

## IHC2018-Symposium 28

### International Symposium on Innovative Plant Protection in Horticulture

#### ORAL PRESENTATIONS

##### KEYNOTE 1

#### IDENTIFYING AND EXPLOITING WILD RELATIVES FOR GENOMICS-BASED BREEDING OF PEST AND PATHOGEN RESISTANT STONE FRUIT CROPS

**Veronique Decroocq**, Shuo Liu, David Tricon, Stéphane Decroocq, Amandine Cornille, Thierry Pascal, Jaroslav Salava, Sevda Babayeva, Raul Karychev, Tatiana Kostritsyna, Wei-Sheng Liu, Bayram M. Asma, Tatiana Giraud

INRA Centre de Bordeaux, IBVM, UMR BFP, Virologie, BP81, 33883 Villenave d'Ornon, France;  
[veronique.decroocq@inra.fr](mailto:veronique.decroocq@inra.fr)

Because of their long-term cultivation, fruit trees are susceptible to ever-changing environments due to climate changes and pathogen outbreaks. Sustainable fruit production relies on the introduction of natural, genetic resistance to diseases and pests when available in the cultivated germplasm. However, the occurrence of bottlenecks during plant domestication and subsequent breeding results in a reduction of genetic diversity and a loss of valuable alleles at genes not directly targeted by human selection. As a consequence, important traits such as resistance to major crop pest or diseases may be absent in the cultivated germplasm while present in wild relatives. The challenge is thus to investigate the genetic and phenotypic diversities of wild close relatives of crop species in order to identify resistance traits that can be introgressed into elite lines in future breeding programs.

As a proof-of-concept, we conducted a world-wide search of resistance source(s) to sharka (caused by the Plum Pox Virus –PPV infection) in stone fruit species, i.e. apricot, almond, peach, and plum, including their related, undomesticated species. For this purpose, we implemented two different strategies: (1) a genome-wide analysis of sources of resistance available in wild related species (*Armeniaca* and *Amygdalus*), (2) a candidate gene approach through which we targeted impaired alleles of PPV susceptibility genes.

In *Armeniaca*, we showed that the wild apricot progenitor, *P. armeniaca vulgaris*, exhibited in its native Central Asian range a high frequency and variability in resistance to sharka (Decroocq et al., Molecular Ecology 2016). In *Amygdalus* subgenus, resistance to sharka was identified in both cultivated (*Prunus dulcis*) and wild relatives. We are currently evaluating the potentiality of those new sources of resistance by implementing controlled molecular assisted breeding methods as well as extending a similar approach to resistance to other pathogens.

Keywords: Sharka disease, pathogen management, genetic resistance, wild related species

##### SESSION I: Virology

##### OS 1-1:

#### EVALUATION OF SOME PRUNUS ROOTSTOCKS TO NATURAL INFECTION TO PLUM POX VIRUS IN ENDEMIC AREA

**L.A. Zagrai**, I. Zagraia, G. Guzu  
Fruit Research & Development Station Bistrița, Romania  
[izagrai@yahoo.com](mailto:izagrai@yahoo.com)

*Plum pox virus* (PPV), which causes Sharka disease, is considered the most detrimental viral pathogen affecting *Prunus* spp. Rootstock resistance is very important for PPV containment strategies, given that rootsuckers represent gateways for the virus inoculum, mediated by aphid vectors. Different types of myrobalan rootstocks are frequently used for some *Prunus* spp. propagation. Myrobalan BN 4Kr is a mutant of *Prunus cerasifera* developed as resistant to PPV, and hence its great potential for reducing the impact of PPV. The aim of this study was to evaluate its behavior to high natural infection pressure with PPV in an endemic area in comparison with other two commonly rootstocks used for plum, precisely Myrobalan 29C and St. Julien. In this regard, two field trials were established under an experimental nursery with inoculum sources of PPV nearby, and without any phytosanitary treatments. Thus, a first field trial with BN 4Kr and St. Julien rootstocks was set up on 2014 and a second one, with BN 4Kr and Myrobalan 29C, on 2016. Plants were grown in pots and prior to field planting were tested to check their PPV free status. PPV symptoms on leaves were evaluated twice every



vegetative period. Serological and molecular tools were used to evaluate the rate of infections with PPV of the investigated rootstocks. Typical PPV symptoms were observed on Myrobalan 29C and St. Julien, but not on BN 4Kr. DAS-ELISA and IC-RT-PCR tests revealed a high infection rate of PPV on Myrobalan 29C and St. Julien rootstocks, while none of BN 4Kr plants became infected during two or four years of field testing. The results suggest that the resistance of BN 4Kr against PPV in field condition of endemic area remained stable and durable, and hence a potential interest for its wide use.

Keywords: DAS-ELISA, IC-RT-PCR, *Prunus cerasifera*, nursery, resistance, sharka.

## OS 1-2:

### IDENTIFICATION AND PARTIAL CHARACTERIZATION OF RASPBERRY BUSY DWARF VIRUS INFECTING CHERRY TREES

**Kadriye Caglayan**, MonaGazel, EminurElci, KivilcimOrdek, MehtapAcioglu, Mojca Marn, Irena Mavric Plesco

Hatay Mustafa Kemal University, Agriculture Faculty, Plant Protection Dep., Hatay, Turkey

[kcaglayan@yahoo.com](mailto:kcaglayan@yahoo.com)

Raspberry bushy dwarf virus (RBDV), the only member of genus *Idaeovirus*, is a seed and pollen-borne virus commonly found in raspberries. RBDV infects wild and cultivated *Rubus* spp. throughout the world and is one of the most important viruses of raspberries. RBDV was reported to naturally infect grapevine, the first non-*Rubus* natural host. Its genome consists of three segments of linear, positive-sense, single-stranded RNA. RBDV can be vertically and horizontally transmitted by pollen. However, mechanisms by which pollination with virus-contaminated pollen grains cause systemic viral infection to healthy plants have been unknown for years. Recently, Isogai et al. (2014) showed that infected raspberry pollen grains can transfer RBDV to healthy *Torenia* (*Torenia fournieri*) plants. Therefore, it might be possible that RBDV spreads in its host plant species beyond the plant family level by pollen through wind and/or pollinating insects, if the virus infection was established at stigmas by penetration of infected pollen tubes into these stigmas. During the survey studies of wild and commercial plantations of *Rubus* spp. in Marmara region of Turkey in 2015, some cherry plants grown in blackberry orchards in Bursa province were tested for some *Rubus* viruses. Fifty cherry samples were tested for Raspberry bushy dwarf virus (RBDV), arabis mosaic virus (ArMV), strawberry latent ringspot virus (SLRSV), tomato ringspot virus (ToRSV) and tobacco ringspot virus (TRSV). Among the tested viruses only RBDV was detected in 8 samples by RT-PCR when the primers amplifying a 280 bp fragment of CP were used. In order to confirm the presence of a new pathogen on cherries in Turkey, the amplified fragments were cloned and sequenced. All the obtained sequences from *Rubus* spp. and cherries were compared with RBDV sequences deposited in the NCBI. The results showed a presence of possible divergent RBDV isolate obtained from cherry.

Keywords: *Prunus avium*, Turkey, RBDV, RT-PCR, cloning, sequencing

## OS 1-3:

### EXPLORING DIFFERENT MUTATIONS AT A SINGLE AMINO ACID POSITION OF CUCUMBER GREEN MOTTLE MOSAIC VIRUS REPLICASE TO ATTAIN STABLE SYMPTOM ATTENUATION

**Qinsheng Gu**, Liming Liu, Bin Peng, Zhenwei Zhang, YangWu, Manuel Miras, Miguel A.Aranda

The South End of Weilai Road, Zhengzhou, China

[guqinsheng@caas.cn](mailto:guqinsheng@caas.cn)

Cucumber green mottle mosaic virus (CGMMV) is a member of the genus Tobamovirus (family Virgaviridae) which causes serious economic losses in cucurbit crops. A possibility for CGMMV control is the use of cross-protection, for which stable attenuated isolates are required. In this study, an infectious clone was constructed for the hn isolate of CGMMV. Unexpectedly, this clone carried a non-conserved mutation involving a single nucleotide change resulting in the replacement of Arg to Cys at residue 284 of the replicase protein; this mutation correlated with delayed symptom induction and RNA accumulation, as shown in time course experiments. Sequencing of the viral progeny showed that restoration of wild-type symptoms and increased RNA accumulation correlated with reversion of the mutation to the wild-type sequence, a phenomenon that occurred at around 7 to 10 days post-inoculation. Thus, Arg284 seems to be crucial but not strictly necessary for virus infection. Subsequently, four ot



her mutants in the triplet encoding Arg284 were constructed and assayed. Results showed that symptoms and the timing were diverse for the different mutants, with enhanced pathogenicity and RNA accumulation always correlating with reversion to Arg284. Therefore, the nature of the mutation strongly influenced the genetic stability of the mutant. At least two mutants were identified for which reversion did not occur by 30 days post inoculation, and these were defined as good candidates to attain stable symptom attenuation that could be useful in cross-protection.

Keywords: CGMMV, infectious clone, replicase protein, reversion, pathogenicity

## OS 1-4:

### THE STATUS OF GRAPEVINE LEAFROLL-ASSOCIATED VIRUSES IN IRAN

**Masoud Naderpour**, Raheleh Shahbazi, Asadollah Alizadeh, Siavash Karimi, Mohammad Tabeei, Mohammad Hajizadeh, Karim Hosseinybay

Dept. of Res. Techno. and Seedling Quality, Improvement, Seed and Plant Certification, and Registration  
Institute, Karaj, Iran

[m.naderpour@areo.ir](mailto:m.naderpour@areo.ir)

Infection to plant viruses is one of the most important factors affecting plant productivity and longevity. Slow declines and rapid collapse of plants are mainly related to infection by viruses and phytoplasmas. Grapevine leafroll disease (GLD), caused by a group of serologically distinct viruses known as *Grapevine leafroll-associated viruses* (GLRaVs, *Closteroviridae*), is supposed the main factor in decreasing the quality and quantity of grapes and longevity of grapevine plants. In order to revise the Iranian national standards for grapevine plant propagating materials in certification schemes, surveys were carried out in 2014-2016 in the vineyards of the main grapevine producing provinces of Iran namely Western-Azerbaijan, Qazvin, Fars, Khorasan Razavi, Khorasan Shomali and Chaharmahal Bakhtiari. A total of 68, 92, 65, 74, 27 and 45 leaf samples showing GLRaVs symptoms were collected from grapevine plants of those provinces, respectively. Samples were first processed in liquid nitrogen and checked for GLRaV-1+3, GLRaV-2 and GLRaV4-9 by double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) using the specific antibodies purchased from the Agdia (USA). Genomic RNAs were then extracted from all samples using RNA extraction Kit (GeneAll, South Korea) and the presence of viruses was rechecked by reverse-transcription polymerase chain reactions (RT-PCR) applying virus specific primer pairs. GLRaV1+3, GLRaV-2 and GLRaV4-9 were detected from 2.94, 7.33, 1.47 (Western-Azerbaijan), 6.15, 0, 3.08 (Qazvin), 80, 0, 3.08 (Fars), 23, 0, 1.35 (Khorasan Razavi), 28.9, 0, 3.7 (Khorasan Shomali), and 28.9, 0, 0 (Chaharmahal Bakhtiari) percent of samples, respectively by DAS-ELISA. RT-PCR assays revealed the presence of GLRaVs-1, -3 and -7 in 71.78, 10.94, 14.06 (Fars), 21.87, 17.18, 12.50 (Qazvin) and 12, 0, 74.47 (West -Azarbaijan) percent of samples, respectively. Samples of other provinces are under analyzing with RT-PCR assays to identify the GLRaV species. Except for the Western-Azerbaijan province, GLRaV1+3 seems to be the most predominant GLRaVs in all vineyards. GLRaV-3 has been shown to be the main causal agent of GLD worldwide and then could be a big threat for the Iranian grape industry.

Keywords: *Vitis vinifera*, GLD, Iran

## OS 1-5:

### THE RESEARCH ON THE PREVALENCE OF SEVERAL NEWLY IDENTIFIED GRAPEVINE-INFECTING VIRUSES IN TURKEY

**Serkan Önder**, Çiğdem Ulubaş Serçe, Osman Çifçi, Bülent Altan, Z. Neslihan Öztürk Gökçe, Eminur Elçi

Manisa Viticulture Research Institute, Planth Health Department, 45125, Yunusemre, Manisa, Turkey  
[onderserkan@gmail.com](mailto:onderserkan@gmail.com)



Recently, several emerging viral diseases have been identified on grapevines. Comprehensive surveys in grapevine growing areas and developing effective detection tools need to be performed to prevent the entrance and spread of these viruses. Therefore to detect and gain information on the prevalence of several newly emerging viral pathogens (Grapevine Pinot gris virus, GPGV; Grapevine Syrah virus-1, GSyV-1; Grapevine vein clearing virus, GVCV; Grapevine red blotch-associated virus, GRBaV; Grapevine deformation virus, GDefV; Grapevine Anatolian ringspot virus, GARSV) in Turkish vineyards, a survey was performed in the most important grapevine producing locations in 2015-2016. A total of 1658 grapevine samples were collected from Aegean, Marmara, Mediterranean, Eastern and South-Eastern Anatolia and Central Anatolia Regions of Turkey. The samples were analyzed with PCR (samples from Central Anatolia Region) or SYBR Green based real time PCR against GPGV, GSyV-1, GVCV, GRBaV, GDefV and GARSV. Among the tested viruses, the most prevalent one was GPGV with the infection rate of 9.23 % followed by GSyV-1 (5.19 %) and GDefV (1.15 %). The viruses GVCV, GRBaV and GARSV were not detected among the tested samples. GPGV was in the highest incidence in Aegean Region with rate of 33.72 %, followed by Eastern Anatolia (11.98 %), Marmara (8.15 %) and South-Eastern Anatolia (6.43 %) regions. GPGV did not detected in grapevine samples collected from Mediterranean and Central Anatolia Regions. GSyV-1 was detected in Aegean, (29.46 %); Mediterranean, (1.81 %); Central Anatolia, (1.18 %) and Marmara, (0.74 %), but not in Eastern and South-Eastern Anatolia Regions. GDefV was detected in all regions (1.34% in South-Eastern Anatolia, 3.10% in Aegean, 1.18 % in Central Anatolia and 0.37 % in Marmara) except Mediterranean and Eastern Anatolia. This study provides the first comprehensive survey of the GPGV, GSyV-1, GDefV, GARSV, GRBaV and GVCV in Turkey.

