined. Results of the experiments indicate very good efficacy of insecticides from the group of neonicotinoids in the control of *M. persicae*. The efficacy of acetamiprid three days after treatment (3DAT) was 98.23%, while seven days after treatment (7DAT) it was 99.43%. Imidacloprid showed maximum efficacy (100%) in both evaluation terms (3DAT and 7DAT). The efficacy of thiamethoxam was high, 99.69% (3DAT) and 99.92% (7DAT), respectivelly. Deltamethrin showed efficacy of 61.37% (3DAT) and its efficacy was 47.17% at 7DAT. The efficacy of chlorpyrifos ranged from 31.75% (7DAT) to 68.84% (3DAT). Flonicamid, considering the mode of action (anti-feeding), had a lower initial efficacy (82.13%), while the efficacy at 7DAT was significant higher (99.65%).

Keywords: *M. persicae*, nectarine, field trials, insecticides, efficacy

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Subgroup 2 - Sustainable use of pesticides

Soil reflectance spectroscopy - a tool for determining and monitoring soil properties

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Abstract: Intensive agriculture has slowly degraded soils through pollution with pesticide residues, nutrients, and salinization, as well as crop residue removal, loss of soil organic carbon, and other threats. Therefore, a loss of soil fertility is observed. Soil analysis is an essential tool for precise management of fertilisation and irrigation, which enables to obtain high quality crops. Soil spectroscopy has proven to be a rapid, cost-effective, environmentally friendly, non-destructive, and analytical technique for determining soil properties. The main objective of this study was to propose an effective approach based on FTIR spectroscopy for determining soil properties of soil samples from different sites and management regimes. Spectral signatures in the mid-infrared range (4000-700 cm-1) were acquired using a spectrophotometer, and chemometric methods were used to correlate chemical and physical soil properties with their spectral signatures. Various calibration models can be used to quantitatively predict soil properties - such models were developed as a function of measured data from soil laboratory analyses and soil reflectance spectra. The FTIR spectra of the soil samples were subjected to multivariate analysis in the form of principal component analysis (PCA) and cluster analysis (CA). The multivariate analysis of the FTIR soil spectral data showed that it is possible to distinguish and classify soils at different sites based on their spectral signatures. These results demonstrate that FTIR spectroscopy and multivariate analysis can be used as a tool to identify and classify soil samples.

Keywords: soil properties, FTIR spectroscopy, reflectance, agriculture

Subgroup 3 - Plant feeders

Effects of spiropidion on survival and parasitism of Aphidius collemani Viereck (Hymenoptera: Braconidae)

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Abstract: The objective of the study was to determine whether the new active ingredient spiropidion has a residual effect on the adults and mummies of the parasitic wasp *Aphidius colemani* and what effects it has on the biotic potential of wasps that have developed from treated mummies. Laboratory experiments were conducted using spiropidion at three different dosages, two standard insecticides, and an untreated control. Parasitic wasps' mummies were treated with the insecticide, and the release of newly hatched wasps was monitored over the following five days. The surviving wasps were sexed, and the females were then subjected to a residual toxicity test. They were individually dropped onto previously grown bell pepper plants infected with cotton aphids (*Aphis gossypii*), and parasitism rates were monitored. The bell pepper plants were treated with insecticides and placed in individual cages where the adults were released 24 hours and seven days after treatment. The mortality rate was observed. The percentage of newly hatched wasps from treated mummies did not differ significantly between treatments. The percentage of parasitism achieved by wasps developed from the treated mummies was not significantly different from the untreated control. Spiropidion also showed weak residual activity on the adult wasps exposed on plants treated 24 hours and seven days before release. Efficacy reached 23.54% at the highest dose, which cannot be considered a significant decrease in wasp population. Based on the results obtained, spiropidion can be classified as harmless and safe for the parasitic wasp *Aphidius colemani* according to the IOBC scale.

Keywords: *Aphidius colemani*, contact activity, mummies, parasitism rate, residual effect,

Subgroup 3 - Plant feeders

Electrical penetration graph (EPG) – promising tool for measuring feeding behaviour of *Bemisia tabaci*

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Abstract: *Bemisia tabaci* (Sweet potato whitefly) is one of the most important pests in greenhouse production systems worldwide. It causes great damage to vegetables at all stages of development. It is highly adaptable to new hosts and climatic conditions, which is why it has been found on 300 different hosts and reported from all over the world. *B. tabaci* belongs to the herbivorous hemipteran insects that penetrate plant tissue with their piercing-sucking mouthparts. They damage plants by depriving them of photosynthetic substances as they feed, by excreting large amounts of honeydew on which saprophytic fungi spoil leaves and fruits, and by transmitting yield-reducing viruses. Therefore, it is important to know the feeding habits and preferences of this pest. A useful tool for studying the feeding habits of sucking insects is the electrical penetration graph (EPG). In an EPG measurement, an electrical circuit is established between the plant and the insect when the insect contact the plant. Thus, using this method, it is possible to visualize the feeding behavior of hemipteran's in real time. A good knowledge of insect-plant interactions is necessary to identify and evaluate resistant traits for selection in plant breeding programs. In our research we used tomato leaves, which were treated with clay and water to see the differences in feeding habits. We will present preliminary results of the EPG as a promising tool to measure the feeding behavior of *B. tabaci*. Our preliminary data will be used in future research on the feeding behavior of this important pest.

Keywords: insect-plant interaction, sucking insects, feeding behavior, insect pest, *Bemisia tabaci*

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Subgroup 3 - Plant feeders

Impacts of landscape composition on the occurrence of Halyomorpha halys and biological control potential in newly invaded areas

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Abstract: Early understanding of spreading pathways of alien pests in newly invaded areas is crucial to plan efficient strategies to prevent serious outbreaks. *Halyomorpha halys* is an East Asian invasive species, now established across Europe and North America, causing important economic losses. The pest was recorded for the first time in Northern Italy in 2012 and in 2016 in the Apulia region (Southern Italy), spreading across the Italian Peninsula, often as hitchhiker following commercial trade ways. Information regarding its occurrence and factors shaping its population dynamics in Southern Italy remain scarce. In this study we investigated the occurrence of *H. halys* in orchards, urban gardens, and fruit warehouses habitat in the Apulia region. Sites were selected along a gradient of urbanization in the landscape. We also measured the control potential provided by parasitoids and generalist predators exposing refrigerated egg masses in orchards and urban gardens. Our results showed no differences in the occurrence and abundance of the pest across habitats. We found a positive effect of urban area in the landscape on the occurrence and abundance of the pest in orchard habitat. We also observed significant positive effect of seminatural habitat on the percentage of parasitized and preyed eggs. These preliminary results suggest that the *H. halys* can use multiple habitats and that its spreading is linked to the presence of human settlements, while seminatural habitats play a key role in supporting the biological control. Our findings might be useful to plan more efficient monitoring and control strategies able to limit its further spread.

Keywords: Brown Marmored Stink Bug, invasive pest, monitoring program, pest dynamics, landscape composition

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Subgroup 3 - Plant feeders

Parasitoids of *Halyomorpha halys* (Heteroptera: Pentatomidae) in Bulgaria

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Abstract: The brown marmorated stink bug (*Halyomorpha halys*) is an invasive species causing serious damage on many agricultural crops in Bulgaria. The aim of this study was to establish which of the native parasitoid species would attack the eggs of *Halyomorpha halys* and to evaluate the rate of parasitism at field conditions. Egg masses were collected from a number of agricultural crops in the region of Plovdiv and reared under laboratory conditions until hatching. A total of five egg parasitoids emerged from the collected eggs and were identified as *Trissolcus cultratus*, *Trissolcus basalis*, *Anastatus bifasciatus*, *Ooencyrtus telenomicida*, and *Ooencyrtus sp*. The rate of parasitism in 2021 was 10.57% in June, 21.17% in July and 17.57% August.

Keywords: Halyomorpha halys, egg parasitoids, Scelionidae, Eupelmidae, Encyrtidae

Subgroup 3 - Plant feeders

Tuta absoluta egg density and distribution on tomato plants affect the efficacy of mirid predators

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Abstract: *Tuta absoluta* is the most serious pest of tomato crops. Over reliance to chemical control has led to its resistance development, adverse effects on human health and deterioration of the product quality. Alternatively, the predators *Macrolophus pygmaeus* (*Mp*) and *Nesidiocoris tenuis* (*Nt*) (Hemiptera: Miride) are effective in its control. However, their efficacy under variable egg densities and distribution patterns on tomato plants has been little searched. In this study the predation rate of single predators (*Mp*/*Nt*), conspecific (2*Mp*/2*Nt*) or heterospecific pairs (*MpNt*) was recorded on tomato plants where eggs of *T. absoluta* had been placed on the respective positions that *T. absoluta* females laid their eggs when used at different densities (1, 2, 3, 10 females/plant). Our results showed that the number of eggs laid per *T. absoluta* female was highest when used singly and the eggs were mainly detected on 3rd and 4th leaves counting from the top. Single *M. pygmaeus* showed a higher predatory efficacy than *N. tenuis* when 14 and 30 eggs were used per plant. Conspecifics of *M. pygmaeus* were more effective than *N. tenuis* at 17 and 110 eggs. A pair was as effective as a single predator at the 14, 17 and in many cases at the 30 and 110 egg densities. *M. pygmaeus* (singly or in combination) may have a higher efficacy than *N. tenuis* at lower and higher *T. absoluta* pest pressure levels. This information is valuable for more effective use of these predators in the management of *T. absoluta*.

Keywords *Tuta absoluta*, egg distribution, predatory mirids, biological control, predation rate

Subgroup 3 - Plant feeders

Aphids flight activity on wheat

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Abstract: Aphids (Aphididae, Hemiptera) cause significant economic loss on wheat by direct feeding and by vectoring the viruses. The aim of this study was the monitoring of aphid flight activities and species composition in wheat during the whole season, from beginning of November to middle of June. Study was conducted by yellow water traps in PSS institute Tamiš in Pančevo during autumn 2020/spring 2021. Traps were placed into 18 wheat plots of 60m². Samples were taken once per week. Aphids were identified using a stereoscopic microscope and keys for identification of winged aphids. 42 different taxa were collected; 35 during the autumn and 23 in spring and total of 967 specimens of aphids. The maximum of aphid flight activities was in the middle of November and the end of May. During November the most abundant species was *Myzus persicae* and wheat aphids *Rhopalosiphum padi* and *Sitobion avenae*. During spring the most abundant were specimens of the genus *Aphis*. *Myzus persicae* and *Acyrtosiphon pisum* were presented in high number. Species were also found: *Rhopalosiphum maidis*, *Brachycaudus helichrysi*, *Brachycaudus cardui*, *Dysaphis plantaginea*, *Panaphis juglandis*, *Hyperomyzus lactucae*, *Lipaphis erysimi*, *Wahlgreniella ossiannilssoni*, *Metopolophium dirhodum*, *Phyllaphis fagi*, *Aulacorthum solani*, *Rhopalomyzus poae*, *Schizaphis graminum*, *Phorodon humuli*, *Cinara costata, Cavariella aegopodii, Myzus cerasi, Myzus ascalanicus, Macrosiphum rosae, Macrosiphum euphorbiae, Therioaphis trifolii.* Some of the collected specimens were identified to the genera level: *Anoecia* sp., *Hyadaphis* sp., *Brachycaudus* sp., *Cavariella* sp., *Erisoma* sp,., *Hyperomyzus* sp., *Pemphigus* sp., *Myzocallis* sp., *Tetraneura* sp., *Uroleucon* sp. *Dysaphis* sp., etc.

Keywords: Aphids, wheat, flight activity, autumn, spring

Subgroup 3 - Plant feeders

Natural enemies of *Parthenolecanium corni* (Bouché) (Hemiptera: Coccidae) on grapevine in Neštin, Serbia

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Abstract: Natural enemies are valuable part of every entomofauna, especially in agroecosystems. Many of them are used as biological control agents for controlling different pests, including scale insects (Coccidea). With alternative ways for controlling pests in agriculture being a rising trend in plant protection, aim of this study was to determine natural enemies of *Parthenolecanium corni* (Bouché) and their abundance in vineyard with and without insecticide application. The research was conducted during 2019 in commercial vineyard in Neštin locality (northwest Serbia). Two areas of 0.5 ha were marked for this research. In one, there was no insecticide application while in the other insecticides were applied to control other grapevine pests. Examination of vineyard for the presence of entomophagous insects was done twice a month starting from March to October. Twenty randomly chosen vines were examined in both areas. Fourteen natural enemies species were registered, seven predators and seven parasitoids. In untreated area all fourteen species were recorded. From predators, there were registered three species from Coccinellidae (Coleoptera) family and one from each of the following families: Anthribidae (Coleoptera), Forficulidae (Dermaptera), Chrysopidae and Hemerobriidae (Neuroptera). From parasitoids, six species from Encyrtidae and one species from Aphelinidae families were registered. The most abundant natural enemy was *B. longipennis* (48.61%). In treated area total of six entomophagus insects were collected. From predators, one species was registered from each of the families Coccinellidae and Forficulidae. From parasitoids there were recorded three species from Encyrtidae and one from Aphelinidae families. The most abundant natural enemy in treated area was *B. longipennis* (68.09%).

Keywords: *Coccidae*, grapevine, parasitoids, predators, abundance

Subgroup 3 - Plant feeders

Some important invasive species in agricultural and urban environments of Serbia

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Abstract: Invasive insect species are those that have been introduced to a new natural environment from other parts of the world. These species usually spreads as stowaways during transportation, or as a contaminant with commercial goods. Not all alien insect species successfully establish themselves in a new environment. Species which adapted to the moderate climate of Serbia successfully established their populations in the environment with favourable conditions in combination with the absence of natural enemies. This allowed them to spread and reproduce excessively, competing with native species for habitat and resources. Some invasive species may transmit parasites and disease causing agents endangering the health of cultivated plants, native wildlife species, domestic animals and humans.

Invasion of some important insect species in Serbia will be described: *Nezara viridula*, *Halyomorpha halys*, *Bemisia tabaci*, *Aedes albopictus* and *Aedes japonicus*. The first three species are significant agricultural pests, while mosquitoes, but also stink bugs are molestants of high importance in urban areas. *Nezara viridula* was detected in Serbia in 2008, while *H. halys* invaded Serbia in 2015. These stink bugs are polyphagous, and endanger many agricultural plants. *Bemisia tabaci* is not yet established in Serbia, but its presence was documented several times in greenhouses (2016, 2022). The two invasive mosquito species *Ae. albopictus* and *Ae. japonicus*, both confirmed vectors of several pathogenic agents causing human diseases, were recorded in Serbia for the first time in 2009 and 2018, respectively. Considering the medical importance, *Ae. albopictus* is declared as the most dangerous invasive species in Europe.

Keywords: invasive insects, stinkbugs, mosquitoes, urban areas

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Subgroup 3 - Plant feeders

Sustainable control of insect pests in Mediterranean agroecosystems

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Abstract: Agricultural expansion and intensification with the consequent loss of seminatural habitats and increased application of agrochemicals, are considered major drivers of biodiversity loss. The reduction in the abundance and diversity of natural enemies inhabiting agricultural landscapes can in fact lead to an ineffective natural control of pests, with potential negative effects on production. This study focuses on three important habitats in Mediterranean agroecosystems: vineyards, olive groves and seminatural habitats. The research aims to assess the effect of local habitat and the characteristics of the surrounding landscape on the abundance and diversity of natural enemies and on the control of phytophagous insects. The evaluation will be carried out in twelve landscapes selected along a gradient in seminatural habitats. Within each landscape we will monitor from May to November the three habitats using different methodologies: phytophagous insects will be sampled with steaky traps and observation of the damage on grapes and olives, whereas natural enemies will be collected through pitfall traps, sweep netting and beating net sampling. Seed cards and dummy caterpillar will be exposed in order to measured predation rates in the field. We expect i) seminatural habitats to be an important source of natural enemies, ii) extensive local management in vineyards and olive groves and high cover of natural habitats in the surrounding landscape to generally support the communities of natural enemies, favouring their potential for biological control. However, iii) some pest species may also benefit from extensive management and the presence of seminatural habitats, potentially generating trade-offs.

Keywords: vineyard, olive, landscape, dummy caterpillar, seed cards

Subgroup 3 - Plant feeders

Identification of *Trichogramma* egg parasitoids of the European corn borer *Ostrinia nubilalis* (Hübner, 1796) in Vojvodina (Serbia)

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Abstract: Maize (*Zea mays* Linnaeus, 1753) is the most important cereal crop in Serbia, while the European corn borer (ECB) *Ostrinia* nubilalis (Hübner, 1796) (Lepidoptera: Crambidae) is the major pest of this crop. Regular monitoring of ECB in the province of Vojvodina demonstrated a high percentage of parasitized egg clasters of this pest. Preliminary identification of the egg parasitoids based on morphological traits of emerged adults revealed that they belong to the genus *Trichogramma* Westwood, 1833 (Hymenoptera, Trichogrammatidae). Considering that the fauna of *Trichogramma* wasps has not yet been enough explored in Serbia, the objective of this study was to identify the autochthonous species of *Trichogramma* parasitoids of ECB present in the region of Vojvodina by using sequences of ribosomal DNA. The research conducted in Vojvodina during 2016 and 2017 revealed presence of two *Trichogramma* species: *Trichogramma brassicae* and *Trichogramma evanescens*. Intraspecific variation of samples of wasps was assessed by amplifying the mitochondrial cytochrome oxidase I (COI) gene. The results showed the presence of 4 haplotypes of *T. brassicae* in local populations, and a single haplotype of *Trichogramma evanescens*. Wasps were also tested for the presence of the endosymbiotic bacteria *Wolbachia* using *Wolbachia*-specific 16S and *wsp* primers and the results demonstrated the presence of the bacteria in the population of *T. brassicae* in its dominant haplotype (TbSERB-1). Understanding of the diversity and biology of autochthonous *Trichogramma* species is a key step in the potential commercial implementation of these egg parasitoid wasps in the protection of corn fields in Serbia.