**Keywords:** *Grapevine Pinot gris virus, Grapevine Syrah virus-1, Grapevine vein clearing virus, Grapevine red blotch-associated virus, Grapevine deformation virus, Grapevine Anatolian ringspot virus*

## KEYNOTE 2

### CHALLENGES AND PERSPECTIVES ON BIOLOGICAL CONTROL STRATEGIES OF POSTHARVEST DISEASES

**Samir Droby**

ARO, The Volcani Center, P.O.Box 15159, Rishon LeZion 7505101, Israel  
[samird@volcani.agri.gov.il](mailto:samird@volcani.agri.gov.il)

Developing biological control strategies to control postharvest diseases are still challenging. In most cases, there are inherent problems in the biocontrol systems related to poor performance and inconsistency under commercial conditions. The current paradigm that is based on the premise that a single microbial antagonist may no longer be appropriate given our current knowledge on the complex multitrophic interactions taking place between all the components of the biocontrol system (plant host, the antagonist, the pathogen, and the microbiome). Although these interactions have been the subject of research for over thirty years, our understanding is still incomplete and a significant gap still exists between basic research underlying the selection of biocontrol agents and their use as commercially-successful products. This is because of the difficulties associated with the study of complex interactions and the lack of appropriate research tools and technologies. In this context, the multitrophic interactions that occur in postharvest biocontrol systems, and the potential development and use of synthetic microbial communities for postharvest biocontrol will be discussed and preliminary data about this new paradigm for postharvest biocontrol will be presented. The potential of utilizing microbial consortia in a beneficial manner has greatly increased due to advances in '-omic' technologies (metagenomics, metabolomics, transcriptomics, etc.) and bioinformatics. Additionally, using new technologies and cutting-edge microbial network modeling algorithms, may provide a compositional and functional understanding of the microbiome of fresh fruits and vegetables. This knowledge will enable a rational, science-based design of host-specific microbial consortia that can be used to manage postharvest decay in harvested fruit crops more effectively than the prevailing use of single antagonists.

**Keywords:** Biological control, postharvest diseases, antagonists, microbiome





## SESSION II: Mycology-Bacteriology

### OS 2-1:

EFFICACY OF SELECTED POST-HARVEST AGROCHEMICALS IN REDUCING POTATO TUBER SOFT ROT CAUSED BY *PECTOBACTERIUM CAROTOVORUM* SUBSP. *CAROTOVORUM* IN STORAGE

**T. Nghondzweni**, R. Gouws and R. Slabbert

Department of Crop Sciences, Faculty of Science, Tshwane University of Technology, Pretoria, South Africa.

[nghondzwenit@tut.ac.za](mailto:nghondzwenit@tut.ac.za)

The control of pectolytic bacteria (soft rot) is still a challenge in potato production worldwide. Consumer demands for more natural and less toxic alternative post-harvest sanitizers has led the industry into developing different fresh produce sanitizers and preventative methods for potato soft rot. Foodprint® and SporeKill® were evaluated for their efficacy against the pectinolytic Gram negative bacterium, *Pectobacterium carotovorum* subsp. *carotovorum* (Pcc, Agro-255), the causal agent of potato tuber soft rot. The efficacy of the products was tested as a post-harvest wash treatment on artificially infected potato tubers of cultivars Mondial and Fianna which were then stored at room temperature for a period of 35 days. Results showed that tubers of cultivar Mondial are highly susceptible to soft rot (100% soft rot incidence) as compared to tubers of cultivar Fianna (55% soft rot incidence). Foodprint® and SporeKill® reduced soft rot incidence by 43% and 17% on cultivar Mondial potatoes and by 31% and 38% on cultivar Fianna potatoes, respectively. This study concludes that the combination of a Pcc tolerant potato cultivar and an effective post-harvest sanitizer can potentially reduce the incidence of post-harvest soft rot by more than 70%.

Keywords: Bacteria, pectolytic, Gram negative, susceptible, storage, cultivar.

### OS 2-2:

QUANTIFICATION OF THE MICROCLIMATE IN CUT-ROSES AND ITS IMPLICATION FOR POWDERY MILDEW DEVELOPMENT

**Arian van Westreenen**, Leo F. M. Marcelis, Ningyi Zhang, Jochem B. Evers, Niels P. R. Anten  
Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands

[arian.vanwestreenen@wur.nl](mailto:arian.vanwestreenen@wur.nl)

In greenhouses, climate is often close to favourable for powdery mildew development. Measures taken against powdery mildew development are usually based on the overall greenhouse climate, whereas the powdery mildew is exposed to the microclimate. Therefore, in this study we quantified the microclimate compared to the greenhouse climate and linked this to powdery mildew development. Thereby, this study aims to contribute to the field of integrated pest management.

In a cut-rose greenhouse experiment (Wageningen, NL) we measured (net) radiation, (leaf) temperature, relative humidity (RH) and air movement to quantify the greenhouse, micro and leaf climate with a measurement interval of 1s.

The results showed that the temperature difference between the top and the base of the canopy can be up to 5°C, depending on time of the day, conditions outside the greenhouse and greenhouse climate settings. Since dew point temperature did not change within the canopy, the RH difference between the top and the base of the canopy can be up to 65%. During hot summer days, RH could go up to more than 95% in the lower part of the canopy, while 30% in the top. On some days, leaf temperatures were lower than air temperature for more than 75% of the day; thereby, increasing RH even more, so that dew formation could easily occur. Most fungi, and also powdery mildew, prefer high humidities; therefore, in the base part of the canopy there is a higher chance of infection. These observations show the relevance of taking into account the differences between different climates inside the greenhouse to control disease development.



Keywords: Canopy climate; disease development; greenhouse climate; integrated pest management; IPM

## OS 2-3:

### FUTURE OF PLANT PROTECTION: CAN AGRICULTURAL NANOTECHNOLOGY BE A GAME CHANGER?

**Neena Mitter**

Level 3, South, Queensland BioScience Precinct, The University of Queensland, St Lucia QLD 4072, Australia

[n.mitter@uq.edu.au](mailto:n.mitter@uq.edu.au)

A vibrant and sustainable horticulture industry is a must to provide nutritional food for 10 billion people by 2050. In this globalized world and interconnected economies, we need to address to ensure that our food crops are protected from pests and diseases as they account for 20-40% losses in productivity. The ongoing usefulness of chemical pesticides suffers from issues such as residual toxicity, run off, specificity and resistance. Genetic modification is not available for all crops/pathogens, and it is not the preferred choice for all producers and consumers.

The coupling of biology and nanotechnology has opened up new and exciting possibilities in the area of plant protection. Clever nano-carriers of innovative biological 'active ingredients' rather than chemical ones could be a game changer for future crop protection strategies. BioClay is one such non-toxic, non-GM, environmentally friendly biodegradable crop protection platform that delivers pest targeting RNA interference (RNAi) as a topical application using clay nanoparticles as carriers. We have shown that double stranded RNA (dsRNA) delivered as BioClay is stable, does not get washed off and provides protection to the sprayed and unsprayed leaves against the targeted virus for up to 20 days post spray. We have further shown that the clay degrades on the surface of the leaf alleviating any concerns about residues. It also means clean, green produce for domestic consumption and exports. Topical application of RNAi is also being investigated to target fungal pathogens and insect pests of plants. Real world application of topical RNAi-mediated resistance will be governed by factors such as innovative delivery platforms, cost effective production of dsRNA and the regulatory landscape.

Keywords: Nanotechnology, RNA interference, BioClay, Topical application, plant protection

## OS 2-4:

### EFFECTS OF NANOMATERIALS ON SEEDLING GROWTH AND DISEASE CONTROL

**Pi-Fang Linda Chang,** Tao-Ho Chang, Yong-Wen Liu, Chien-Chih Chen, Wen-Yi Li, Wen-Hsin Chung, Jiang-Jen Lin, Jenn-Wen Huang

Department of Plant Pathology, National Chung Hsing University, No. 250 Kuo-Kuang Rd., South District, Taichung City 40227, Taiwan, Chinese Taipei

[pfchang@nchu.edu.tw](mailto:pfchang@nchu.edu.tw)

Materials of size reduced to 1-100 nm are defined as nanomaterials (NMs) which pose new characteristics. Some NMs have been reported to have potential to be applied in plant growth promotion and disease control in agriculture. In this study, silver nanoparticles in forms of nano-scale silica platelets (AgNP/NSP) and nano-scale silica platelets (NSP), together with micro/nano-sized calcium-silica composite (NCaSi) were tested for their effects on seedling growth and disease control. The results showed that AgNP/NSP displayed inhibitory effect on fungal pathogens. We also tested the effects of AgNP/NSP, NSP, and NCaSi on the growth of Chinese cabbage (baby pak choi), lettuce, tomato, and watermelon. AgNP/NSP reduced seed germination, root elongation and seedling growth of some test plants, however, NCaSi promoted tomato seedling growth and reduced diseases. Nevertheless, NCaSi could induce some pathogenesis-related proteins and stress proteins and also provide protection to plants against pathogens. Thus, application of NMs in plant disease management shall be carefully evaluated for their positive or negative effects on plant growth and protection in the future.

Keywords: Disease control, growth inhibition, growth promotion, nanoparticles, plant



## SESSION III: Disease Management

### KEYNOTE 3

#### OS 3-1:

#### ROOT HEALTH IMPROVEMENT IN HORTICULTURE WITH THE INTEGRATED OFFER OF BIOACT, SERENADE AND VELUM

**Marc Rist**, Sarah Hovinga, L Praba Manalavan, Albert Schirring, Kai Wirtz

Bayer AG, Division Crop Science, Alfred-Nobel-Strae 50, 40789 Monheim, Germany

[Marc.Rist@bayer.com](mailto:Marc.Rist@bayer.com)

Plant roots the hidden parts of the plant, consume 30 – 50% of photosynthetic output and provide the basis for healthy and productive plants. Growth and activity of plant roots is affected by a multifold of actors in the soil and rhizosphere with dynamic fluctuations in response to abiotic and biotic factors. Root research using new technologies in the area of genomics, microbiomics and 3D imaging offer exciting opportunities to improve our understanding of the functionality of healthy plant roots and the impact of pests and diseases on their performance. Although horticulture growers understand the importance of healthy roots to plant productivity, crop management is mainly focused on the apparent above ground parts. However, the root as cause of plant health issues is still often underestimated. Bayer's root health strategy, Roots2Success™, offers growers more insight into the biology of healthy, high performing roots and targets key challenges that threaten root health. Root2Success™ provides growers with customized agronomic solutions and services to maintain or optimize root functionality in vegetable fields, fruit- and grape orchards and plantation crops. The concept aims to improve the resilience of the root system with a holistic approach: Application of biological solutions to prevent the development of pest and diseases, protect the crop through activation of the plant defence machinery and cure damaged roots with crop protection products. The Root2Success™ strategy offers a set of root health solutions such as the biological products BioAct™ (*Purpureocillium lilacinum*, strain 251), and Serenade™ (*Bacillus subtilis*, strain QST 713) and chemical solutions like Velum™ (fluopyram). The presentation will include the results of large scale field trials testing the Root2Success™ concept in Costa Rica, Greece, Mexico, Netherlands and Spain. Further, a summary on the use of 3D imaging, qPCR and root development assays for monitoring root health will be presented.

Keywords: Root health, Root2Success™, BioAct™, Serenade™, Velum™

#### OS 3-2:

#### MANAGEMENT OF HAIRY ROOT DISEASE IN PROTECTED TOMATO CROPS: A BIOLOGICAL AND CHEMICAL APPROACH

**W. Vanlommel**, R. Moerkens, L. Bosmans, B. Lievens, H. Rediers, L. Wittemans, B. Van Calenberge, A. Paeleman and S. Van Kerckhove

Research Centre Hoogstraten vzw, Hoogstraten, Belgium

[wendy.vanlommel@proefcentrum.be](mailto:wendy.vanlommel@proefcentrum.be)

Hairy root disease (HRD), also known as 'crazy roots', caused by rhizogenic agrobacteria has in recent years become a serious problem in greenhouse hydroponic cultivation of tomato, eggplant and cucumber in many European countries. The typical symptoms include excessive development of roots, which leads to a more pronounced vegetative growth of the plants and production losses up to 10% and more. Once plants are infected, they cannot be remediated, since the disease symptoms result from the integration of the bacterial T-DNA into the plant host genome, which is irreversible. Due to the large genetic and phenotypic diversity of rhizogenic agrobacteria a company-specific management strategy is recommended. Some strategies are based on reduction



of the infection rate by inhibition of the growth of the agrobacteria in the irrigation system, while other techniques focus on reducing symptoms. In this study, we examined both biological and chemical strategies to reduce the number of agrobacteria in hydroponic tomato cultivation in order to reduce HRD incidence. In the biological approach, we tested three application strategies of a biocontrol organism (BCO), more in particular a *Paenibacillus* strain with demonstrated antagonistic activity against rhizogenic agrobacteria. Although the BCO successfully established itself on the roots by two of the tested application strategies, incidence of disease symptoms could not be prevented. Molecular analyses of root samples suggested *Agrobacterium* needs to exceed a certain threshold to cause HRD incidence. Furthermore, they showed the importance of reaching high BCO/pathogen ratios to be able to prevent HRD incidence. In the chemical approach, we examined the effectiveness of a single hydrogen peroxide application to the substrate before planting. Our results indicate that this strategy shows potential to reduce HRD in practice.

**Keywords:** Antagonistic activity, biocontrol organism, hairy root disease (HRD), silver stabilized hydrogen peroxide, *Paenibacillus*, rhizogenic agrobacteria.

### OS 3-3:

#### BIOLOGICAL CONTROL OF RHIZOCTONIA ROOT ROT OF WHEAT WITH BINUCLEATE RHIZOCTONIA FUNGI

**Filiz Ünal, F. Sara Dolar**

Plant Protection Central Research Institute, Gayrey M. FSM Bul. No66, 06300 Ankara, Turkey

[filiz.unal@tarim.gov.tr](mailto:filiz.unal@tarim.gov.tr)

Current study was conducted to identify the effect of 6 non-pathogen binucleate *Rhizoctonia* (BNR) anastomosis groups (AG A, AG C, AG E, AG G, AG H and AG I) as a biological control agent against *Rhizoctonia* spp. causing root rot and stunting in Central Anatolia wheat fields, Turkey. The pathogen isolates represented anastomosis groups *R. solani* AG 4, 5, 8, *R. cerealis* AG D, *Waitea circinata* var. *circinata*, *Waitea circinata* var. *zeae*. All six BNR isolates, when combined with AG 4, AG 8, *R. cerealis* AG D, *W. cir. var. circinata* and *W. cir. var. zeae*, significantly reduced disease severity compared with them alone. It was also detected that three of six BNR (AG H, AG E and AG C) significantly suppressed disease on wheat caused by *R. solani* AG 5 in greenhouse conditions and *Rhizoctonia* AG H provided a high degree of protection against all pathogen groups. These BNR isolates may have potential use in management of the pathogen *Rhizoctonia* anastomosis groups on wheat, but will require rigorous testing under field conditions.