Keywords: beneficial insects, biological control, *Ostrinia nubilalis*, *Trichogramma* spp, maize

Subgroup 4 - Plant Pathology

Multi-omics approaches to explore phenotypic and genetic diversity in the brown rot fungal pathogens *Monilinia fructicola*, *Monilinia laxa* and *Monilinia fructigena*

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Abstract: *Monilinia fructicola*, *Monilinia fructigena* and *Monilinia laxa* are the main causal agents of brown rot and blossom blight, among the most important diseases on pome and stone fruits, worldwide responsible for heavy losses both in the field and in postharvest. Following the introduction of *M. fructicola* into Europe in 2001, the pathogen spread widely and rapidly, and became prevalent over the endogenous species *M. laxa* and *M. fructigena*. To improve knowledge on the biology, evolutionary history, and diversity of these important pathogens, high-quality reference genomes and transcriptomes of *M. fructicola* strain Mfrc123, *M. fructigena* strain Mfrg269 and *M. laxa* strain Mlax316 were *de novo* assembled and compared. In particular we explored: (i) phylogenomic and synthenic relationships between the *Monilinia* genomes and those of the closely related species within *Sclerotiniaceae*, *Botrytis cinerea* and *Sclerotinia sclerotiorum*; (ii) the abundance and evolutionary dynamics of transposable element; (iii) the genetic basis of mating type and the genome-wide occurrence and extent of Repeat-Induced Point (RIP) mutations; and (iv) common and species-specific effectors, carbohydrate-active enzymes and secondary metabolite gene clusters with some differences that might explain host plants and organ preferences distinguishing the three *Monilinia* species. Moreover, a metagenomic approach was used to investigate the mycovirome of *M. fructicola* in a worldwide collection of isolates from different hosts and revealed a great abundance and variety of mycoviruses infecting the fungus. A total of 32 positive-sense single-stranded (ss)RNA viruses and a new putative ssDNA mycovirus were identified and characterized.

Keywords: Next-generation sequencing, de novo assembly, comparative genomics, transcriptomics, metagenomics, mycovirome

Subgroup 4 - Plant Pathology

Biocontrol activity of epiphytic yeasts against *Penicillium expansum* on apple fruits

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Abstract: *Penicillium expansum* causes apple blue mold resulting in economic losses and threatening human health due to patulin production. Synthetic fungicides are used for the control of the pathogen, but new strategies are necessary for sustainable production, and epiphytic yeasts as biocontrol agents are a possible alternative. Yeast strains were collected from the surface of healthy untreated apple fruits (Dudaš et al., 2022). Biocontrol activity of 17 yeast strains was tested on apple fruits following the method by Sanzani et al. (2021). Four wounds (3x3 mm) were made on Golden Delicious apple fruits and treated with 10 µl of yeast suspension (10^7 cells/ml) and with 10 µl of pathogen suspension (10^4 cells/ml). In fungicide treatment, wounds were treated with 10 µl of thiophanate methyl (0.05 %) instead of yeast. Untreated fruits served as the negative control, while fruits treated with sterile distilled water and afterwards with the pathogen were positive control. Four fruits were used per treatment. Lesion diameters were measured after 9 days at 20 °C. All yeast strains except one caused statistically significant reduction of lesion diameters. Treatment with fungicide resulted in an average lesion diameter of 38.7 mm and showed no statistically significant difference with the positive control (39.1 mm) as well as one yeast strain (38.9 mm). One yeast strain showed the strongest biocontrol activity, with an average lesion diameter of 4.5 mm. Further insights into the biocontrol mode of action of the most effective yeast strain will be conducted, as well as larger-scale trials to assess possible practical field applications.

Keywords: *Penicillium expansum*, apple blue mold, biocontrol, epiphytic yeasts

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Subgroup 4 - Plant Pathology

Overview of the use of GWAS to identify loci for resistance to apple scab caused by Venturia Inaequalis

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Abstract: Apple scab caused by fungus *Venturia inaequalis* is the most devastating disease of the cultivated apple (*Malus domestica*). It is the main limiting factor of a successful production due to losses in fruit quality and yield, causing farmers to treat orchards with fungicides multiple times per season. In this study we will explore the use of Genome Wide Association Study (GWAS) on single nucleotide polymorphism (SNP) to identify genomic regions associated with resistance to apple scab. Obtained results would help us to better understand the resistance to *Venturia inaequalis* in apple and show significant information for future resistance breeding programs.

Keywords: SNP, GWAS, Apple scab, disease resistance, resistance breeding

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Endophytic bacteria from olive drupes as biological control and induced resistance agents of *Colletotrichum acutatum*

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Abstract: Olive anthracnose (OA) is one of the most important diseases affecting olives worldwide. Causal agents of OA are fungi belonging to the genus *Colletotrichum*, while the predominant one is *C. acutatum* species complex. Due to the fungicide withdrawals and the risk of pathogen resistance, finding more sustainable control measures of the disease becomes extremely necessary. The aim of this study is to investigate whether endophytic microorganisms from olive drupes are able to reduce OA disease severity and induce plant's defence mechanisms. Hence, 210 endophytic bacteria were isolated and tested for their antagonistic effect on *C. acutatum* in multiple and dual culture essays. Bacterial isolations that demonstrated satisfactory inhibition of the mycelial growth, were further tested for their effect on the disease severity and conidial production of the fungus, in olive drupes of cv. Kalamon. The most effective isolates were evaluated in olive trees, artificially inoculated by the pathogen, where the bacterium Π8 (Serratia spp.) caused a reduction of the disease severity by approximately 90%. Those isolates were, also, applied on young olive seedlings in greenhouse conditions in order to assess their effect on olive plant defence mechanisms. Total RNA was extracted from leaves, and the expression of ten different defence genes was evaluated by RT-qPCR. All four tested bacterial strains caused increased expression of genes associated with Pathogenesis-related proteins, while genes involved in biosynthetic pathways of phenylpropanoids, salicylic and jasmonic acid were induced by the presence of strains K13 (*Bacillus methylotrophicus*), B1 (*B. amyloliquefaciens*) and Π8 (*Serratia sp.*).

Keywords: *C. acutatum*, defence genes, bacteria, plant- resistance inducers, disease severity

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The volatile organic compounds of the biocontrol agent *Bacillus velezensis* K165 activate plant defenses against *Verticillium dahliae*

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Abstract: *Verticillium dahliae* is one of the most devastating soilborne pathogens worldwide. Due to the unavailability of effective chemical strategies and the lack of resistant plant cultivars, it is urgent to develop innovative disease management strategies. In this respect, the use of the biocontrol strain *Bacillus velezensis* K165 represents a promising approach. Here, we examined the biocontrol efficacy of the volatile organic compounds (VOCs) produced by K165 against *V. dahliae* in *Arabidopsis thaliana*. Initially, it was found that K165 VOCs-exposed *A. thaliana* plants displayed reduced Verticillium wilt symptoms compared to control plants. Subsequently, analysis of RNAseq data and pathogenicity experiments employing *A. thaliana* mutants showed the positive interplay between K165 VOCs and the chitin perception mechanism of plants. The GC/MS analysis of the K165 VOCs profile revealed acetoin as the major chemical compound emitted by K165. Acetoin did not reduce the growth of *V. dahliae in vitro*. Nevertheless, acetoin-exposed *A. thaliana* plants displayed reduced Verticillium disease severity compared to controls. Therefore, the K165 VOCs seem to activate the defense system of plants and contribute to the biocontrol activity of K165 against *V. dahliae*.