**Keywords:** Biological control, binucleate, *Rhizoctonia* anastomosis groups, wheat

### OS 3-4:

#### POTASSIUM PHOSPHATE TO CONTROL ROOT DISEASES IN STRAWBERRY CULTIVATION IN TUNNEL

**Sammar Khalil, Birgitta Svensson**

Department of biosystem and technology, Box 103, 23053 Alnarp, Sweden

[sammar.khalil@slu.se](mailto:sammar.khalil@slu.se)

Cultivation of strawberries in tunnels has been of interest in recent years as a means to improve productivity by extending the cultivation season. The need to move the tunnels due to soil depletion is a disadvantage for this production system. By shifting to a substrate cultivation, tunnels could be stationary and open up the possibility to extend cultivation season and increase yield. However, a number of factors need to be considered when cultivating strawberries in substrates, especially the spread of root pathogens belonging to fungal genera *Phytophthora*, *Pythium*, *Verticillium*, which cause crown rot and wilt diseases. Potassium phosphate (PP) is used as a strategy to strengthen the plants, thereby increasing its defense against root pathogens. However, little is known about the interaction between PP and other factors in the cultivation system. In the current study, the effect of the interaction between PP and the commercial biocontrol agent Binab T, with *Trichoderma* strains as the active isolates, on root pathogen attack and on the resident microflora in the cultivation system was investigated. The results indicated that both PP and Binab T applied individually had a positive effect on the reduction of pathogen attack as well as on the development of microflora with antagonistic potential during the





cultivation period. On the other hand, combined application of PP and Binab T showed a reduction of this effect on both pathogen and resident microflora. This makes PP a good candidate to be used as a disease control strategy against root pathogens in strawberry cultivation.

**Keywords:** Resident microflora, Biocontrol agents *Phytophthora cactorum*, substrate, *Pseudomonas*, *Trichoderma*, *Actinomycetes*

## OS 3-5:

### POTATO SCAB MANAGEMENT WITH BRASSICA BIOFUMIGATION AND EFFECT OF VOLATILES ON STREPTOMYCES GROWTH

**R. Gouws-Meyer**, A. Mcleod and M. Mazzola

Department of Crop Sciences, Faculty of Science, Tshwane University of Technology, Pretoria, South Africa

[gouwsr2@tut.ac.za](mailto:gouwsr2@tut.ac.za)

Common scab of potato is an economically important soilborne disease caused by various *Streptomyces* species. The disease is very difficult to control, but biofumigation has recently shown some potential. Biofumigation consists of the incorporation of Brassica spp. crop residues containing glucosinolates that upon cell disruption are hydrolysed by the enzyme myrosinase to yield a diversity of biologically-active hydrolysis products, of which volatile isothiocyanates are the most toxic to soil microbes. In this study Common scab was significantly reduced through soil incorporation of fresh and air-dried residues of Brassica oleracea var. capitata (cabbage) when applied prior to two consecutive potato plantings. The in-vitro effect of volatile emissions from various Brassica species on pathogenic and non-pathogenic *Streptomyces* isolates was also evaluated using a bioassay method. In the chamber bioassay freshly macerated Brassica tissue, [*B. oleracea* var capitata and *B. juncea*/S. alba mix] suppressed sporulation but not hyphal growth of the 79 evaluated *Streptomyces* isolates. The chamber bioassay also showed that the Brassica tissue volatiles were bacteriostatic, since isolates re-grew when removed from the chamber and transferred to fresh media. The results suggest that soil biofumigation could significantly influence composition of the *Streptomyces* community in agricultural soils and lead to significant suppression of common scab on potato.

**Keywords:** Potato, biofumigation, management, bacterial disease, bioassay

## OS 3-6:

### SURFACE STRUCTURE INFLUENCE ON PLANT-PATHOGEN INTERACTION

**Maya Kleiman**, Neta Ginzburg

68 Hamakkabim Rd., Rishon Lezion 7505101, Israel

[mayakl@volcani.agri.gov.il](mailto:mayakl@volcani.agri.gov.il)

The first point of contact in the interaction between plants and pathogens is the surface of the plant. This interaction is composed of two components: a physical one (due to the surface microstructure) and a chemical/molecular one (due to molecular signals expressed on the surface). The surface microstructure can be viewed as one more form of signaling within the plant system. When studying plant-pathogen interaction using the natural plant, it is impossible to separate those two components as they are entangled together within the biological system. Leaf microstructure changes the interaction of the leaf with different organisms, however, to study this effect, new tools need to be built.

Biomimetics is a field combining chemistry and material sciences to imitate biological systems. Natural systems resolve problems through structural solutions, particularly, microstructures. The structural solutions achieved by nature have fascinated researchers over the years, encouraging them to seek synthetic mimics. One example for microstructure mimic comes from the lotus leaf, known for its 'lotus effect' - self-cleaning properties. The lotus leaf served as a template for microstructure biomimetics, to generate self-cleaning synthetic materials. Biomimetics methods also shed light on the locomotion movement of bed bugs due to bean leaf trichomes and on the washing limitation of *E.coli* bacteria from spinach leaves.



We are currently working on testing how leaf microstructure effects plant interaction with plant pathogens. We are using tomato and several pathogenic fungi and bacteria as a model system. Additionally, we are adopting tools from the leaf microstructure mimetics field into the world of plant roots and we are testing how root surface microstructure effects the pathogeny of root nematodes and pathogenic bacteria. We see this method as a powerful tool in gaining a better understanding of the interface between the plant surface and its biotic and abiotic surroundings.

Keywords: Microstructure, surface, biomimetics, pathogen

## OS 3-7:

### ERADICATION OF *XANTHOMONAS CUCURBITAE* IN PUMPKIN SEED BY HOT-WATER TREATMENT

**M. Babadoost**, X. Zhang

Department of Sciences, University of Illinois, Urbana, IL 61801, U.S.A.

[babadoos@illinois.edu](mailto:babadoos@illinois.edu)

This study was conducted to develop an effective seed treatment to eradicate *Xanthomonas cucurbitae*, the causal agent of cucurbit bacterial spot, in pumpkin seeds. Naturally-infected seeds with *X. cucurbitae* were used in this investigation. Infected and uninfected seeds of 'Howden' pumpkin were collected from symptomatic and asymptomatic fruits, respectively, in the research plots at the Research Farm of the University of Illinois in Champaign, Illinois, United States. Samples of the collected seeds were tested for the presence of *X. cucurbitae*. Infected and uninfected seeds were treated in water at 49, 50, 51, 52, 53, 54, 55, and 56°C for 5, 10, 15, 20, 25, and 30 min at each temperature. Treated seeds were evaluated in the laboratory and greenhouse for germination, seedling vigor, and presence of *X. cucurbitae* in the seeds. Treatments of seeds in water with temperatures below 55°C did not eradicate *X. cucurbitae* in the seeds and treatments at 56°C adversely affected seed germination and seedling vigor. Hot-water treatment at 55°C for 15 min eradicated *X. cucurbitae* in the seeds without any significant adverse effect on either seed germination or seedling vigor.

Keywords: *Xanthomonas cucurbitae*, bacterial spot, cucurbits, pumpkin, seedborne, seed treatment

## OS 3-8:

### PSEUDOMONAS PUTIDA INDUCES RESISTANCE TO *Fusarium oxysporum* f.sp. *radicis-lycopersici* IN TOMATO PLANTS BY ACTIVATING EXPRESSION OF DEFENSE-RELATED GENES

**Birsen Cakir**, Müge Sahin, Ayse GÜL, Hatice Özaktan, Lalehan Yolageldi

Ege University Faculty of Agriculture, Department of Horticulture, Bornova, 35100 304zmir, Turkey

[birsencakir@hotmail.com](mailto:birsencakir@hotmail.com)

Plant growth-promoting rhizobacteria (PGPR) are non pathogenic beneficial soil rhizobacteria that play a key role in plant growth and nutrition. They may also prevent attack from pathogenic microorganisms by eliciting induced systemic resistance (ISR). Phenotypically rhizobacteria mediated ISR resemble pathogen-induced resistance referred to as systemic acquired resistance (SAR). In the present work, the ability of *Pseudomonas putida* isolate TR21/1 to protect tomato plants from wilt disease caused by *Fusarium oxysporum* f.sp. *radicis-lycopersici* (FORL) was evaluated. Bacterial inoculation was carried out prior to sowing as a seed coating and two times after transplanting as a substrate drenching. Tomato seedlings were inoculated using the standard root-dip method with FORL. Four weeks after inoculation, total RNA was extracted from roots of tomato plants and used for RT-PCR. *P. putida* isolate TR21/1 showed significant biological control of tomato seedlings inoculated with FORL. Here, we demonstrated that the SA-response genes *PR-1*, *PR-4*, *PR-6* and *CH9* were downregulated upon induction of ISR by *P. Putida* strain TR21/1 and induced when bacterized tomato roots were inoculated with FORL. This indicates that SAR involves the accumulation of SA-responsive genes but ISR does not. Similarly, expression of ET-regulated genes such as *ACO1*, *ACO3*, *ACO4* were not induced in ISR-expressing



tomato roots and *P. putida* treatment induced only *ACO2* expression supposing that *ACO2* expression is involved in ISR-expressing tomato seedlings. In contrast, the infection of ISR-expressing plants by FORL strongly induced *ACO3*, *ACO2*, and *ACO1* indicating the transcriptional regulation of *ACO* genes in response to FORL attack which may be related to a possible ethylene synthesis in response to the pathogen. Here *P. putida* treatment increased *ETR1* gene expression in roots and this induction was upregulated in the presence of FORL, indicating that *ETR1* play a role in the protection of plants against FORL by reducing ethylene sensitivity.

**Keywords:** *Pseudomonas putida*, systemic acquired resistance (SAR), induced systemic resistance (ISR), *Fusarium oxysporum* f.sp. *radicis-lycopersici* (FORL), gene expression

## OS 3-9:

IMPACT OF TRUNK INJECTIONS AND FOLIAR SPRAYS OF SALICYLIC ACID AND ACTIGARD® ON APPLE SCAB AND FROGEYE OR BLACK ROT INFECTIONS AND CHANGES IN LEAF PROTEIN PROFILES

**Pervaiz Abbasi**, Gordon Braun, Eric Bevis, Honghui Luo, Jun Song, Sherry Fillmore, Shawkat Ali

32 Main Street, Kentville NS B4N 1J5, Canada

[pervaiz.abbasi@agr.gc.ca](mailto:pervaiz.abbasi@agr.gc.ca)

*Venturia inaequalis* [apple scab] and *Botryosphaeria obtusa* [frogeye leaf spot or black rot on fruit] are two polycyclic fungal pathogens of apples that infect both foliage and fruit, resulting in substantial economic losses to growers. In this 3-year study (2014-2016), salicylic acid and Actigard® were applied to field-established 'Honeycrisp' as either trunk injections or foliar sprays and 'Cortland' (injection only) trees at the tight cluster stage of flower bud development and at late pink bloom. Incidence of leaf infections was assessed 1, 2, and 3 weeks after the second treatment while disease incidence on fruit was assessed at harvest. For injection treatments, leaves and fruit on the branch directly above the injection site were assessed. In 2014, both salicylic acid and Actigard® treatments showed less leaf infections of apple scab and frogeye on 'Honeycrisp', but only salicylic acid reduced incidences of apple scab and black rot on 'Honeycrisp' fruit. In 2015, trunk injections of both salicylic acid and Actigard® reduced incidences of frogeye or black rot on 'Cortland' foliage and fruit. In 2016, salicylic acid and Actigard® treatments reduced incidences of apple scab and frogeye on foliage of both cultivars, but there were no significant treatment effects on scab or black rot infections on harvested fruit. Quantitative proteomic investigations employing LC-MS analysis of leaf samples from 2014 and 2015 showed that both salicylic acid and Actigard® treatments resulted in changes in several proteins involved in many metabolic and regulatory pathways. Further studies are needed to integrate salicylic acid or Actigard® treatments into an apple foliar disease management program with registered fungicides.

**Keywords:** Cortland, Honeycrisp, Disease management, Induced resistance, Proteomics, Summer apple diseases

## SESSION IV: Entomology

### OS 4-1:

DISTRIBUTION AREAS AND HOST PLANTS OF MADEIRA MEALYBUG, *Phenacoccus madeirensis* (GREEN) (HEMIPTERA: *Pseudococcidae*) FROM THE EASTERN MEDITERRANEAN REGION OF TURKEY

**Başak T. ULAŞLI**, Asime Filiz ÇALIŞKAN and Mehmet Rifat ULUSOY

Mustafa Kemal University, Agricultural Faculty, Plant Protection Department, Hatay, Turkey

[basaktok@yandex.com](mailto:basaktok@yandex.com)

In recent years, some insects have begun to be economically important pests in some countries. Scale insects (Hemiptera: Pseudococcidae) are some of them which can be easily spread over the continents because of their high adaptation ability in almost all temperate areas. Scale insects have a wide range of host plants and cause serious damages on different plantation all over the world. According to this study, 195 Madeira Mealybug, *Phenacoccus madeirensis* (Green) (Hemiptera: Pseudococcidae) samples were collected from the Eastern



Mediterranean Region of Turkey in recreation areas from September 2012 to September 2013 and in September 2015. Sixteen new plant families and forty-nine new hostplants were determined as new record for *P. madeirensis*.

Keywords: Invasive mealybug, pest spreading area, ornamental plants, new host plants

## OS 4-2:

### ASSESSMENT ON THE POTENTIAL DECREASE OF INSECTICIDE TREATMENTS AGAINST APHIDS IN 'HONEYSWEET' PLUM [*PRUNUS DOMESTICA* (L.)] PLANTINGS

I. Zagrai, L. Zagrai, M. Ravelonandro, S. Ralph, Z. Jakab, G. Guzu

Fruit Research & Development Station Bistrita, Romania

[izagrai@yahoo.com](mailto:izagrai@yahoo.com)

'HoneySweet' transgenic plum is protected against the detrimental Plum pox virus (PPV) by a RNA interference mechanism. Field trials performed in different PPV endemic European countries demonstrated that its use represents an efficient strategy for PPV containment. Regulatory authorities in the U.S. have found no safety concerns and approved 'HoneySweet' for cultivation. Fruit growers are facing safety issues related to the use of pesticides and are obliged to comply with EU requirements to reduce their use. We have raised the question as to whether some treatments against aphid vectors might be avoided in 'HoneySweet' plantings. Aiming to evaluate the requirements, a field trial including 'HoneySweet' [*Prunus domestica* (L.)] and two conventional *P. domestica* plums cultivars ('Stanley' and 'Reine Claude d'Althan') was established on 2013. Since 'HoneySweet' cannot be naturally infected with PPV by aphids the question about the use of insecticides arose. Through two years of observations, the situation appeared complex because avoiding some treatments, raises questions of direct damages done by aphid feeding and, more importantly, of controlling other important insect pests, i.e. *Laspeyresia funebrana* (Tr.). Therefore, both pests were monitored at the same time. Our results revealed that a reduced number of insecticide treatments did not lead to significant aphid damage due to their feeding on young shoots and leaves. On the other hand, the flight curve of *Laspeyresia funebrana* Tr. partly overlaps those of aphids and, consequently, treatments with insecticides are necessary to control this pest, regardless of a need to control aphids. However, the identification of periods when the flight curve of the two pests do not overlap might allow avoiding some treatments. Interestingly, we have identified a such period in September, when the aphids are resuming their flight for a short period and, hence under the conditions of our study a slight decrease in the number of treatments with insecticides could be possible.