Keywords: acetoin, biological control, chitin, induced systemic resistance, soilborne pathogens

Subgroup 4 - Plant Pathology

Grapevine rootstock and scion canes as an important inoculum source of Petri disease associated pathogens

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Abstract: Petri disease of grapevines constitutes a major threat to grapevine cultivation and is widely distributed in Greece and worldwide. The occurrence of the disease in grapevine nurseries has been reported many years ago while the implication of several pathogens makes it difficult to control. The aim of this study was the investigation of the occurrence and frequency of the dominant pathogens in different clonal rootstock and scions canes. Detection of the pathogens was carried out in plant tissues at three parts of the canes (basal end, middle part, and cane tip) and a Nested PCR approach targeting species specific regions was used. For the quantification of the dominant pathogen *Phaeomoniella chlamydospora*, a Nested Real – Time TaqMan PCR method was developed, in which the ITS region flanking the TaqMan probe sequences was amplified and subsequently TaqMan PCR reactions were carried out using pre-amplification products as template. Nested PCR reactions revealed that the two pathogens could be detected along rootstock and scion canes, while biomass of *Phaemoniella chlamydospora* did not exceed the levels of fg/100 ng of plant DNA. These findings show that even low pathogen concentration could contribute to vine losses in newly established vineyards and indicate that mother vine plants play a significant role in diseases spreading.

Keywords: rootstock, scions canes, *Phaeomoniella chlamydospora*, TaqMan PCR

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Botryosphaeriaceae as postharvest pathogens of apple fruit

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Abstract: Species of the family Botryosphaeriaceae are important pathogens of woody plants, including apple fruit trees, known to cause stem and branch cankers, dieback, and pre- and postharvest fruit rot. In the survey conducted from 2016 to 2018, several Botryosphaeriaceae species were isolated from apple fruit with symptoms of brown rot collected from different storages (controlled atmosphere, normal atmosphere, and cellar) and orchards during harvest. The obtained isolates, whose pathogenicity was confirmed on apple fruit, were identified and characterized based on multilocus phylogeny and anamorph morphology. Five species from the family Botryosphaeriaceae were revealed as postharvest pathogens of apple fruit in Serbia. *Diplodia seriata*, followed by *Botryosphaeria dothidea*, were the most prevalent species, both of which were previously recorded on apple fruit in Serbia. *Diplodia bulgarica*, *Diplodia sapinea* and *Neofusicoccum yunnanense* represent first reports on this host in the country. It has been noticed in this study that rot symptoms caused by these species can occur during harvest but are more frequent after harvest following unfavourable storage conditions. This may suggest that Botryosphaeriaceae species persist endophytically, as latent pathogens, in apple fruit and that warmer storage conditions favour disease development. The results of this study imply that species of the family Botryosphaeriaceae represent an increasing threat to successful apple production due to their endophytic nature, pathogenic potential that comes to full expression under plant stress conditions such as global climate change, as well as the ability to cause other diseases on their hosts.

Keywords: *Botryosphaeria*, *Diplodia*, *Neofusicoccum*, multilocus phylogeny, apple fruit decay

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Antagonistic activity of endophytic *Bacillus* strains against phytopathogenic fungi. Mode of action studies and the strain compatibility issue

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Abstract: The effects of agrochemical overuse on environmental and human health highlighted the necessity of improving and developing biological approaches to achieve increase of crop yield and decrease of losses. In this study, we isolated and analysed for their beneficial characteristics endophytic bacterial strains of the genus *Bacillus* with antagonistic effect against several phytopathogens. We tested their benefits under *in vitro* and *ex vivo* conditions. All *Bacillus* strains studied successfully colonized the plant tissues and competed with the phytopathogenic fungi for nutrients and space. We applied an integrative approach coupling genome mining and metabolic profiling to decipher the potential of these endophytes as biological control agents against pathogenic fungi. The chemical analysis of their extract indicated that these *Bacillus* endophytes were able to secrete several bioactive secondary metabolites. The extensive metabolomic (HPLC-HRMS) and whole genome analysis demonstrated the ability of these endophytes to biosynthesize and secrete a significant number of bioactive secondary metabolites (fengycin, surfactin, iturin, mojavensin, bacilysin etc.) and lytic enzymes (chitinase, cellulose, protease, etc.). All of these compounds determine their competitiveness, colonization and survival ability, the compatibility with each other and the induction of induced systemic resistance (ISR). Also, we investigate their ability for fungal growth suppression either as individual strains or as bacterial mixtures. The selected strains were paired for the development of mixtures after assays regarding their *in vitro* compatibility, combining strains with different abilities. Formulation of compatible bacterial strains resulted in some successful mixtures with strong biological control activity.

Keywords: Biocontrol, endophytic bacteria, biostimulants, secreted metabolites, strain compatibility

Subgroup 4 - Plant Pathology

Antifungal activity of peppermint, sweet basil, and sage essential oils on plant pathogenic fungi

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Abstract: The application of pesticides is still a common practice to protect plants, fresh fruits, and vegetables, which aims to ensure adequate yield and product quality. However, some of the chemical compounds used can have an adverse effect on human health, enter the food chain, and some microorganisms become resistant to the chemicals used. Due to these concerns, there is an increasing need to find new, more effective, and safe alternative protective agents of natural origin. The aim of this work was to investigate the antifungal effect of peppermint (*Mentha pipperita*), basil (*Ocimum basilicum*), and sage (*Salvia officinalis)* oils on the growth of fungi from the genus *Fusarium* sp. and *Aspergillus* sp. The oil was extracted from dried plant stems and leaves by hydrodistillation, using an adapted Neo Clevenger apparatus, according to ISO-standard 857-1984 (E). The antifungal activity was determined by the test-diffusion method on a PDA substrate. Paper discs with a diameter of 6 mm were impregnated with 15 ml of selected oils and placed on PDA with inoculated pure cultures of the fungi. The incubation was performed at 22°C. The inhibition zones were measured after the third and sixth day of incubation. In the control variant, distilled water was used. The results showed a reduction in the growth of the tested fungi after the incubation period, indicating a potential use of the analyzed oils in protection against fungi from the genus *Fusarium* sp. and *Aspergillus* sp.

Keywords: antifungal activity, essential oils, *Fusarium* sp., *Aspergillus* sp.

Subgroup 4 - Plant Pathology

Physiological response in winter wheat varieties depending on *Fusarium* infection and N fertilization

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Abstract: Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in the world. Under field conditions, wheat is exposed to both abiotic and biotic stresses that have a great impact on its yield and quality. Inadequate nitrogen fertilization represents an abiotic stress factor that causes numerous physiological and metabolic changes in wheat tissues. An important biotic stress factor in wheat production is the occurrence of Fusarium head blight (FHB), a disease caused by phytopathogenic species of the genus *Fusarium*. These stressors enhance the rapid accumulation of reactive oxygen species (ROS) and the occurrence of oxidative stress in plant tissues. However, plants have developed enzymatic and non-enzymatic antioxidant defense mechanisms to control the excessive ROS levels. For the purpose of this study, the field experiment was set up during two growing seasons in the experimental field of the Agricultural Institute Osijek. It was set-up in a split-split-plot design as a complete randomized block in two replications, as a factorial experiment with three main factors: variety, N fertilization levels, and *Fusarium* infection. Biomarkers of oxidative stress and antioxidant response were determined in wheat samples. The aim of this study was to determine the variety-specific oxidative and antioxidant response of wheat to different nitrogen fertilization and FHB and to determine potential biochemical mechanisms of wheat resistance.

Keywords: wheat, nitrogen, *Fusarium* spp., oxidative stress, antioxidant response

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Grafting as a sustainable approach in response to infections transmitted by arthropods

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Abstract: Grafting is an agronomic technique used as an integrated strategy for the management of abiotic and biotic stresses like bacteria, viruses and fungi in a sustainable and environmentally friendly approach. Grafted tomato plants could also tolerate infections of air-borne viruses like the CiPz Sw5-breaking strain of *tomato spotted wilt virus* (TSWV-CiPz), strains of *cucumber mosaic virus* supporting stunting or necrotic satellite RNAs (CMV-TTS and CMV-77, respectively) and of a recombinant strain of *potato virus Y* (PVY^{C}-to), necrotic to tomato. The graft promotes the transfer of tolerance from the rootstock to the scion in susceptible tomato F1 UC82 (UC) varieties on the tolerant tomato local ecotype, denoted Manduria (Ma). The grafting techique reduced the differentially expressed genes (DEGs) in the UC and Ma plants by approximately 54% upon the infection with PVY^{c}-to. Moreover, viral infection modulated the up-regulation of specific differentially expressed genes (DEGs) that were significantly expressed in susceptible variety UC and in UC and Ma self- or hetero-grafted plants. It is proposed to use the same type of approach to obtain useful levels of tolerance to *tomato leaf curl New Delhi virus* (ToLCNDV) for cucurbits. ToLCNDV is an emerging begomovirus listed in the EPPO Alert-list 2, present in the mediterranean area, including South-Italy. Twenty-one local cucurbit ecotypes were screened to assess tolerance levels against mechanical transmission of ToLCNDV. The results will lead to the identification of tolerant cucurbit ecotypes to use as potential rootstocks to achieve adequate levels of tolerance against the virus in commercial cucurbit varieties.