Keywords: *Plum pox virus*, genetic engineering, resistance, insecticide treatments

## OS 4-3:

### CONTROL OF *ANTHONOMUS* SPP. WEEVILS IN IPM POME FRUIT ORCHARDS

Tim Beliën, Rik Clymans, Eva Bangels, Tom Thys, Dany Bylemans

pcfruit vzw, Fruittuinweg 1, 3800 Sint-Truiden, Belgium

[tim.belien@pcfruit.be](mailto:tim.belien@pcfruit.be)

Since the withdrawal of broad spectrum insecticides like carbamates and organophosphates and the restricted use of neonicotinoids, weevils have become an increasing problem in pome fruit in Belgium. In particular, the apple blossom weevil *Anthonomus pomorum* and the pear bud weevil *Anthonomus pyri* (syn. *A. cinctus* or *A. piri*), that used to be secondary pests, have developed into important pests for many apple and pear growers, respectively. Recently, also the pear blossom weevil *Anthonomus spilotus* was found to be present in several pear orchards in Belgium, causing considerable damage. Here we present an overview of recent monitoring data, field and laboratory trials, executed in the Belgian fruit growing area near Sint-Truiden. Laboratory trials on *A. pyri* indicated a high direct contact activity as well as a high indirect residual contact activity of the neonicotinoid insecticides thiacloprid and acetamiprid, while the anthranilic diamide insecticide cyantraniliprole reached only good control activity after exposure of the *A. pyri* weevils to spray residue on leaves. In a field trial, application of thiacloprid and cyantraniliprole targeting the active *A. pyri* weevils in autumn also resulted in





very high control efficacies, leaving opportunities for a successful combination of those insecticides with biological control by the parasitoid *Scambus pomorum*. This opens perspectives for control strategies in line with sustainable integrated pest management (IPM) principles.

Keywords: *Anthonomus* spp. weevils, insecticides, Integrated Pest Management, apple, pear

## OS 4-4:

### BIOLOGICAL CONTROL OF PEPPER PESTS IN ORGANIC AGRICULTURE

**M. Calin**, T.O. Cristea, P. M. Brezeanu, S. Ambarus, C. Brezeanu, S. P. Muscalu, F. Sova, I. Serban, M. Prisecaru, M. Costache, G. Sovarel, L. Bratu, F. Burnichi, G. Sbarciog

Vegetable Research and Development Station Bacau – Romania

[sclbac@legumebac.ro](mailto:sclbac@legumebac.ro)

During 2016 – 2017, tunnels experiments were performed at Vegetable Research and Development Station Bacau - Romania, in order to evaluate the biological control of major pests of organic peppers grown in tunnels. The main pests in the pepper crops were as it follows: onion trips - *Thrips tabaci* Lind., red spider mite - *Tetranychus urticae* Koch and corn earworm - *Helicoverpa armigera* Hbn., greenhouse whitefly – *Trialeurodes vaporariorum* Westw. The technique of reducing trips degree attack by release of *Amblyseius swirskii* At.-H. at pepper was effective in August - September using the release rates between 700,000 ex /ha - 1,000,000 ex/ ha. The predator, *Phytoseiulus persimilis* At.-H. had a very good efficiency in control of red spider mite in peppers at 50.000 and 100.000 ex./ha release rate. In control of corn earworm, the best efficacy was achieved by V1 treated with Konflic - 0.3%, efficacy 95.8%, followed by V2 Neem oil - 0.3%, efficacy 86.7% and ProBalance - 0.3% efficacy 45.2%, 3 days after treatment. In order to control the greenhouse whitefly attack, the variants with *Eretmocerus eremicus* Rose and Zolnerowich at the same release rate (6 ex. per square meter) had a better parasite rate - 75.4% in the third decade of August, compare with *Encarsia formosa* Gahan. 40.2%.

Keywords: Tunnels experiments, pests, organic peppers, whitefly, onion thrips, red spider mite, corn earworm, predators, parasites

## OS 4-5:

### PERFORMANCE OF EGG PARASITOID *Ooencyrtus pityocampae* (MERCET) (HYMENOPTERA: Encyrtidae) ON THREE SUBSTITUTE HOSTS IN LABORATORY

**E. Tabone**, H. Tunca, E.-A. Colombel, M. Venard, T. Defferier, J.-C. Martin,

INRA, Villa Thuret, 90 chemin Raymond, 06160 Antibes, France

[elisabeth.tabone@inra.fr](mailto:elisabeth.tabone@inra.fr)

*Ooencyrtus pityocampae* (Mercet) (Hymenoptera: Encyrtidae) is a solitary, thelytokous, synovigenic and polyphagous egg parasitoid which mainly attacks lepidopteran and hemipteran hosts. Releases this parasitoid may be an appropriate way of decreasing insect pest populations. For this, it is first necessary to rear the parasitoid. Because of allergy risks and problems of life cycle and behavior, *Thaumetopoea pityocampa*, natural host of *O. pityocampae*, is not easy to rear so the use of substitute host is essential. In this study, three substitute hosts were evaluated, *Philosamia ricini* (Danovan) (Lepidoptera: Saturniidae), *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae) and *Nezara viridula* (Linnaeus) (Hemiptera: Pentatomidae). Experiments were conducted at 25 ± 1°C, 65 ± 5% RH, and a photoperiod of 16:8 h (L: D). Different biological characteristics of *O. pityocampae* were determined for each substitute host. Results show that *P. ricini*, *N. viridula* and *H. halys* can be used to rear *O. pityocampae*.

Keywords: *Ooencyrtus pityocampae*, *Philosamia ricini*, *Halyomorpha halys*, *Nezara viridula*, biocontrol, rearing.



## OS 4-6:

### SEASONAL CHANGES IN ODOUR PREFERENCES OF SPOTTED WING DROSOPHILA (SWD) AND THEIR IMPLICATIONS FOR MONITORING

**Tim Beliën**, Vincent Van Kerckvoorde, Ammar Alhmedi, Rik Clymans, Eva Bangels, Dany Bylemans

pcfruit, Zoology Department, Fruittuinweg 1, B-3800 Sint-Truiden, Belgium

[tim.belien@pcfruit.be](mailto:tim.belien@pcfruit.be)

The Asiatic vinegar fly *Drosophila suzukii* (Spotted Wing *Drosophila*, SWD) has recently invaded Europe, and immediately became a key pest of grapes, stone and soft fruits. Unlike other fruit flies that typically infest only overripe and rotten fruit, SWD females oviposit in ripening fruit, leading to considerable economic damage in a broad range of soft-skinned fruits. Here we present recent outcomes from applied research revealing important insights into SWD population dynamics and seasonal changes in odour preferences. Firstly, we demonstrated that the currently widely applied monitoring programs, with traps and liquid attractant based on apple cider vinegar (ACV), provide a distorted picture of the actual SWD population dynamics profile. Use of alternative attractants clearly showed that there is an underestimation of the SWD population development during the main soft and stone fruit production periods (late spring-summer). Secondly, we attempted to unravel the seasonal shifts in preference of the SWD population between fermentation cues (like ACV) and fruit odour. Differences in seasonal odour preferences between winter and summer morphs of SWD were observed in a two-year field experiment. A lab experiment only partially confirmed these findings.

Keywords: *Drosophila suzukii*, monitoring, apple cider vinegar, fruit odour, winter morphology, choice assay

## SESSION V: Pest Management

### OS 5-1:

#### THE EFFECTS OF KAOLIN ON SOME BIOLOGICAL PROPERTIES OF PEAR SUCKER [*Cacopsylla pyri* (L.) (HEMIPTERA: Psyllidae)]

**V. Bozkurt**, A. Uğur

Plant Protection Central Research Institute, 06172, Ankara/TURKEY

[vilb2002@yahoo.com](mailto:vilb2002@yahoo.com)

*Cacopsylla pyri* (L.) (Hemiptera: Psyllidae) is the most important harmful species in pear growing areas. The most frequently method is chemical method applied to control the pear psylla which is the main pest of pear. Due to various problems arising from the chemical control of the pest it has become necessary to find solutions that may be alternative. In this study, it was aimed to find alternative method to control pear psylla and to reduce the use of insecticide by using kaolin. This study conducted in the laboratory kaolin doses and surround licensed in abroad were used to determine the effects of kaolin on some biological properties of *C. pyri*. Laboratory studies were conducted on leaf cages cultivated in a climate chamber set at  $26 \pm 1$  °C temperature,  $65 \pm 5\%$  relative humidity and 16: 8 hours (light and dark) photoperiod conditions. The characters of the experiment were kaolin 3 doses (10 g/l, 20 g/l and 30 g/l), comparison (surround 30 g/l) and control characters. The experiments were set up in 10 repeats. The number of eggs left by *C. pyri*, egg hatching duration and rate, nymphal



development duration and effect rate, nymphal survival rate and effect rate, adult life span, oviposition duration were determined with these studies. At the end of the studies it was seen that while kaolin application doses increased, the developmental duration of nymphs periods and adult survival duration were decreased comparing with the control character. Moreover, kaolin application has been cause to delay the laying of eggs and the rate of hatching of eggs. Based on the obtained data it has been concluded that the use of kaolin in control to *C. pyri* will be effective in reducing the population.

Keywords: *Cacopsylla pyri*, pear, kaolin, surround, biological development

## OS 5-2:

INVESTIGATION OF FORMULATION PREPARATION OF SOME PLANT EXTRACTS AND DETERMINATION OF THE EFFECTIVENESS ON *Tetranychus urticae* KOCH (ARACHNIDA: Tetranychidae)

P. Erdogan, P. Aksu, G. E Kilinc, M. Kahyaoglu and N. E Babaroglu

Plant Protection Central Research Institute, Ankara, Turkey

[pervin.erdogan@tarim.gov.tr](mailto:pervin.erdogan@tarim.gov.tr)

In this study plant extracts of *Xanthium strumarium* L., *Tanacetum parthenium* L. and *Achillea wilhelmsii* C. (Asteraceae) were prepared. Then formulation studies of these extracts were carried out with several inert ingredients. Obtained preparations were subjected to quality control tests in the laboratory. As a result of these tests, preparations which were found successfully were separated/chosen for effectiveness studies on *Tetranychus urticae* Koch. Then the acaricidal effect of the formulations/preparates were carried out on *T. urticae* by using method of bioassay under laboratory conditions. Effect of prepared formulations at three different concentrations (5, 7, 10 ml/L) were determined on *T. urticae* again by using leaf dipping *T. urticae* was reared in insectary using green beans. For dipping bioassay experiments fresh green bean leaves of 3cm diameter were used. According to the results of laboratory studies, the highest dose found to be effective and theirs two upper doses (10, 15, 20 ml/L) were taken to examine effect on mites at the greenhouse conditions. The trial was established as randomized block design and 5 times in greenhouse. Each plot consists of 10 plants. When the density of mite population 1-3 live individual/leaf, the plants were sprayed. Counts were carried out before application of formulations and after application 1, 3 and 7 days. Neem Azal T/S was applied as standard in greenhouse trials. As a result, laboratory experiments, all preparations/formulations showed the highest effect at 10ml/L concentrations. In this concentration the highest effect was formulation of *T. parthenium* (89.62%). Also in the greenhouse results, it was determined that the formulations of *X. Strumarium* and *T. parthenium* caused phytotoxicity at concentration 20 ml/L. It was revealed that the formulations of *A wilhelmsii* had effect on 83.44% at this concentration. The effects were *X. Strumarium*, *T. parthenium*, *A wilhelmsii* 80.42, 80.42 and 83.44% respectively at concentration 15 ml/L. Neem Azal T/S showed the highest effect (94.38%).

Key words: Plant extract, formulations, acaricidal activity, two spotted spider mite

## OS 5-3:

INSECTICIDAL EFFECT OF GAMMA-T-OL FROM *Melaleuca alternifolia* (MAIDEN & BETCHE) CHEEL AND FEVERFEW (*Tanacetum parthenium* L.) (ASTERACEAE) ON *Cydia pomonella* (L.) (LEPIDOPTERA: Tortricidae)

A.Ozdem, P. Erdogan, E.Hassan, S. Erturk

Plant Protection Central Research Institute, Ankara, Turkey

[ayse.ozdem@tarim.gov.tr](mailto:ayse.ozdem@tarim.gov.tr)

This research was undertaken as an alternative management strategy for codling moth, which present control is to use synthetic insecticides. Codling moth causes serious economic damage on apples, pears, quinces and walnut orchards in Turkey. Botanical insecticides were used extracted from *Melaleuca alternifolia* (Maiden & Betche ) Cheel (Myrtaceae) and *Tanacetum parthenium* L. (Asteraceae). In these experiments only first instar



larvae with same age was used. First instar larvae were dipped into the prepared four different dose of solutions of Gamma-T-ol, Fungatol and four different dose solutions for the *T. parthenium* for and after air dried, five larvae were placed in the each petri dish containing artificial diet. Deltamethrin 2.5 EC was used as positive control and as a negative control untreated control was used. The experiment was replicated six times. All three plant extract experiments none of the treated larvae were reached to pupal stage. The data was collected daily. According to results, Gamma-T-ol had the highest mortality and effect the highest cocenration 93,34% and 93,33% respectively. Also, Fungatol the highest mortality occurred at a concentration of 0,3% and the lowest at 0,05%. For *T. parthenium* the highest mortality taken place at a concentration of 1% and the lowest at 12%. All larvae died during the first day when they treated with Deltamethrin. Larvae in untreated control 93.33% were reached to pupal stage which they hatched to normal adults. From these results it can be concluded that Gamma - T-ol with 93,34%, mortality showed near results compared with synthetic insecticide Deltamethrin. Therefore Gamma-T-ol may be used as an alternative to synthetic pesticides which is compatible with biological control and with integrated pest management systems.

Keywords: *Cydia pomonella*, plant extract, insecticidal effect

## OS 5-4:

BIOCONTROL EFFICACY OF NEMATODE TRAPPING FUNGI *ARTHROBOTRYS OLIGOSPORA* AND *A. DACTYLOIDES* AGAINST ROOT-KNOT NEMATODE IN GINGER

P.U.S. Peiris, C. Y. Xu, K. M. Groves, P. H. Brown, Y.J. Li

School of Health, Medical and Applied Sciences, Central Queensland University, Bundaberg, Queensland 4670, Australia

[u.peiris@cqu.edu.au](mailto:u.peiris@cqu.edu.au)

Fungal biocontrol is a rapidly developing research area, and there is an emergent interest in the exploration of fungi for controlling root-knot nematodes. Root-knot nematode remains one of the most serious soil-borne pathogens affecting ginger cultivations, causing considerable yield damage. Although most growers rely on chemical controls to manage root-knot nematodes, regulatory authorities no longer advise chemical usage. Hence, many researchers have examined eco-friendly control measures. In this study, two nematode-trapping fungi, *Arthrobotrys dactyloides* and *A. oligospora* encapsulated in kaolin-alginate granules were separately assessed for their efficacy in controlling root-knot nematode damage in ginger. Four weeks after planting, both fungi and chemical treatments had significantly less root-knot nematodes than control irrespective of soil sterilization. This indicated the biological control potential of these two fungi against root-knot nematodes in early growth period of ginger. At harvest, the root-knot nematode numbers recovered from both fungi treatments were lower than control but higher than chemical, although the difference was not statistically significant. In addition, the relative fungal efficiency of root-knot nematode control was not significantly different between the heated and unheated soils. This suggested that the biological factor present in the grey sandy loam soil had no distinct influence on the root-knot nematode control efficacy of these two fungi. Compared to control, application of both fungi in both soils reduced root galling and damage lesions similar to the chemical treatment. The rhizome yield, number of shoots, above ground biomass, plant height, number of leaflets and weight of feeder roots were not significantly different between nematode treatments.

Keywords: Root-knot nematodes, biocontrol, nematode-trapping fungi, kaolin-alginate granules, ginger cultivation

## SESSION VI: Plant-Pathogen Interaction

### OS 6-1:

HOST-STATUS AND HOST-SENSITIVITY OF POTATO CULTIVARS 'BP1' AND 'BUFFELSPOORT' TO *Meloidogyne javanica* AND *Meloidogyne incognita* RACE 2 UNDER GREENHOUSE AND MICRO PLOT CONDITIONS

Retha Slabbert, Kenneth Mulandana, Martha Pofu

Department of Horticulture, faculty of Science. Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa





[slabbertmm@tut.ac.za](mailto:slabbertmm@tut.ac.za)

The withdrawal of highly effective synthetic chemical nematicides has left a void in management of plant parasitic nematodes in particular the root-knot nematodes. The objective of this study was to determine the host-status and host-sensitivity of potato cvs. 'BP1' and 'Buffelspoort' against *Meloidogyne javanica* and *M. incognita* race 2 under greenhouse conditions, with cultivar 'BP1' further tested under micro-plot conditions. Two separate studies were conducted under greenhouse conditions arranged in a randomised split-plot design with main plots being the cultivars and subplots being seven levels of nematodes, replicated six times and micro plot with seven treatments arranged in RCBD replicated eight times. Greenhouse studies: Cultivars were inoculated with seven different nematode levels of *M. javanica* and *M. incognita* race 2. The reproductive factor values (Rf) of greater than one were observed on both potato cultivars under the two *Meloidogyne* species. The final population (Pf) of *M. javanica* on cvs. 'BP1' and 'Buffelspoort' was highly significant contributing 77% and 95% to the total treatment variation (TTV), respectively. The Rf contributed 9% to the TTV. *Meloidogyne incognita* race 2 significantly contributed 34% and 71% to the TTV in Rf and Pf respectively in cv. 'Buffelspoort', whereas 38% contribution was recorded on cv. 'BP1'. Under micro-plot conditions, the Rf for 'BP1' was highly significant contributing 63% to the TTV. Measured plant variables were not reduced under greenhouse conditions, however plant height was significantly reduced by *M. javanica* under micro plot conditions for cv. 'BP1'. In conclusion, the two potato cultivars were tolerant under greenhouse conditions and 'BP1' was susceptible to both tested *Meloidogyne* species under micro plot conditions.

Keywords: Host status, *Meloidogyne*, root knot, potato,

## OS 6-2:

DRY SEASON CLIMATIC CHANGE ADAPTATION STRATEGY IN TROPICS' CROPPING SYSTEMS: A CASE STUDY FROM IRRIGATED WATERMELON (*Citrullus lanatus*) AS LIVE MULCH

**Ojo David**, Aiyelaagbe Isaac

National Horticultural Research Institute (NIHORT), PMB 5432, Idi-Ishin, Ibadan, Nigeria.

[davidojo@hotmail.com](mailto:davidojo@hotmail.com)

Crops like watermelon (*Citrullus lanatus*) could reduce soil temperature and improve soil moisture, resulting in reduced irrigation and additional income from produce harvested in mixed cropping systems in the no rain dry off-season of sub Saharan Africa rainfall agriculture. This study therefore seek to quantify the impact of watermelon live mulch densities on the irrigation water requirement, climatic change adaptation capability and yield potential in off season of amaranth production system. Treatments comprised three sowing densities of watermelon: 1.5 x 0.45m; 1.5 x 0.90m; 1.5 x 1.50m. Grain amaranth as an intercrop was transplanted at 0.75 x 0.75 m spacing. There was a control plot with only grain amaranth, forming twelve treatments in each of four replications in an RCB design. Averaged over two consecutive cropping, irrigation water requirement was optimally ( $P=0.05$ ) reduced compared to the control plot, while amaranth grain and watermelon fruit yields were highest at 1.5 x 0.90 m watermelon plant spacing. Maximum soil temperature was reduced by melon mulch relative to the control. Soil moisture content was significantly ( $P=0.05$ ) greater in the live mulch treatments compared to the control. Our research demonstrated that live mulch lower soil temperature amplitude that account for reduced irrigation water requirement in the dry season; and we believe offer opportunities in adaptation of agricultural production systems under climate change scenarios.

Key words: dry season, climate change, tropics, temperature, moisture, watermelon

## OS 6-3:

SELECTION AND COMBINATION OF WAVELENGTHS: A KEY FOR SUCCESS OF OPTICAL BASED MANAGEMENT OF POWDERY MILDEWS

**Suthaparan Aruppillai**, Ranjana Pathak, Knut Asbjørn Solhaug, Hans Ragnar Gislerd



Department of Plant Sciences, NMBU, Aas, Norway

[aruppillai.suthaparan@nmbu.no](mailto:aruppillai.suthaparan@nmbu.no)

It is known that certain wavelength ranges of optical radiation [ultraviolet (UV) below 310 nm and red light above 730 nm] may inhibit development of powdery mildews in wide range of crops, if applied properly. Growth chamber experiments were conducted to examine the efficacy of different doses and wavelengths of UV below 315 nm with subsequent exposure to radiation in the 310 nm to 730 nm wavelength range on inhibition of conidia germination of *Oidium neolycopersici* (tomato powdery mildew). Conidia were dusted onto water agar in Petri dishes followed by brief exposure to UV peaking at 254, 283, or broadband UV at four different doses: 8  $\mu\text{mol}/\text{m}^2/\text{s}$  applied for 30 sec, 1 min, 2 min, or 4 min. Immediately after UV treatments, samples were exposed to seven different radiation sources with peaks between 310 and 730 nm at 50  $\mu\text{mol}/\text{m}^2/\text{s}$  for 16 h. Twenty-four hours after UV treatment, samples were assessed for conidia germination efficiency with light microscope. Results showed significant interaction among UV (dose and wavelength) and subsequent incubation wavelength. Relative to non-treated control, conidia germination efficiency was lowest with 254/283 nm UV with subsequent dark incubation (< 10%). Similarly, lower germination efficiency were obtained when 254/283 nm UV treated samples were subsequently exposed to wavelength above 500 nm (< 35% dependent on UV dose). On the other hand, conidia germination efficiency increased when the 254/283 nm UV treated samples were incubated immediately with wavelength below 500 nm (nearly 100% with lowest UV dose). These studies also included effects of the above treatments on plants with detailed studies on the damaging mechanisms to powdery mildew. A combination of optimal wavelength ranges and doses with correct timing will improve the efficacy of UV treatments against powdery mildews.

Keywords: Optical radiation; Powdery mildew

## OS 6-4:

### CHALLENGES FACING THE DETECTION OF SYSTEMIC PATHOGENS IN CERTIFICATION PROGRAMS

**Masoud Naderpour**

Seed and Plant Certification and Registration Institute (SPCRI), Agricultural Research, Education and Organization (AREEO), Karaj, Iran.

[m.naderpour@areeo.ac.ir](mailto:m.naderpour@areeo.ac.ir)

Viruses, phytoplasmas and a few species from bacteria and fungi transmit systemically within plant tissues. As no effective control measures have been developed for systemic pathogens, using certified and pathogen-free planting materials is suggested as the most effective way to prevent their introduction into orchards. However, certification of planting materials demands sensitive and reliable methods for pathogen detection. Several detection methods on the basis of proteins (e.g. Enzyme-linked immunosorbent assay, ELISA, dot blot immunoassay, DIBA, Sodium dodecyl sulfate polyacrylamide gel electrophoresis, SDS-PAGE), nucleic acids (e.g. polymerase chain reaction (PCR) and its derivatives like reverse transcription-PCR, RT-PCR, SDS-PAGE) and indexing of pathogens on indicator plants (biological indexing) have been developed for pathogen detection in pure and applied sciences. Even though any of those methods has its own advantageous, applying some of them (e.g. biological indexing) are limited in certification programs due to labor, cost and time consuming except for nuclear stocks. Some others like ELISA and DIBA are not enough sensitive and demand specific antibodies for each virus. Specific antibodies for some viruses are not commercially available and for some pathogens like viroids ELISA and DIBA are not applicable. Assays like SDS-PAGE is not applicable for reliable detection of pathogens specifically viruses and viroids in young plants and saplings due to low concentration of these pathogens. In spite of higher sensitivity and reliability of PCR-based detection methods, several challenges including purity of RNA and DNA templates, false positive and false negative results, presence of inhibitors and most importantly the necessity for designing isolate-specific primers face these methods. The present article will focus on details of the advantageous and disadvantageous of all three methods in detection of viruses and phytoplasmas resulted from ten years of experience in working on certification of different group of planting materials.

Keywords: Pathogen detection, nucleic acid, protein, biological indexing, planting materials



## OS 6-5:

IDENTIFICATION A OF NOVEL PEPTIDE FAMILY THAT REGULATES DEFENSE RESPONSE AND ROOT DEVELOPMENT IN *Arabidopsis thaliana*.

**Jean-Pierre Renou**, Kay Gully, Sandra Pelletier, Marie-Charlotte Guillou, Marina Ferrand, Sophie Aligon, Emilie Vergne, Mathilde Fagard, Philippe Grappin, Etienne Bucher, Sébastien Aubourg

IRHS (Institut de Recherche en Horticulture et Semences), UMR 1345, INRA, Agrocampus-Ouest, Université d'Angers, SFR 4207 QuaSaV, Beaucauzé F-49071, France.

[jean-pierre.renou@inra.fr](mailto:jean-pierre.renou@inra.fr)

Small secreted peptides are important actors in plant development and stress response. Even though numerous genes have the potential to produce such peptides, the vast majority of them have not yet been characterized for their biological functions. In this study, using a targeted *in silico* approach, we identified a family of 14 *Arabidopsis* genes encoding precursors of serine rich endogenous peptides (PROSCOOP). Transcriptomic analyses revealed that one member of this gene family is involved in processes linked to biotic and oxidative stress as well as root growth. Plants defective in this gene were less susceptible to *Erwinia amylovora* infections and showed an enhanced root growth phenotype. We identified a conserved motif present in *Brassicaceae* homologs indicating that the protein could be the precursor of a small secreted peptide. Exogenous application of this synthetic peptide induced various defense responses in *Arabidopsis*. Our findings show that it has numerous properties of damage/danger-associated molecular pattern (DAMP). In conclusion, we uncover a gene family with all structural features of post-translationally modified peptides that modulate defense responses and root development. That could provide new targets for breeding strategies for crops adaptation to challenging environments.

Keywords: Secreted peptides, *Erwinia amylovora*, *Arabidopsis*, plant defense, root growth

## OS 6-6:

SOLID SET CANOPY DELIVERY SYSTEM FOR EFFICIENT AGROCHEMICAL DELIVERY IN MODERN ARCHITECTURE APPLE AND GRAPEVINE CANOPIES

**Lav R. Khot**, Rajeev Sinhaa, Rakesh Ranjana, Guobin Shia, Gwen A Hoheisela, Matthew Grieshopb,

Center for Precision and Automated Agricultural Systems, Department of Biological Systems Engineering, Washington State University, Prosser, WA-99350

[lav.khot@wsu.edu](mailto:lav.khot@wsu.edu)

A solid set canopy delivery system (SSCDS) has potential to reduce off-target deposition and human exposure to pesticides used in tree fruit production. Importantly, growers can apply chemicals timely, even when ground conditions are not favorable to spray. In this study, different SSCDS configurations, with different emitter types, were evaluated for spray deposition (using plastic cards) and coverage (using water sensitive papers [WSPs]) at different locations in the apple and grapevine canopies at mid canopy growth stages in 2017 season. Deposition samples were analyzed using fluorometry and image processing was used to analyze WSPs. In apple canopies, configuration CA3 with hollow cone emitters, installed in a 3-tier arrangement, provided optimal spray deposition and coverage on both upperside and underside of the leaves at different canopy zones. However, CA3 offered the most complex design. Configurations CA2 and CA4 were simple designs but may only be useful to spray systemic chemicals, as minimal to no coverage was reported for underside of leaves. In grapevines, configuration CG6 with two hollow cone emitters per vine installed near the drip line had highest deposition in the bottom (or fruiting) zone compared to other configurations. Moreover, CG4 and CG5 configurations, with emitters installed in a way to spray both top and bottom zones might be ideal for spraying in vineyards. SSCDS



automation concept was also successfully implemented using low-cost microcontroller, relay switches and wireless trans-receivers integrated with single board computer and control interface that has on-site and wireless remote actuation capabilities.