Keywords: vegetable grafting, plant viruses, disease tolerance, RNAi, sustainability

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Cold Plasma as a new technology in the sustainable management of plant diseases

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Abstract: In the last decade, the need of sustainable, innovative and efficient control methods is a primary goal for the management of plant disease. Non-thermal plasma, also known as cold plasma, is proposed as a green technology for eco-friendly control of phytopathogens on fruits, seeds and plants. It is a partially ionized gas, composed of a mixture of ions, electrons, radicals, reactive oxygen and nitrogen species (RONS) and UV radiation that have a specific role in the decontamination activity carried out directly by air plasma or indirectly by water activated by plasma (PAW). Working conditions at atmospheric pressure and ambient temperature makes this technology suitable for biological application. The *in vitro* efficacy of cold plasma against different fungal and bacterial species was evaluated using different configurations of plasma sources, *i.e.* Surface Dielectric Barrier Discharge (SDBD), Atmospheric Pressure Plasma Jet (APPJ), Volume Dielectric Barrier Discharge (VDBD) and treatment conditions. Albino mutants of *Botrytis cinerea* and *Aspergillus carbonarius* was used to explore the protective role of fungal melanin on sensitivity to plasma exposure, with mutants showing higher sensitivity to treatments compared to the melanized wild-type strains. Efficacy of plasma treatments against pathogenic fungi and bacteria contaminating seeds was evaluated on tomato seeds artificially inoculated with *Cladosporium fulvum* and *Pseudomonas syringae* pv. *tomato* and on barley seeds inoculated with *Fusarium* spp.. Experiments on cherry and citrus fruits demonstrated that the application of plasma may significantly extend their shelf life during postharvest storage by direct microbial inactivation and possible activation of plant defence responses.

Keywords: Non-thermal plasma, green technology, phytopathogens, melanin, decontamination

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Evaluation of biological and synthetic plant protection products for the management of downy mildew in grapevines

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Abstract: Grape downy mildew caused by the oomycete *Plasmopara viticola* is the most serious threat of grapevines in virtually all viticultural regions worldwide, where rainfall occurs regularly during the late spring and summer. The pathogen can destroy a vineyard if no measures are taken to control it. The main strategies to restrict the pathogen are mainly based on fungicides, which are frequently applied in vineyards during each season for several years and result in soil accumulation and environmental hazard. Control strategies are mainly based on the use of preventive copper treatments from the beginning of the period during which plants are susceptible to infection. In this study different commercial biological and synthetic plant protection products (PPPs) were evaluated against the grape downy mildew in two sensitive grapevine cultivars after artificial infection of the plants with zoosporangia of the oomycete. According to the results from two pathogenicity trials conducted in greenhouse and the experimental field, all tested synthetic PPPs and most of the bio-PPPs were efficient at controlling the disease. Four selected bio-PPPs were further evaluated in experimental vineyards for their ability to induce in 2 different grapevine varieties (Agiorgitiko and Mochato), 28 plant genes involved in plant defense pathways using the qPFD® tool (Quantitative Low-Density Chip). The results of the comparative study of the different PPPs will be presented.

Keywords: *Plasmopara viticola*, biological control, chemical control, plant resistance, grapevine

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Response of indigenous tetraploid wheat landraces from Montenegro to infection caused by Barley Yellow Dwarf Virus

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Abstract: Barley Yellow Dwarf Virus (BYDV) is one of the most economically important viruses in cereals. BYDV causes substantial losses throughout the world wherever wheat, barley, and oats are grown. The yield loss caused by this virus depends on aphid activity, BYDV strain, growth stage at infection, and environmental conditions. Montenegrin collection consists of 85 indigenous tetraploid wheat populations belonging to alternative seasonal types. Twenty spikes of each population were sown in Banjaluka, Bosnia, and Hercegovina during 2020. Sowing was performed in a spike per row system. During the vegetation period, plants originating from five populations were completely destroyed by this virus in the tillering growth stage. This result shows that BYDV did not affect a large fraction of a large part of the Montenegrin tetraploid wheat population (94%). Since the control of the virus itself is limited, the only mechanism of infection control is engagement in the production of resistant or tolerant genotypes. Considering the devastating effect of this virus on the wheat, there is an indication that local populations from Montenegro might be the source of resistance or tolerance mechanisms to BYDV.

Keywords: BYDV, tetraploid wheat, landraces, resistance mechanisms

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Studying epidemiology of *Xanthomonas euvesicatoria* strains using molecular genotyping methods

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Abstract: Bacterial spot, caused by *Xanthomonas euvesicatoria*, is one of the most devastating bacterial diseases of pepper (*Capsicum annuum* L.). The research will include strains originating from different localities and different years of isolation. Newly isolated *X. euvesicatoria* strains, as well as strains stored in the Laboratory Collection, both identified by classical bacteriological and molecular tests, will be subjected to epidemiological studies by using molecular genotyping methods. Genotyping will be performed by analyzing the variability in the number of short repetitive gene sequences at different loci in the bacterial genome (multiple loci variable number of tandem repeat analysis - MLVA), as well as by comparing the genetic similarity of the strains isolated in Serbia with strains from neighboring countries in order to determine level of genetic similarities and distribution of the pathogen population. MLVA is a very popular assay in bacterial genotyping due to its high level of specificity, reproducibility, efficiency and low cost of performance. With this method, it can be determined whether there are similarities between strains from different regions and countries, which facilitates monitoring spread of the pathogen into new areas.

Keywords: Pepper, *Xanthomonas euvesicatoria*, MLVA

Subgroup 4 - Plant Pathology

Root rot of sugar beet and strawberry caused by *Rhizoctonia* spp. in Serbia

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Abstract: *Rhizoctonia* spp. are economically important soil-borne pathogens infecting a wide range of host plants. Due to the prominent diversity, according to cell nuclear condition, *Rhizoctonia* spp. are classified as multinucleate (teleomorphs: *Thanatephorus* and *Waitea*), binucleate (teleomorphs: *Ceratobasidium* and *Tulasnella*) and uninucleate (teleomorph: *Ceratobasidium*), whereas multinucleate *Rhizoctonia* are further divided into 13 (AG-1 -13) and binucleate *Rhizoctonia* into 23 anastomosis groups (AG-A -W).

At two localities in Serbia, in the vicinity of Belgrade and Vašica (Belgrade City and Srem Districts), sugar beet and strawberry plants expressing prominent root and crown necrosis were sampled and multiple, morphologically uniform isolates were obtained. Two representative isolates originating from sugar beet and strawberry (270-15 and 101-16) were identified based on hyphal branching pattern, nuclear status and conventional AG pairing with known tester isolates. The identification was confirmed by sequencing of ITS region of rDNA and isolate 270-15 from sugar beet was identified as *R. solani* AG-2-2 (Acc. No MK123309) while isolate 101-16 from strawberry proved to be binucleate *Rhizoctonia* sp. AG-A (Acc. No MH517393). Pathogenicity was confirmed after artificial inoculations of strawberry runners and sugar beet seedlings, respectively.

Managing Rhizoctonia root rot of sugar beet and strawberry is difficult due to the soil-borne nature and wide host range of the pathogen. There are differences among AGs regarding host range and fungicide sensitivity, so identification of *Rhizoctonia* AG causing root rot of diseased host, including sugar beet and strawberry, is the first step in developing a successful disease management strategy.

Keywords*: Rhizoctonia*, root rot, sugar beet, strawberry, identification

Subgroup 4 - Plant Pathology

The effect of plant essential oils on in vitro growth of Pectobacterium punjabense, Pectobacterium brasiliense and Pectobacterium carotovorum

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Abstract: *Pectobacterium* spp. have emerged as one of the top 10 phytopathogens affecting plants during production, handling, storage and transportation. These wide distributed pathogens are downgrading the potato industry every year. Many efforts have been made to control bacterial soft rot on potato but with limited success. Essential oils (EOs) and compounds of wild and cultivated plants have been recognized as powerful antibacterial agents. This study evaluated the *in vitro* effect of *Ocimum basilicum*, *Satureja hortensis, Origanum vulgare*, *Calluna vulgaris* and *Thymus vulgaris EOs on P. punjabense (MMZCVR2), P. brasiliense (MMKC19) and P. carotovorum (MMDC11)* strains originating from potato from Serbia and two reference strains from Lebanon (DAPP-PG 752) and Brasil (LMG 21370), using vapour diffusion method (Clemente et al., 2016), obtaining concentration of 0.16 µl/ml of air. The results were recorded after 72h of incubation at 26°C. It was found that all tested EOs varied in effect on growth of bacterial strains. Results showed that EO of *S. hortensis* and *C. vulgaris* showed the highest bacterial growth inhibition, significantly higher compared to *Th. vulgaris* EO, while *O. basilicum* and *O. vulgare* EOs showed the lowest growth inhibition, however significantly higher compared to control. The vitality of bacterial colonies was checked by streaking on NA medium and incubation during 48h at 26°C. It was revealed that *S. hortensis* and *C. vulgaris* EOs showed bactericidal effect on all strains, as well as *Th. vulgaris* EO on MMKC19 and both DAPP-PG 752 and LMG 21370. *O. basilicum* and *O. vulgare* EOs showed bacteriostatic effect on all isolates, as well as *Th. vulgaris* EO on MMDC11 and MMZCVR2.