Keywords: Alternate sprayers; SSCDS; Spray deposition and coverage; Agricultural automation

## OS 6-7:

### STUDIES ON BIOLOGY, EPIDEMIOLOGY AND CONTROL OF *Pseudocercospora pistacina* ON PISTACHIO

**Kamil Sarpkaya**, Ali Erkilic

Antepfistigi Arastirma Enstitusu Mudurlugu , Sahinbey, Gaziantep, Turkey

[kamilsarpkaya@gmail.com](mailto:kamilsarpkaya@gmail.com)

Leaf spot disease, known as “Karazenk”, is one of the most significant diseases that affect Pistachio yield in Turkey. The causal agent was originally misnamed taxonomically but has since been renamed as *Pseudocercospora pistacina* Crous, Quadv. & Sarpkaya. Survey studies conducted in 2009, 2010 and 2011 in Turkey revealed 47.5%, 42.5 %, 55.2% of disease prevalence, respectively. The disease was seen less in Gaziantep, Şanlıurfa and Siirt, which are common producer provinces in Turkey, than the other regions. Studies to determine the reactions of Pistachio varieties to Karazenk disease showed that Kırmızı and Uzun varieties as females and Kaşka as male were more sensitive than other varieties, with ratios of 80.5%, 78.9%, 73.7%, respectively. In vitro studies to define infection conditions for the pathogen showed leaf wetness for at least 12 h was required for initial infection, and temperatures of 24°C and 30°C were favored for disease progression. Some registered fungicides were also experimented in vitro and in vivo in this study. It was found that copper oxychlorur and dodine, known as preservative fungicides, were ineffective if they were sprayed after the infection. However, propiconazole + difenoconazole, which has systemic effect, was effective in controlling the disease even if it was used after first symptom were seen on the leaves.

Keywords: *Pseudocercospora pistacina*, Karazenk, Pistachio, Chemical Control, Epidemiology

## OS 6-8:

### IDENTIFICATION AND CHARACTERIZATION OF COLLETOTRICHUM SPECIES ASSOCIATED WITH MANGO ANTHRACNOSE IN CHINA

**Qili Li**, Junyan Bu, Jianyou Mo, Tangxun Guo, Suiping Huang, Tom Hsiang, Lihua Tang

174 Daxue Road East, Nanning, China, Nanning, 530007, China

[liqili@gxaas.net](mailto:liqili@gxaas.net)

Mango (*Mangifera indica*) is an economically important fruit crop in southern areas of China including Guangxi, Hainan, Yunnan, Taiwan, Sichuan, Guizhou, Guangdong and Fujian provinces. The purpose of this study was to identify *Colletotrichum* species associated with mango (*Mangifera indica*) in different provinces of China (not including Guangxi) and examine their pathogenicity on leaves and fruits of mango in vitro. Diseased leaves and fruits were collected from mango orchards in different areas of China. A total of 195 isolates were obtained from mango leaves or fruits with anthracnose symptoms, and these were further identified based on morphological and molecular characteristics. One hundred and thirty two isolates from different areas were selected for sequencing and analyses of the rDNA-internal transcribed spacer (ITS) region, glyceraldehyde-3-phosphate dehydrogenase (GAPDH), partial actin (ACT),  $\beta$ -tubulin (TUB2), chitin synthase (CHSI), mating type gene (MAT1-2-1) and APMAT genomic regions. The most common fungal isolates were these 14 species: *Colletotrichum asianum*, *C. siamense*, *C. fruticola*, *C. karstii*, *C. endophytica*, *C. cliviae*, *C. brevisporum*, *C. nymphaeae*, *C. musae*, *C. kahawae*, *C. gloeosporioides*, *C. aotearoa*, *C. tropicale*, *C. gigasporum*. *Colletotrichum asianum* was the most common and widely distributed in China (33.3%), followed by *C. siamense* (30.3%) and *C. fruticola* (22.7%). Pathogenicity assays showed that all the isolates were





pathogenic to mango leaves and fruit (cv. Tainong). There was no relationship between the source of isolates and their virulence. This is the first description of *C. karstii*, *C. endophytica*, *C. cliviae*, *C. brevisporum*, *C. nymphaeae*, *C. musae*, *C. kahawae*, *C. gloeosporioides*, *C. aotearoa*, *C. tropicale*, *C. gigasporum* as causal agents of mango anthracnose in China.

Keywords: Mango Anthracnose; Colletotrichum; Phylogeny; Pathogenicity

## OS 6-9:

SURROUND WP® AN ALTERNATIVE TO IMPROVE PRODUCTIVITY AND REDUCE DISEASE INCIDENCE IN COFFEE CROP. A COMPILATION.

R.A. Ortiz, A.F. Bermúdez

Bioestimulantes Agropecuarios Internacionales S. A. (BIOAGRO), Heredia, Costa Rica

[ruben.ortiz@agrosoil.com](mailto:ruben.ortiz@agrosoil.com)

A research compilation of trials was made to evaluate the effect of heat stress - crop protectant Surround WP® (calcined kaolin, Novasource, USA) to improve productivity and reduce disease incidence in coffee crop (*Coffea arabica*). Trials were made during four production cycles (PC) in four different coffee production locations (San Isidro, Carrizal, Los Ángeles de Grecia y San Isidro de Grecia, Alajuela) located between 1.100 and 1.400 m.a.s.l. in Costa Rica. Coffee variety was Catuaí Rojo, under a full sun exposure production system (without shade), except Carrizal location where varieties Catimor CR-95 and Catuaí Rojo were used under a total shade production system using pine (*Pinus caribaea*) and eucalyptus (*Eucalyptus* sp.) shade trees. Treatments were the following: T1) Surround WP® application at 5% concentration of commercial product and T2) Control without Surround WP® application. Experimental design was a randomized block design using farm locations as blocks and two treatments with and without Surround WP® with replicated variable measures in time (consecutive year's harvests). Yield in fanegas/ha and grain weight/ha was measured from harvested coffee grain (kgs) and disease incidence from leaf counting and presence of the following main coffee diseases: *Hemileia vastatrix*, *Cercospora coffeicola*, *Colletotrichum coffeanum*, and *Mycena citricolor*. Kaolin applications as Surround WP® showed higher yields in fanegas/ha ( $P < 0,0271$ ) and grain weight/ha ( $P < 0,0423$ ) as compared to the control treatment in all locations. Incidence of all assessed diseases was lower ( $P < 0,002$ ) in Surround WP® treated areas as compared to the control. Surround WP® is a very valuable tool and alternative to reduce heat stress and disease incidence increasing productivity in coffee crop.

Keywords: Surround WP; calcined kaolin; *Coffea arabica*; yield; incidence; diseases.

## OS 6-10:

EGG HATCH INHIBITION OF ROOT-KNOT NEMATODES BY *Tagetes patula* EXTRACTS

O. Aiyelaagbe, O. Olaide, A. Claudius-Cole and I. Aiyelaagbe

Department of Chemistry, University of Ibadan, Ibadan 200284, Nigeria

[ola\\_olu57@yahoo.com](mailto:ola_olu57@yahoo.com)

*Tagetes patula* (Asteraceae) is a plant cultivated for its ornamental property and biological activities. The objectives of this research were to identify the phytochemicals in *T. patula* grown in Nigeria and test the extracts against root-knot nematodes. Phytochemicals in the leaves stems and roots of *Tagetes patula* cv. Petit were extracted with different organic solvents and subjected to Thin Layer Chromatography and chemical analyses using standard procedures. In – vitro nematocidal assay (*Meloidogyne incognita* egg hatch inhibition) of the methanol extracts was carried out using 20%, 40%, 60% and 80% v/v concentrations in transparent glass blocks. Distilled water was used as control. The treatments were applied following a completely randomised design replicated thrice on laboratory bench. Hatched juveniles were counted daily for eight days under a microscope. Percentage hatching was calculated and the data analysed using analysis of variance (ANOVA). The extracts from *T. patula* contained secondary metabolites including alkaloids, terpenoids, steroids, glycosides, tannins and saponins which showed inhibitory activity towards egg hatch of *M. incognita*. Egg hatch inhibition increased with concentration and contact time of the extracts. The root methanol extract of *T. patula* showed a consistent



egg hatch inhibition at all concentrations suggesting a higher concentration of the active phytochemicals in the roots. Methanol extracts of *Tagetes patula* leaves, stem and roots can be used to produce potent and environmentally-friendly organic nematicides.

Keywords: French marigold, biocidal activity, *Meloidogyne incognita*,

## POSTER PRESENTATIONS

### P1:

#### CHARACTERISATION OF *Trichoderma* ISOLATES AS AGENTS FOR ENGINEERING DISEASE SUPPRESSIVE COMPOSTED GROWING MEDIA

Conor McGee, Owen Doyle, , Michael Gaffney  
University College Dublin, Belfield, Dublin 4, Ireland

[owen.doyle@ucd.ie](mailto:owen.doyle@ucd.ie)

Six isolates of *Trichoderma* were assessed for suitable attributes for potential inoculation into composted material to develop disease suppressive growing media. Each isolate had previously been shown to possess *in vitro* suppressive properties against root-rot diseases via the production of inhibitory secondary metabolites. In the present study, isolates were further investigated for *in vitro* mycoparasitic properties and *in vivo* suppression of the pathogens *Pythium ultimum* and *Fusarium oxysporum*. Mycelial growth of each isolate was also tested *in vitro* on potato dextrose agar (PDA) against ranges of abiotic properties found in composted materials, such as electrical conductivity(EC), pH and temperature. Four of the six isolates displayed no reduced growth on PDA medium with EC values of 9.45 mS cm<sup>-1</sup>, with two isolates showing slightly reduced growth. pH was found to have a much more influential effect on mycelia growth, with only two of six isolates displaying uninterrupted *in vitro* growth across a range of pH6 to pH10. The *Trichoderma* isolate CS30-01 was found to be the sole isolate with identifiable mycoparasitic properties *in vitro*. Isolate CS30-01 also displayed no reduced growth at the EC and pH ranges tested. Temperature tests found isolate CS30-01 to possess the highest tolerance at 37°C, while also displaying good growth across a temperature range of 15-35°C. Inoculation of a peat based growing medium with a suspension of CS30-01 spores had no negative effects on plant germination or growth, and indicated co-incubation of CS30-01 and *P. ultimum* significantly reduced disease severity ( $P=0.005$ ) on *Brassica rapa* seedlings. Evidence of suppression of *F. oxysporum* disease severity on *Allium cepa* was observed, but not found to be statistically significant. The results from this study indicate that the isolate CS30-01, identified as a strain of *T. harzianum*, possesses suitable biocontrol and growth properties for developing disease suppressive growing media.

**Keywords:** Biocontrol, Compost, Disease suppression, *Fusarium*, *Pythiaceae*, *Trichoderma*

### P2:

#### IDENTIFICATION AND CHARACTERIZATION OF *Colletotrichum* SPECIES ASSOCIATED WITH MANGO ANTHRACNOSE IN GUANGXI, CHINA

Jianyou Mo, Guang Zhao, Qili Li, Lihua Tang, Suiping Huang and Tangxun Guo, Tom Hsiang  
Institute of Plant Protection, Guangxi Academy of Agricultural Sciences, Nanning, Guangxi, 530007, China,

[mojianyou@gxaas.net](mailto:mojianyou@gxaas.net)

Mango (*Mangifera indica*) is widely grown across southern China especially in the provinces of Guangxi, Hainan, Yunnan, Sichuan, and Taiwan. Guangxi itself has over 86,667 ha of mango production. The purpose of this study was to identify *Colletotrichum* species associated with mango in different parts of Guangxi and examine their pathogenicity on leaves and fruits of mango *in vitro*. Diseased leaves were collected from 25 mango orchards in different areas of Guangxi province. Sixty-five isolates were obtained from mango leaves with anthracnose symptoms, and these were further characterized based on morphology and DNA sequencing. Twenty-nine isolates from different areas were selected for sequencing and analyses of the internal transcribed spacer (ITS) region, glyceraldehyde-3-phosphate dehydrogenase (GAPDH), partial actin (ACT),  $\beta$ -tubulin (TUB2), and chitin synthase (CHS I) genomic regions. The most common fungal isolates were these three



species: *Colletotrichum asianum*, *C. fructicola* and *C. siamense*. *Colletotrichum asianum* was the most common and widely distributed in Guangxi (51.7%), followed by *C. fructicola* (37.9%) and *C. siamense* (10.2%) both found in Tiandong, Tianyang and Wuming counties. There was no evidence of geographical specialization of the different species. Pathogenicity assays showed that all isolates were pathogenic to mango leaves and fruit (cv. Tainong). No relationship was found between origin of isolates and their virulence. This is the first description of *C. asianum*, *C. fructicola* and *C. siamense* as causal agents of mango anthracnose from Guangxi province, China.

## P3:

### PESTS OF CRIMEAN PEAR GARDENS

**S. Tsiupka**, E. Balykina, L. Yagodinskaya, D. Korzh, T. Rybareva  
Nikita botanical Gardens – National Scientific Center, Yalta, Russian Federation

[tsupkanbg@mail.ru](mailto:tsupkanbg@mail.ru)

In the Republic of Crimea *Pyrus communis* L., is the second after the apple tree on the economic value of the fruit crop. However, starting from 2014, yields declined, which is due to the negative impact on the pear of the phytophagous families Psyllodea and Acari. The pest complex of pome fruits, consisting of more than 100 species, was described from 1940 to 1980 by Lazarev A.M., Mitrofanov V.I., Vasilyev V.P. and Livshits I.Z. Since the 80s of the last century, a number of significant changes have taken place in the species and quantity composition of phyto and entomoacariphages. The reason for this was the use of highly toxic insecticides, from the group of phosphorus and organochlorine compounds, as well as the widespread introduction of new planting schemes for gardens, from trefoil-dwarf ones with a flattened crown to meadow on super-dwarfish rootstocks. Thus, due to the almost total absence of interspecific competition, the pest of the Crimean pear agroecosis since 1980 is the pear-shaped gall mite *Eriophyes pyri* Pgst. and the hawthorn mite (*Amphitetranychus viennensis* Zacher.) Along with the most harmful phytophage - the pear leaf flea (*Psylla pyri* L.). In studies it was established that in 2013 and 2016 *Psylla pyri* L. developed in V, in 2014 and 2015 - VI generations, with the population density exceeding the economic threshold of damage 5-6 times annually. *Amphitetranychus viennensis* Zacher massively occurs in industrial pear plantations from 2012, develops throughout the growing season in 7-9 generations. The pear-shaped gall mite *Eriophyes pyri* Pgst. develops in three generations, damaging the leaves, buds, fruits, forming on the damaged parts of the plant round plaque-shaped galls. The degree of damage in certain years reaches 70% of the leaves. Young plantations of this culture suffer more severely.