Keywords: *Pectobacterium,* potato, blackleg, softrot, essential oils, biocontrol

Clemente, I., Aznar, M., Silva, F. and Nerín, C., 2016. Antimicrobial properties and mode of action of mustard and cinnamon essential oils and their combination against foodborne bacteria. *Innovative Food Science & Emerging Technologies*, *36*, pp.26-33.

Subgroup 4 - Plant Pathology

Resistance of *Olea europaea* towards *Xylella fastidiosa* subsp. *pauca* ST53: influence of cultural practices and endogenous factors

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Abstract: *Xylella fastidiosa* subsp. *pauca* ST53*(Xfp)* is responsible for Olive Quick Decline Syndrome (OQDS), which has resulted in a devastating socio-economic impact in Apulia (Southern Italy) over the last ten years. Replanting with resistant genotypes appears the most feasible and promising strategy to manage the disease to date, and the cultivars 'Leccino' and 'FS17' showed a certain level of resistance. However, no systematic and detailed information is available on neither the behaviour of the different clones of 'Leccino' towards a single or multiple infection by *Xfp*, nor the influence of certain cultural practices in modulating the resistance/susceptibility of olive trees. Moreover, a role of other endogenous factors, such as mycobiome and raw sap composition, in determining the outcome of the host/pathogen interaction cannot be excluded. The overall research plan of the PhD course aims to i) evaluate intra-cultivar variability of the cv. Leccino response towards *X. fastidiosa* infections, ii) investigate the effect of some cultural practices in modulating the resistance of different cvs towards *Xfp*, iii) verify the effect of the mycobiome and raw sap composition on the susceptibility/resistance of selected cultivars through nuclear magnetic resonance (NMR) approach, iv) investigate the diversity of wood inhabiting fungal population and their possible correlation with *Xfp* symptom severity. The results of this study, in the framework of the project ResiXO cofunded by the Regional government and CNR, could increase the chance to reduce the disease spread in Apulia and help in restoring olive cultivation in the region.

Keywords: mycobiome, raw sap, intra-cultivar variability, endophytes, cultural practices

Subgroup 5 - Weed science

Gene flow from herbicide-tolerant hybrids to weedy sunflower

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Abstract: Weedy sunflower is invasive form of sunflower (Helianthus annuus) which widely distributed in some parts of Serbia (mainly Vojvodina province). This weed are commonly controlled by ALS-inhibiting herbicides, but wide-spread adoption of sunflower hybrids tolerant to herbicides (imazamox and tribenuron-methyl) enabled flow of genes responsible for tolerance to herbicides from that hybrids to weedy populations. The objective of this study was to check gene flow from two tolerant hybrids and estimate effect of distance between hybrid and weedy sunflower on gene flow. Gene flow was studied in the field experiments and based on DNA analysis. In the field experiments weedy sunflower were grown on different distances from tolerant hybrids. Response of progeny of weedy sunflower (collected from different distances from tolerant hybrids) to recommended rates of target herbicides were determined. As mutations responsible for sunflower tolerance to herbicides (imazamox and tribenuron-methyl) indicate gene flow, DNA analyses of selected survived plants were conducted. Although weedy sunflower progeny exposed to pollen of imazamox tolerant hybrid was survived recommended rates of herbicides, mutations were not confirmed. On the other hand gene flow from tribenuron-methyl tolerant hybrid was confirmed on molecular level. The gene responsible for tolerance was confirmed in weed sunflower samples taken from 30 and 120 m distance from the tolerant hybrid.

Keywords: DNA analysis, gene flow, herbicide, hybrid, weedy sunflower

Subgroup 5 - Weed science

Predicting *Echinochloa crus-galli* L. emergence in maize with hydrothermal modelling

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Abstract: Weed emergence prediction models can help determine the right time to apply herbicides and reduce herbicide input into environment. Hydrothermal models rely on soil temperature and soil moisture as key factors that promote weed emergence. A prerequisite for the use of hydrothermal models is the estimation of base temperature (T_b) and base water potential (Ψ_b) of the native population of weed species. In this study, the hydrothermal AlertInf developed in the Veneto region (Italy) was validated in a maize field in Croatia for the problematic weed *Echinochloa crus-galli*. Prior to validation, germination parameters (T_b and Ψ_b) for *E. crus-galli* were estimated in laboratory experiments and then compared with Italian population built in AlertInf. The estimated T_b and Ψ_b were 0.8°C and 0.97 MPa, respectively with statistical differences only for the T_b parameter. Therefore, AlertInf was calibrated for the T_b parameter of the Croatian population. The calibrated model was used for the validation of the emergence prediction in the maize field in Croatia, Šašinovečki Lug (45°50'59.6 "N 16°09'53.9 "E) in 2019 and 2020. The overall performance of the model was evaluated using the root mean square error (RMSE) and modelling efficiency (EF). The RMSE is 1.69 and 1.38 for 2019 and 2020, respectively. In addition, EF is 0.97 and 0.98 for 2019 and 2020, respectively. The successful prediction of the calibrated model AlerInf opens the possibility to extend the model to similar geographical regions and to calibrate the model for other problematic species in the maize field in Croatia.

Keywords: barnyardgrass, base temperature, base water potential, integrated weed management, weeds

Subgroup 5 - Weed science

Secondary metabolites of *Cuscuta campestris* as bioherbicides

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Abstract: The harmful effects of synthetic herbicides on human health and the environment, and the increase in the number of weed species that have developed resistance to herbicides are problems that stimulated the development of new environmentally friendly approaches for weed control. A possible solution to these problems was seen in the use of the allelopathic potential of many plant species. The objective of this study was to examine the bioherbicidal potential of a secondary metabolites (phenolic compound) extracted from the stem of field dodder (*Cuscuta campestris* Yunck.) on seed germination, early seedling growth (radical and shoot length) and early plant growth tests of *Amaranthus retroflexus* and *Portulaca oleraceae*. The combined effects of the stem extract and a reduced dose of the synthetic herbicide metribuzin were also examined. The data obtained in the seed bioassay confirmed the inhibitory effect of plant stem extract on the germination and early growth of *P. oleraceae* and *A. retroflexus* seedlings at higher concentrations (0.75% and 1%). On the other hand, a synergy of field dodder stem extract and the herbicide metribuzin was revealed in plant bioassay, as their combination was found to achieve better results in the control of both weed species. Based on these obtained data, it could be concluded that *C. campestris* stem extract notably rich in phenolic acids and flavonoids could be a potential source of natural herbicide.

Keywords: *Cuscuta campestris*, phenolic compounds, bioherbicides, stem extracts, metribuzin.

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Subgroup 6 - Mycotoxins and food safety

Innovative green technologies to improve the sustainability of viticulture and safety of grape products

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Abstract: The wine sector is a driving force for the Italian economy and Apulian region is one of the leading grape growing regions in Italy. The need to adopt "green" technologies to improve the sustainability of production processes, reduce the environmental impact, rationalize the use of resources, maintaining global economic competitiveness nowadays is no longer postponable.

Phytosanitary management of vineyards is a crucial point, and it is therefore necessary to adopt new disease management strategies that lead to satisfy market demands of low environmental impact and safety and security of wine, free of the mycotoxin Ochratoxin A (OTA) and other unwanted contaminants. The objective of the research project is to integrate innovative green technologies into the grape growing process to increase the sustainability of the wine industry. The main goal will be realized through the following tasks: i) identification of new biomolecules with antimicrobial activity and biological resources with antagonistic activity; ii) development of new bio-nanocarriers to make more efficient the delivery of effective antimicrobials to the target; iii) increase knowledge on the integration of different tools to improve the effectiveness of crop protection strategies and prevent new phytosanitary emergencies; iv) improve knowledge on biosynthesis and biological role of Ochratoxin A; v) improve the quantitative detection of OTA producing *Aspergillus carbonarius* in the lab and even directly in the field through portable devices; vi) validation of disease forecasting models for vineyards in southern Italy.