## P4:

### FIRST REPORT ON SOFT ROT OF *Cucurbita pepo* CAUSED BY *Pseudomonas syringae* pv. *syringae*

**Reinette Gouws-Meyer**, Teresa Goszczynska, Jeancy Mpenge, Vallry Moloto  
Building 5-428 TUT Pretoria West, Pretoria, South Africa

[gouwsr2@tut.ac.za](mailto:gouwsr2@tut.ac.za)

During the 2017/18 *Cucurbita pepo* growing season, a new and damaging disease was observed in several commercial plantings in the Northern Cape Province of South Africa. Fruits were covered by dark, brown to black, oval, 3-6 cm in diameter, soft and water soaked lesions. From all diseased fruits, almost pure cultures of fluorescent bacteria were isolated on KBC and Milk-Tween media. Several colonies were purified for identification. They were all found to be gram-negative rods, fluorescent on King's B medium, oxidase and levan positive. All isolates utilised sucrose, sorbitol, erythritol, mannitol and inositol as a sole carbon sources. Three bacterial isolates were used in pathogenicity tests performed on detached *C. pepo* fruits. Fruits inoculated with a suspension of bacterial isolates produced symptoms observed in the field within one week of incubation at 25°C in a humid chamber. The results of the pathogenicity tests confirmed Koch's postulates and showed that the disease is caused by bacteria isolated from symptomatic fruits. A nBLAST search of the EMBL/NCBI GenBank database conducted with *gyrB* and *cts* sequences revealed 89-90% similarity with previously determined sequences of *Pseudomonas syringae* pv. *syringae*. This is the first report of soft rot caused by *P. syringae* pv. *syringae*. *C. pepo* is amongst the most important crops grown in South Africa by both commercial



and emerging farmers. On some farms up to 90% of fruits were spoiled, making them unfit for marketing and causing great financial losses. Further studies are needed to determine the spread and alternative hosts of the pathogen.

**Keywords:** First report; *Cucurbita pepo*; Soft rot; *Pseudomonas syringae* pv. *syringae*

## P5:

### *Bemisia tabaci* POPULATION DENSITY DEPENDENT ON TOMATO ROOTSTOCK

G. Dumičić, M. Mandušić, S. Goreta Ban, K. Žanić

Institute for Adriatic Crops, Split, Croatia; <sup>2</sup>Institute of Agriculture and Tourism, Poreč, Croatia

[gdumicic@krs.hr](mailto:gdumicic@krs.hr)

The tobacco whitefly *Bemisia tabaci* is among the most damaging pests in greenhouse production of tomatoes. Insecticide resistance management of *B. tabaci* requires continuous improvement of nonchemical methods for pest control. The goal of this study was to test the effects of scion and rootstock cultivars on the population densities of *B. tabaci* adult and large nymphs (4<sup>th</sup> instar to pupae), in a hydroponically grown tomato crop. The experiment was conducted using tomato cultivars (cv.) Clarabella and Estatio during the spring-summer season. The tomato plants were nongrafted, self-grafted or grafted onto the rootstocks of cv. Arnold, Buffon, Emperador, and Maxifort. A two-factorial experimental design was applied. Initially, 3 days after infestation (DAI), the scion cv. Estatio was more attractive to adults of *B. tabaci*, while 6 DAI, this difference was no longer apparent. For both assessments, the number of pest adult individuals was lower when scions were grafted onto tested rootstocks. Thus, plants of nongrafted or self-grafted cv. Clarabella and Estatio were more infested than the plants grafted onto the rootstocks. The density of large nymphs was higher on cv. Estatio than on cv. Clarabella at 54 DAI, while such a difference was not observed at 35 and 77 DAI. In terms of the rootstock effect, tomato grafting onto commercial rootstocks reduced nymphal populations in all three assessment periods. The differences among the rootstocks for nymphal population density were not confirmed. The results indicated that grafting tomato plants could be included in an integrated management strategy for *B. tabaci*.

**Keywords:** cultivar, grafting, IPM, *Solanum lycopersicum*, tobacco whitefly

## P6:

### PHYTOPLASMAS AND THEIR POTENTIAL VECTORS IN SWEET AND SOUR CHERRIES GROWING IN DIFFERENT PROVINCES OF TURKEY

Mona Gazel, Kadriye Caglayan, Kamuran KAYA, Huseyin Baspinar, Bahar Tunç, Hamide Deniz Kocabag, Seral Yücel

Selcuk University, SilifkeTasucu Vocational School Mersin, Turkey

[seralyucel@hotmail.com](mailto:seralyucel@hotmail.com)

During 2014-2017 extensive surveys were carried out in different provinces of Turkey to verify the presence and distribution of phytoplasmas in sour and sweet cherry trees. The occurrence of cicadellid vectors was also considered. The presence of phytoplasmas in plant and insect samples was detected by symptom observation in the orchards, nested polymerase chain reaction (nested-PCR), restriction fragment length polymorphism (RFLP) analyses and DNA sequencing. Totally 298 sweet cherry, 32 sour cherry and 20 weed samples in or around of





cherry plantations were collected from surveyed areas. The most obvious symptoms observed on cherry plants were reddening, witches broom, proliferation and reduced fruit size. According to nested-PCR analysis 7 out of 298 sweet cherry samples were found infected by phytoplasmas, but they were never found in sour cherry and weed samples. 259 out of 1580 insects, belongs to Cicadellidae family, collected from and around of sweet cherry orchards were found phytoplasma positive. The incidence of phytoplasma in the insect body was detected as 16,39%. Phytoplasmas belonging to 16SrX and 16SrI group were identified in plant and insect samples, respectively. Sequence analysis of phytoplasma isolates were compared with GenBank isolates and 99% identity was found.

This study was supported by TUBITAK project (213O279)

## P7:

SOME BIOLOGICAL FEATURES AND CURRENT STATUS OF VINE BUD MOTH, *Theresimima ampelophaga* (BAYLE-BARELLE 1808) (LEPIDOPTERA: Zygaenidae) IN TURKEY

**Feza Can**, Kamuran Kaya, Nihat Demirel

Hatay Mustafa Kemal University, Agriculture Faculty, Plant Protection Dep., Hatay, 31000 Antakya, Turkey

[cezafan\\_onurcan@hotmail.com](mailto:cezafan_onurcan@hotmail.com)

The grape, *Vitis vinifera* (L.), is one of the most important fruits that are widely grown in Turkey. The vine bud moth, *Theresimima ampelophaga* (Bayle-Barelle 1808) (Lepidoptera: Zygaenidae), is a pest on grape vine, ornamental vine *Parthenocissus quinquefolia* (L.) and other *Parthenocissus* species. Its recent distribution in Europe is relatively well known, but there is a paucity of locality data for Turkey. In spite of this, the presence of this pest in the vineyards in the Aegean region, Marmara and the Mediterranean region of Turkey were known, emphasizing the need for detailed investigations on this pest for which even the number of generations is ambiguous. Most of the reports on *T. ampelophaga* in Turkey and even the more recent publications do not provide detailed information on its occurrence and population densities and the levels of damage caused by this pest species. Therefore, in decade, large-scale investigations on the biology, pest status and improving control methods by using pheromone traps of this pest were conducted in the eastern Mediterranean and Aegean regions of Turkey. These investigations have shown that *T. ampelophaga* produces one or two generations per year in these regions of Turkey. The study in the eastern Mediterranean region is the first well documented evidence of the occurrence of a second generation of the vine bud moth in Turkey. The moths of the first generation fly in June, and those of the second generation in August in this region. In the Aegean region of Turkey, the pest has two generations with the second generation being more numerous than the first one.

Keywords: *Procrudinae*, vine bud moth, pest, Turkey

## P8:

PROMISING APRICOT HYBRIDS OBTAINED FROM THE BREEDING PROGRAM OF PLUM POX VIRUS RESISTANCE IN TURKEY

Bayram Murat Asma, **Kadriye Caglayan**, Mona Gazel, Emine Tanriver, Fırat Ege Karaat, Fabienne Moreau,

Hatay Mustafa Kemal University, Agriculture Faculty, Plant Protection Dep., Hatay, Turkey

[kcaglayan@yahoo.com](mailto:kcaglayan@yahoo.com)

Plum pox virus (PPV) is one of the most restricting factors of apricot production especially in Europe. Even though, the virus is not currently detected in Malatya where located in the Eastern Anatolia and called world's capital of apricot production, as a measure against the possibility of transmission of the virus, a cross breeding program was conducted for breeding new PPV resistant apricot cultivars suitable for drying and table consumption purposes. For this aim, PPV resistant varieties 'Stella', 'Goldrich', 'Stark Early Orange' and 'Harcot' were crossed with 'Hacıhaliloğlu', 'Kabaası', 'Çataloğlu', 'Adilcevaz-5', 'Hasanbey', 'Soğancı' and 'Şekerpare' varieties which were selected for their fruit quality properties. Obtained hybrids were subjected to



marker assisted selection (MAS) for PPV resistance via SSR DNA marker analysis. The markers PGS1.121, PGS1.124 and ZP002 co-segregating with resistance to PPV were used to screen a total of 1755 apricot progenies. According to the primary results, 570 and 311 progenies presented resistant and recombinant alleles, respectively. Candidate hybrids, resistant to PPV were evaluated in terms of fruit quality (skin color, flesh color, blush color, fruit shape, kernel shape, kernel taste, fruit attractiveness, flesh firmness, fruit weight, kernel weight, TSS, titrable acidity) and yield in 2016 and 2017. According to the results, eight promising genotypes were selected. As an average of two years evaluations, the results of selected genotypes varied between; 16.15 and 26.2 kg/tree for yield, 33.0 and 51.82 g for fruit weight. 2.81 and 3.39 g for kernel weight, 2.25 and 3.25 kg/cm<sup>2</sup> for flesh firmness, 16.67 and 20.93 for TSS and 0.86 and 1.10% for titrable acidity. Primary results showed that there are good candidates for PPV resistant apricot hybrids which are suitable for apricot market.

**Keywords:** *Prunus armeniaca*, Sharka, cross breeding, marker assisted selection, fruit quality

## P9:

### IDENTIFICATION OF HOPE STUNT VIROID (HSVd) FROM AN APRICOT TRANSCRIPTOME DATA

Kahraman Gürcan, Saffet Teber, Antonio Olmos, Ana Belén Ruiz-García, **Kadriye Caglayan**

Hatay Mustafa Kemal University, Agriculture Faculty, Plant Protection Dep., Hatay, Turkey

[kcaglayan@yahoo.com](mailto:kcaglayan@yahoo.com)

Hope stunt viroid (HSVd) is the viroid with the widest host range. Although its infection is mostly latent in stone fruits, it causes apricot fruit disorder known as “fruit degeneration”. Deep-sequencing technology and bioinformatics analyses is a promising strategy for identifying pathogens in fruit crops. It allows the discovery of novel viruses/viroids that elude conventional testing and discovery of isolates of known viruses/viroids. Here, we have analyzed transcriptome data of an apricot variety, Stark Early Orange (SEO), for viroid screening. Trimmed 49,774,804 reads produced by HiSeq 2000 in length of 101 nt were local blasted against NCB viroid database and 228 reads out of the total were aligned to Hop stunt viroid (HSVd) isolate apr22 (GenBank Accession no: AJ297838.1). The consensus complete nucleotide sequence of the isolate in SEO had a length of 297 nucleotides exactly identical to the isolate HSVd.apr22 which was identified in Greece. SEO is not a local accession of Turkey and was imported to Turkey from Europe via bud transmission. Identification of HSVd.apr22 isolate in SEO rather than a unique or local HSVd isolates suggests that the apricot accession SEO was probably infected with the isolate HSVd.apr22 before importing the plant material to Turkey. The result also confirms efficient use of deep-sequencing in viroid detection even in symptomless apricot sample. This study was supported by COST Project (FA1407).

**Keywords:** *Prunus armeniaca*, Next Generation Sequencing, Viroid

## P10:

### USE OF BIO-ENVIRONMENTAL MODELS TO MANAGE FRUIT FLIES IN AUSTRALIA FOR MARKET ACCESS OF CITRUS, APPLES, PEARS AND STONE FRUITS

**Francis De Lima**

Aghort Analytics, 84 Queenscliffe Road, Doubleview, Perth 6018, Australia

[cpfdelima@hotmail.com](mailto:cpfdelima@hotmail.com)

Avocados are a valuable export crop from the south-west of Western Australia where the Mediterranean fruit fly is present. Eradication methods being such as sterile insect techniques require many years for success. Meanwhile, market access must be retained and new markets gained. The non-host status of avocado fruits was assessed for Hass, Sharwil, Fuerte and Reed cultivars. Adult fruit fly populations were monitored in orchards for 5 years and fruits were sampled for infestation of immature stages. Data was obtained of host fruit GDD (growing day degrees) and pest IDD (insect day degrees). This shows that avocados are not hosts of



Mediterranean fruit fly. The work also showed that Western Australian avocados are grown in areas of low pest prevalence. This enabled the avocado industry to gain market access within Australia.

Keywords: Mediterranean fruit fly, quarantine security, host status, area of low pest prevalence, area wide management

## P11:

### CURRENT STATUS OF SOIL DISINFESTATION AFTER METHYL BROMIDE IN EASTERN MEDITERRANEAN GREENHOUSE GROWN VEGETABLES

Seral Yücel, Hale Günaçlı, Hülya Demirbaş Pehlivan, Canan Can

Selcuk University, SilifkeTasucu Vocational School, Mersin, Turkey

[seralyucel@hotmail.com](mailto:seralyucel@hotmail.com)

Greenhouse soils are biologically polluted due to consecutive use of same crop plant each year. Soil borne plant pathogens (*Fusarium spp.*, *Rhizoctonia solani*) and nematodes (*Meloidogyne incognita*) result in serious reductions in yield quantity and quality. In addition to this, when the seedlings are planted prior to soil disinfestation, pesticide residues in plants become a problem due to chemical applications conducted against soil borne diseases and nematodes in the growing season. Hence soil disinfestation before planting is emphasized, with soil fumigants metam sodium (MS), metam potassium, dimethyl disulfide and dazomet being applied at reduced dosages (40-60 %) to greenhouses in combination with solarization for 4-8 weeks. In addition to these registered fumigants, a new soil fumigant, Ethanedinitrile (EDN-C<sub>2</sub>N<sub>2</sub>), is being tested with biological activity experiments in tomato and pepper as to be foundation base registered fumigant. Naturally infected pepper and tomato greenhouses were treated separately with MS (500 g/l) and EDN. After 2 weeks of solarization, MS at 500, 750, 1000 L/ha dosages were added through drip irrigation and tomato seedlings were planted in the greenhouses. EDN at 300, 400, 500 g/m<sup>2</sup> before transplanting were applied in pepper greenhouses. Evaluations were conducted for 7 and 10 months for MS and EDN, respectively. In tomato, the disease incidence in control plots was 24-58 %. Effect on disease incidence (%) in solarized plots and MS at 500, 750, 1000 L/ha were 48-57, 65-70, 85-90, 92-94, respectively. In pepper, % effect on disease incidences were 87, 99, 100 and 89 at EDN concentrations of 30, 40, 50 g/m<sup>2</sup> dosages and metam sodium 125 ml/m<sup>2</sup>, respectively. Yield values were determined, advantages and disadvantages of different fumigant applications were compared and evaluated. Studies are being conducted through further experimental trials and education meetings to rectify errors in application techniques.