Keywords: Ochratoxin A, *Aspergillus carbonarius*, plant protection products, nanocarriers, wine

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Subgroup 6 - Mycotoxins and food safety

Cyclopiazonic acid production in *Penicillium* spp. causing postharvest pome fruit decay

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Abstract: *Penicillium* spp, are diverse and cosmopolite fungi which cause blue mold, one of the most economically important postharvest diseases of pome fruit, worldwide. In addition to causing fruit decay, *Penicillium* spp. are known to produce a range of mycotoxins including patulin, ochratoxin A, citrinin, penitrem A, roquefortine, citreoviridin, and cyclopiazonic acid. Cyclopiazonic acid is also an extrolite useful in the identification of a *Penicillium* isolate. In Serbia, *Penicillium* spp. responsible for postharvest decay of pome fruit (apple, pear, quince, and medlar) are *P. expansum, P. crustosum,* and *P. solitum*. The production of cyclopiazonic acid in a total of 26 *Penicillium* isolates from pome fruit belonging to three species: *P. expansum, P. crustosum,* and *P. solitum* was examined using Ehrlich's test (Lund, 1995). Filter paper emersed in Ehrlich reagent was placed on top of the mycelial side of agar plugs and after incubation, reaction was recorded based on the appearance of color. Amongst *P. expansum,* 12 out of 18 isolates formed yellow rings and six isolates formed faint violet rings. All seven *P. crustosum* isolates formed faint yellow to yellow rings and *P. solitum* isolate also formed a yellow ring. Observed reactions indicated that six *P. expansum* isolates produced cyclopiazonic acid, while the other 12 *P. expansum* isolates, and all *P. crustosum* and *P. solitum* isolate produced other alkaloids.

Keywords: Ehrlich's test, mycotoxins, *Penicillium expansum, Penicillium crustosum, Penicillium solitum*

Subgroup 6 - Mycotoxins and food safety

Antifungal action of quaternary pyridinium compounds on phytopathogenic polyphagous fungi species of the genera *Fusarium*, *Botryotinia* and *Sclerotinia*

Tamara Siber*

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Abstract: Plant diseases are a serious and global problem for food security and human health. More and more virulent/pathogenic and fungicide-resistant strains of pathogens are emerging that cannot be controlled with previously effective fungicides. Phytopathogenic fungi such as species of the genera *Fusarium*, *Botryotinia*, and *Sclerotinia* pose a major threat to many important crops by significantly reducing crop quantity and quality and increasing economic damage. As pollution prevention moves to the forefront of environmental management, chemists are increasingly using synthetic compounds to develop safe products and processes. Nicotinamide is an important heterocyclic compound that, together with nicotinic acid, forms vitamin B3. Nicotinamide derivatives have attracted considerable attention due to studies indicating their antimicrobial, fungicidal, insecticidal, and herbicidal activity. The aim of the above research is to determine the antifungal effect of a series of quaternary pyridinium salts on mycelial growth, conidia/sclerotia viability, and germ tube growth, mycelial growth, and sporulation in an *in vivo* assay of phytopathogenic fungi of the genera *Fusarium*, *Botryotinia* and *Sclerotinia.* The effect of 24 concentrations of the synthesized compounds was tested in four replicates. In vitro tests investigate the influence of the synthesized compounds on mycelial growth, germination of conidia/sclerotia, and length of germ tubes. *In vivo* tests are performed on natural substrates where artificial infection occurs: Genus *Sclerotinia* - carrot, Genus *Botryiotinia* - tomato fruit, Genus *Fusarium* - wheat. Scientific studies on cytotoxicity profiling of nicotinamide derivatives have shown that these compounds are not classified as highly toxic. If their fungicidal activity is confirmed, they can be used as ecologically acceptable fungicides.

Keywords: phytopathogenic fungi, antifungal activity, pyridinium compounds, nicotinamide derivatives

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Subgroup 6 - Mycotoxins and food safety

Occurrence of ochratoxin A in Blatina wine from the Mostar vineyards

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Abstract: Blatina is an autochthonous and most represented red wine variety in Herzegovina. Wine is the second source of daily micotoxins intake for humans with domination of ochratoxin A (OTA) contamination of grapes. The aim of this paper was to determine occurence of OTA in Blatina. Representative sampling was achieved by selecting twenty quality and premium wines from Mostar vineyard produced in 2018 and 2019. Quantification of OTA was performed by high performance liquid chromatography with a fluorescent detector (HPLC-FLD). OTA values ranged from 0.205 to 0.933 µg/L. It can be concluded that the presence of ochratoxin A in Blatina wine is within acceptable limits of Regultaion in the European Union (EU). The level of ochratoxin A in wine depends on the type of grape, wine region, agricultural practice, weather conditions and the process of wine production. In order to protect consumer health, it is necessary to monitor its values in wines on the market.

Keywords: *red wine, ochratoxin A, HPLC-FLD*

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Subgroup 6 - Mycotoxins and food safety

Biological control of aflatoxins using non-toxigenic strains of *Aspergillus flavus* on maize

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Abstract: Mycotoxins are one of the major threats to food and feed safety and quality worldwide. More specifically, aflatoxin AFB1 and its metabolite AFM1, have been classified by the International Agency for Research on Cancer (IARC) among the most carcinogenic compounds for humans. Due to the inability of chemical methods to control aflatoxin levels on maize, the use of non-toxigenic strains of *Aspergillus flavus* has been characterized by numerous studies as the most effective control strategy. The purpose of the present study was to evaluate 15 non-toxigenic strains in terms of their ability to reduce aflatoxin production *in situ*, on artificially infected corn seeds with a highly toxigenic *A. flavus* strain from the collection of the Laboratory of Phytopathology, AUA. Previous experiments have indicated the high effectiveness of these specific non-toxigenic isolates in inhibiting the biosynthesis of aflatoxins on pistachios, reaching reduction rates of aflatoxin levels between 80-90% both in laboratory experiments and in field experiments. In the context of biological management, the most effective of the non-toxigenic isolates in corn kernels will be further applied to maize cultivation, under field conditions in order to further evaluate their effectiveness. The results of the above experimental studies will be presented.

Keywords: *Aspergillus flavus*, aflatoxins, biological control, non-toxigenic strains, maize

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Subgroup 7 - Bio-diversity and bio-indicators in sustainable agriculture

Neglected and Underutilized Crop Species, an alternative to improve food supply and nutrition security by protecting biodiversity in Korça region, Albania

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Abstract: Agrobiodiversity as part of humanity cultural heritage is essential for a sustainable agriculture production, food, and nutritional security, of which neglected and underutilized species are key elements. Many of these species are well adapted to specific regions, to various environmental stresses and have good *resistance* to common *diseases and pests. They have* a high potential for providing food, and nutritional security to support local food system transformation and contribute to the diversity and stability of agro-ecosystems and the diversification of agriculture. Korça region characterized by diverse agro-ecology and it considered as one of the richest crop genetic resource centers in Albania. The cultivation and use of minor crops is declining from time to time and nowadays have limited attention on the diversity and conservation of those genetic resources. As a result, some of them are endangered, and to be lost in near future. The aim of this paper is to indicate several crop species that are neglected or underutilized in Korça region, which can be included and used as future smart foods, and may contribute on diversification of food and cultivated crops.

Keywords: neglected crop, underutilized crop, biodiversity, future smart foods.

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Nematodes as bioindicators of soil ecosystem status in the intercropping system of woody species and agricultural crops

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Abstract: The aim of this study was to determine the impact of intercropping of permanent plantation and agricultural crops on biodiversity, community structure and soil disturbance indices and ecological diversity indices as well as on fertility parameters. For the purpose of the research, experiments were conducted on three different ecosystems, the intercropping ecosystem of agricultural crops and walnut (K+O), the walnut ecosystem (O) and the agricultural crops ecosystem (K), on two sites (Ivankovo and Đakovo), from 2017 to 2019. The ecosystem K+O has shown a positive impact on total and average diversity of genera, especially on the diversity of useful omnivores, which indicates the stability of the ecosystem. Bacterivores were significantly more numerous in the ecosystem K, and fungivore in the ecosystem O. The ecosystem K+O indicates the decomposition of organic matter by both bacterial and fungal pathways. The values of the MI and MI 2-5 indicates the greatest disturbances in the ecosystem K. The CI values in the ecosystem O indicate a higher proportion of fungi and fungivores that participate in the decomposition of organic matter. BI and EI values in all ecosystems indicate that soil disturbance is present, but the soil food network is not depleted. SI values indicate the developed soil food web and a good share of higher trophic groups in ecosystems K+O and O. Metabolic footprints of nematodes, high activity of bacteria and fungi, higher amounts of organic matter and soil moisture also indicate a positive impact of the ecosystem K+O, when compared to the ecosystem K.

Keywords: nematodes, biodiversity, indices, intercropping, walnut

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Program

Program of the conference

Color index:		SG index:	
New day	Section name	SG 1 - Diagnosis in plant health and IPM	SG 2 - Sustainable use of pesticides
		SG 3- Subgroup 3 - Plant feeders	SG 4 - Plant Pathology
Hall	Breaks	SG 5 - Weed science	SG 6 - Mycotoxins and food safety
		SG 7 - Bio-diversity and bio-indicators in sustainable agriculture	

Monday, September 5th 2022	
15:00-20:00	Participants arrival
Tuesday, September 6th 2022 Faculty of Agriculture, University of Novi Sad Trg Dositeja Obradovica 8, Novi Sad	
9:00-10:00	Registration of participants
10:00-10:15	**Opening Session**
	Amphitheatre, ground floor
	Prof. Aleksandra Konjević PhD, local project coordinator, president of the organising committee **Prof. Branko Ćupina PhD**, Vice Dean for Science and International Relations, Faculty of Agriculture, University of Novi Sad
10:15–13:15	**"Presentation of WPs project results "**
	Amphitheatre, ground floor
10:15-10:35	**Prof. Renata Bažok PhD**, project leader: Project HarISA, short overview
10:35-10:50	**Prof. Vili Harizanova PhD**, leader of WP2: General rules
10:50-11:20	**Prof. Aleksandra Ignjatović-Ćupina PhD, Prof. Eustachio Tarasco PhD**, leaders of WP3: Curriculum of the Joint PhD study Program
11:20-11:30	**Discussion**
11:30-12:00	Coffee break
12:00-12:15	**Prof. Dimitrios Tsitsigiannis PhD, Prof. Magdalena Cara PhD,** leaders of WP4: Equipment and contracts
12:15-12:30	**Prof. Renata Bažok PhD, Prof. Ilir Nicko PhD,** leaders of WP5: Mobility of students and professors
12:30-12:45	**Prof. Marija Grgić PhD**, leader of WP6: Quality Control Board report
12:45-13:00	**Prof. Renata Bažok PhD, Prof. Jurica Primorac PhD,** leaders of WP7: Dissemination of project activities and results
13:00-13:15	**Discussion – How to proceed?**
13:15-14:45	Lunch break

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Program

14:45-17:30	"Lectures" – part 1
	Amphitheatre, ground floor, SG1, SG2 **Chaired by: Maja Čačija, Matteo Spagnuolo**
14:45-15:00	**Charikleia Kavroumatzi**: Integrated management of *Alternaria dauci* in carrots
15:00-15:15	**Nađa Milutinović**: Watermelon anthracnose disease in Serbia - importance and management
15:15-15:30	**Helena Virić Gašparić**: Pesticide residue analysis of plant samples
15:30-15:45	**Dana Čirjak**: Overview of automatic monitoring systems for apple pests
15:45-16:00	**Evgenia-Anna Papadopoulou**: Olive tree endophytes: a new source of bioactivity in plant protection
16:00-16:30	Coffee break
16:30-16:45	**Uroš Vojinović**: Current status of *Erysiphe necator* populations sensitivity to fungicides in Serbia
16:45-17:00	**Sandra Skendžić**: Soil reflectance spectroscopy - tool for the detection and monitoring of soil contaminants
17:00-17:30	**Discussion**

20:00 JOINT DINNER
Venue: "Plava frajla" Restaurant, No. 2, Sutjeska str., Novi Sad

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Program

Color index:		SG index:	
New day	Section name	SG 1 - Diagnosis in plant health and IPM	SG 2 - Sustainable use of pesticides
		SG 3- Subgroup 3 - Plant feeders	SG 4 - Plant Pathology
Hall	Breaks	SG 5 - Weed science	SG 6 - Mycotoxins and food safety
		SG 7 - Bio-diversity and bio-indicators in sustainable agriculture	

Wednesday, September 7th 2022

Faculty of Agriculture, University of Novi Sad
Trg Dositeja Obradovica 8, Novi Sad

9:30-11:45	**"Lectures" – part 2 - Parallel sessions**	
	P1, ground floor, SG3 **Chaired by: Ivana Majić, Nedžad Karić**	Amphitheatre, ground floor, SG4 **Chaired by: Sotiris Tjamos, Nataša Duduk**
9:30-9:45	**Renata Bažok**: Effects of spiropidion on survival and parasitism of *Aphidius collemani* Viereck (Hymenoptera: Braconidae)	**Rita Milvia De Miccolis Angelini**: Multi-omics approaches to explore phenotypic and genetic diversity in the brown rot fungal pathogens *Monilinia fructicola*, *Monilinia laxa* and *Monilinia fructigena*
9:45-10:00	**Martina Kadoić Balaško**: Electrical penetration graph - Promising tool for measuring feeding behaviour of *Bemisia tabaci*	**Tatjana Dudaš**: Biocontrol activity of epiphytic yeasts aginst *Penicillium expansum* on apple fruits
10:00-10:15	**Ilaria Laterza**: Impacts of landscape composition on the occurrence and the control of *Halyomorpha halys* in newly invaded areas	**Almira Konjić**: Overview of the use of GWAS to identify loci for resistance to apple scab caused by *Venturia inaequalis*
10:15-10:30	**Aleksandar Ivezić:** Identification of Trichogramma egg parasitoids of the European corn borer *Ostrinia nubilalis* (Hübner, 1796) in Vojvodina (Serbia)	**Anastasia Venieraki**: Antagonistic activity of endophytic *Bacillus* strains against phytopathogenic fungi
10:30-10:45	**Sofia Dervisoglou**: *Tuta absoluta* egg density and distribution on tomato plants affect the efficacy of mirid predators	**Eirini Poulaki**: The volatile organic compounds of the biocontrol agent *Bacillus velezensis* K165 activate plant defenses against *Verticillium dahliae*
10:45-11:00	**Ivana Lalićević**: Aphid flight activity in wheat	**Christos Tsoukas**: Grapevine rootstock and scion canes as an important inoculum source of Petri disease associated pathogens
11:00-11:15	**Marija Milošević**: Natural enemies of *Parthenolecanium corni* (Bouché) (Hemiptera: Coccidae) on grapevine in Neštin, Serbia	**Nina Vučković**: Botryosphaeriaceae as postharvest pathogens of apple fruit

Program

11:15-11:30	**Mihaela Kavran**: Some important invasive species in agricultural and urban environments of Serbia	**Discussion**
11:30-11:45	**Short discussion**	
11:45-12:15	Coffee break	
12:15-13:30	**"Lectures" – part 2**	
	P1, ground floor, SG5 **Chaired by: Maja Sćepanović, Mirha Đikić**	Amphitheatre, ground floor, SG4, SG6 **Chaired by: Dimitrios Tsitsigiannis, Magdalena Cara**
12:15-12:30	**Dragana Božić**: Gene flow from herbicide-tolerant hybrids to weedy sunflower	**Anastasia Papageorgiou**: Endophytic bacteria from olive drupes as biological control and induced resistance agents of *Colletotrichum acutatum*
12:30-12:45	**Valentina Šoštarčić**: Predicting *Echinochloa crus-galli* L. emergence in maize with hydrothermal modelling	**Angelo Agnusdei**: Innovative green technologies to improve the sustainability of viticulture and safety of grape products
12:45-13:00	**Teodora Tojić**: Secondary metabolites of *Cuscuta campestris* as bioherbicides	**Discussion**
13:00-13:15	**Short discussion**	
13:15-14:45	Lunch	
14:45-16:30	**Poster session**	
	Amphitheatre, hall, ground floor **Chaired by: Mirjana Brmež, Nedeljko Latinović**	Meeting hall, dean's office
14:45-15:15	**Online posters presentation and discussion**	WP2 and PMB meeting
15:15-16:30	**Poster session on site**	

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Program

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		SG 7 - Bio-diversity and bio-indicators in sustainable agriculture	

Thursday, September 8th 2022 Faculty of Agriculture, University of Novi Sad Trg Dositeja Obradovica 8, Novi Sad		
9:00-11:30	**Students' mobility presentations and Final discussion**	
	Amphitheatre, ground floor **Chaired by: Karolina Vrandečić, Marta Loc**	P1, ground floor
9:00-11:00	**Round table:** Student's experience and feelings about the mobilities	**PMB meeting**
11:00-11:30	**Discussion about future activities and conclusions**	
11:30-12:00	Coffee break	
12:00	**Field trip**	
Friday, September 9th 2022		
	Departures	

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