Keywords: Soilborne pathogens, nematods, Turkey, alternative control

## P12:

### RELATIVE SUSCEPTIBILITY OF *Prunus cerasifera* L. ROOTSTOCKS TO *Verticillium dahliae* KLEB. ISOLATES ORIGINATED FROM DIFFERENT HOST PLANTS

Ferenc Izsépi, Virág Varjas, Tímea Tóth, Tamás Lakatos

Park utca 2., 1223 Budapest Budapest, Hungary



[izsepi.ferenc@gmail.com](mailto:izsepi.ferenc@gmail.com)

The aim of the study was to evaluate the susceptibility of *Prunus cerasifera* L. rootstocks to *Verticillium* wilt and investigate the virulence of Hungarian *Verticillium dahliae* Kleb. isolates. *P. cerasifera* plants were inoculated by stem puncture method with four *V. dahliae* isolates from different host plants (VD1=sea buckthorn, VD2=sweet cherry, VD3=sour cherry, VD4=sycamore maple). The plants were seedlings of Myrobalan C.162 rootstock. 20 plants per isolate were inoculated with conidial suspension of the pathogen. The inoculum density was  $\sim 1 \times 10^7$  conidia per centimeter cubed. Control plants were treated with sterile distilled water. External and internal symptoms of the disease were assessed on a weekly basis for 10 weeks on scales from 0 to 4 and 0 to 2, respectively. External symptom severity (ESS), internal symptom severity (ISS) and the area under disease progress curve with reference to the maximum value (RAUDPC) were calculated during the experiment. VD3 isolate caused severe symptoms (RAUDPC=41%), VD1 and VD4 isolates caused moderate symptoms (RAUDPC=28%) while VD2 isolate caused mild symptoms (RAUDPC=8%) on inoculated plants. Differences in virulence between isolates were observed during the experiment. Isolates collected from stone fruits (VD2 and VD3) showed significant difference in all disease values, therefore no correlation was found between virulence and the origin of isolates. According to our results the four Hungarian *V. dahliae* isolates showed different virulence levels on *P. cerasifera* seedlings.

This research was supported by the project GYU08 at NARIC-FCRI and the NARIC Researchers Recruitment Programme.

Keywords: Hungary, *Verticillium dahliae*, *Verticillium* wilt, *Prunus cerasifera*, rootstock

## P13:

IMPORTANT OF SPECIES POPULATION DEVELOPMENT DETERMINE AND BASED IN SPIDER MITE SPECIES IN VEGETABLE FIELDS OF DIYARBAKIR AND MARDIN

**Burcu YAMAN**, Ayhan OGRETEN, Sultan COBANOGU

Fruit Research Station, Isparta, Turkey

[burcu.ymn84@gmail.com](mailto:burcu.ymn84@gmail.com)

The study aims to determine first appearance time of the pest and population density rises to economic damage level in Diyarbakır (Bismil, Ergani, Silvan, Merkez, Kulp, Lice, Çermik ve Çınar) and Mardin (Kızıltepe, Nusaybin, Merkez, Midyat, Derik ve Ömerli) which are provide basic information about control of pests. Also studies will be carried out to determine population development of beneficial mite which will provide information for application of Integrated Pest Management (IPM) in vegetable growing areas (tomatoes, pepper, eggplant). In the first year of the study surveys is going to be carried out at areas that represent countries. Examples of areas of vegetable leaf, vegetable seedlings after planting until the end of the harvest (end of September-beginning of May) will be taken at weekly intervals by the method of random sampling. Population density was determined Bismil and Ergani in district in areas that spraying untreated areas. As a result, important pest species of *Tetranychus urticae* Koch. (Tetranychidae) is identified in the survey area was made. The density population has also been demonstrated and found to be the data to be the basis for the struggle. Furthermore, it was determined individuals from Tydeidae, Ascidae, Erythraeidae ve Phytoseiidae families. *Phytoseius finitimus* was identified as beneficial mite species. Also *Cheiroseius necorniger* was identified from Ascidae family.

Key Words: Mardin, Diyarbakır, vegetables, spider mite, population development

## P14:

FIRST DETECTION AND INVESTIGATION OF BIOLOGICAL CONTROL POSSIBILITIES OF SOUTHERN BLIGHT CAUSED BY *Athelia rolfsii*, ON TURFGRASS AREAS

**Filiz Ünal**, Ayse Askin, Ercan Koca, . Mesut Yildirim, Mesrur Umid Bingöl

Plant Protection Central Research Institute, Ankara, Turkey

[filiz.unal@tarim.gov.tr](mailto:filiz.unal@tarim.gov.tr)





On January, June and October 2015, surveys performed the turfgrass areas in İstanbul, Antalya, Ankara, İzmir, Kayseri, Bursa, Aydın, Muğla Provinces, Turkey and disease symptoms were observed as chlorotic or reddish-brown frog-eye or crescent-shaped circular patches in diseased areas. It was observed that the fungus especially creates problem in stadiums and golf courses in Marmara, Mediterranean and Aegean Regions with high humidity and temperature. One thousand and four hundred (1400) turfgrass samples were collected from turfgrass areas and total 32 *Athelia rolfsii* (anamorph: *Sclerotium rolfsii*) isolates were obtained. Disease severity in pathogenicity tests carried out in petri dishes ranged from 98-99%, in the greenhouse ranged from 87-92%. Identifications of both fungal and bacterial isolates was performed by DNA sequence analysis. For the biological control studies, the antagonistic bacterial strains were tested to determine their antifungal properties against the fungal pathogen in vitro conditions. A total of 5 antagonistic bacterial isolates were selected for determining antifungal properties in controlled condition. They tested for suppressing southern blight disease and turfgrass plant growth parameters by using seed coating method in pot experiments. It was found that two of the antagonistic bacteria both suppressed the disease and provided important contributions to the development of the plant. *Bacillus cereus* 44 Bac was found to be the most effective isolate with 91.01% effect. Consequently our results indicated that *Bacillus cereus* 44 Bac and *Stenotrophomonas rhizophila* 88 bfp can be used as both biopesticide for the control of southern blight disease and biofertilizers for turfgrass areas. Existence and injury of *Athelia rolfsii* is the first record on turfgrass for Turkey.

Keywords: *Athelia rolfsii*, southern blight, turfgrass, virulens, biological control

## P15:

OCCURENCE AND INVESTIGATION OF BIOLOGICAL CONTROL POSSIBILITIES OF DOLLAR SPOT DISEASE CAUSED BY *Sclerotinia homoeocarpa*, ON TURFGRASS AREAS

Filiz Ünal, Ayse Askin, . Ercan Koca, Mesut Yildirim

Plant Protection Central Research Institute, Ankara, Turkey

[filiz.unal@tarim.gov.tr](mailto:filiz.unal@tarim.gov.tr)

Surveys of turfgrass areas in parks, gardens, golf courses, recreation areas, stadiums, picnic areas and refuges in İstanbul, Antalya, Ankara, İzmir, Kayseri, Bursa, Aydın and Muğla Provinces were conducted in January, June and October 2015. During the surveys, small circular spots and larger irregular patches of sunken, bleached and straw-coloured turfs were observed especially on golf courses and stadiums in Antalya, İstanbul and Bursa Provinces. Affected leaves had light-tan lesions with light reddish-brown margins. From the 1400 turfgrass samples collected from survey areas, 34 *Sclerotinia homoeocarpa* isolates were obtained from symptomatic samples. Disease severity in pathogenicity tests carried out in petri dishes ranged from 89-96%, and in the greenhouse ranged from 84-88%. Identifications of both fungal and bacterial isolates was performed by DNA sequence analysis. For the biological control studies, the antagonistic bacterial strains were tested to determine their antifungal properties against the fungal pathogen in vitro conditions. Five antagonistic bacterial isolates were selected for determining antifungal properties (suppression dollar spot) and plant growth parameters using the seed coating method in pot experiments under controlled condition. Three of the antagonistic bacteria both suppressed the disease and provided important contributions to the development of the plant. *Pseudomonas putida* 88cfp was found to be the most effective isolate with 92.9% effect. Consequently our results indicated that *Pseudomonas putida* 88cfp, *Bacillus cereus* 44 Bac and *Stenotrophomonas rhizophila* 88bfp can be used as both biopesticide for the control of dollar spot disease and biofertilizers for turfgrass areas. This is the first report of *Sclerotinia homoeocarpa* on turfgrass in Turkey.

Keywords: *Sclerotinia homoeocarpa*, dollar spot, turfgrass, virulens, biological control

## P16:

MEALYBUGS (HEMIPTERA: *Pseudococcidae*) ON ORNAMENTAL PLANTS IN EASTERN MEDITERRANEAN REGION, TURKEY

Basak Ulasli, Asime Filiz Caliskan Keçe, Mehmet Rifat ULUSOY

Hatay Mustafa Kemal University, Agriculture Faculty, Plant Protection Dep., Hatay, Turkey

[basaktok@yandex.com](mailto:basaktok@yandex.com)



Insect pests have been spreading very fast in recent decades due to of the increase in trade of plant species. Because of scale insects (Hemiptera: Coccothraupidae) are often cryptic in habit they can escape detection during quarantine inspection of plants and became one of the most important invasive pest species all over the world. In this study pseudococcid samples were collected from ornamental woody plants and shrubs occurring in the parks and recreation areas in Adana, Mersin, Hatay between 2011 and 2017. Specimens were taken twice a week during the spring and summer seasons of the three-year study. As a result, seven species belonging to three genera were determined that follows; *Peliococcus salviae* Hadzibejli, 1963 *Planococcus citri* (Risso, 1813), *P. ficus* (Signoret, 1875), *P. vovae* (Nasonov, 1909), *Phenacoccus madeirensis* Green, 1923, *P. solani* (Ferris, 1918), *P. solenopsis* (Tinsley, 1898).

Keywords: Coccothraupidae, invasive pests, distribution, Mediterranean basin, host plants

## P17:

### SCREENING STRATEGY TO SELECT NEW FUNGAL BIOCONTROL PRODUCTS AGAINST PLANT DISEASES

**Muriel Marchi**, Franck Bastide, Daniel Sochard, Bruno Hamon, Sophie Aligon, Thomas Guillemette

IRHS UMR 1345, 42 rue Georges Morel , CS60057 , 49071 Beaucouzé, France

[muriel.marchi@inra.fr](mailto:muriel.marchi@inra.fr)

Seeds are the staple of human and animal diets but they are also efficient microorganism vectors. Seed sanitary quality and vigor are crucial for seedling development and crop production in general (horticulture, cereal and vegetable production). The seed microbiota structure and dynamics affect plant health and development. In this context, characterization of microorganism interactions between themselves and with the plant contribute to plant adaptation to biotic and abiotic stresses and represent new sources for biocontrol and biostimulation innovations. This work displays the set of fungal phenotyping tools developed in our laboratory to screen fungal strains in order to quantify biocontrol and biostimulation activities during seedling development. This screening strategy considers the antagonistic properties (in vitro and in planta antagonism assays, effect on the plant defenses) and the biological properties of each isolate (including spore production, growth rate, mycotoxin risks, germination and growth at 37°C, cold tolerance, compatibility with fungicides). To screen the strains, parasitism and competition between them are also observed by cultural approach and using filamentous fungi – tailored procedure based on liquid culture and automated nephelometric recording of growth in 96 wells microplate. This growth monitoring technique is applicable for the evaluation of antifungal activity and for large-scale phenotypic profiling. A molecular diagnostic tool called qPFD® (quantitative low-density microarray: microplate quantitative RT-PCR / low-density DNA microarray) was used to provide information on the level of stimulation of the plant defenses in contact with antagonist strains or metabolites.

Some results will be exposed as proof of concept concerning this phenotyping strategy.

Keywords: screening strategy , fungi biocontrol products

## P18:

### COMPARISON OF DIFFERENT DE NOVO ASSEMBLY TOOLS FOR PERCEIVING THE SUCCESS OF GRAPEVINE VIRUSES AND VIROIDS DETECTION IN NEXT-GENERATION SEQUENCING (NGS) DATA VIA BLASTN

**Serkan Önder**, Cigdem Ulubas Serce, Z. Neslihan Ozturk Gokce, Antonio Olmos



Manisa Viticulture Research Institute, Planth Health Department, 45125, Yunusemre, Manisa, Turkey

[onderserkan@gmail.com](mailto:onderserkan@gmail.com)

Plant virus diagnostics have gained extraordinary improvement with Next Generation Sequencing (NGS) technologies and bioinformatics approaches. In this study, leaves of a symptomatic local grapevine variety (*Vitis vinifera* L. cv. Kürt Üzümlü) which was previously found to be infected with Grapevine Pinot gris virus (GPGV) and Grapevine Syrah virus 1 (GSyV-1), were collected for NGS study from Çanakkale province of Turkey in 2015. For RNA-Seq, total RNA was extracted and rRNA depletion was performed by treatment of Ribo-Zero rRNA Plant Removal Kit. NEBNext® Ultra™ RNA Library Prep Kit was used for library preparation. Deep sequencing was performed using Illumina HiSeq 2000 technology with 2x150 read length and a minimum of 40 million depths for each read. At the end of the deep sequencing analyses, 110.841.018 sequences were derived as raw data. Bioinformatic analyses were carried out via CLC Genomic Workbench V10 and Geneious R11 software using only raw data and with performing quality trimming. For each pipeline, de novo assembly was performed with host genome and without host genome via CLC, SPAdes and Tadpole de novo assemblers, followed by blastn analyses via derived contigs from each de novo assemblers against viral RefSeq database separately. With different de novo assemblers, derived contig numbers were between 17.008 to 175.614, minimum contig length was between 31 to 200 nt, maximum contig length was between 996 to 7.442 nt and N50 numbers were found between 150 to 253. At the end of the blastn results, Tadpole contigs with and without host genome and quality trimming options, were matched minimum numbers of viral agents whereas SPAdes contigs with host genome and no quality trimming were matched maximum numbers of viral agents. Grapevine yellow speckle viroid-2 (GYSVd-2), Cucumber mosaic virus (CMV) RNA3 segment and Grapevine virus A (GVA) were matched only through SPAdes contigs whereas Australian grapevine viroid (AgVd) could be detected via only direct mapping interestingly. As a genome mapping results; Grapevine leafroll associated virus-1 (GLRaV-1, 7.1%), Grapevine leafroll associated virus-2 (GLRaV-2, 7.3%), Grapevine leafroll associated virus-5 (GLRaV-5, 1.1%), Grapevine rupestris stem pitting associated virus-1 (GRSPaV, 78.2%), Grapevine fleck virus (GfV, 1.7%), Grapevine deformation virus RNA1 (GDefV, 43%), GVA (1.6%), GPGV (97.3%), Grapevine fanleaf virus RNA1 (GFLV, 34 %), Arabis mosaic virus RNA1 (ArMV, 2.7%), Grapevine roditis leaf discoloration associated virus (GRLDaV, 10.4%), GSyV-1 (6.7%), ArMV RNA2 (24.7%), GDefV RNA2 (89%), GFLV RNA2 (72.2%), CMV RNA3 (7.8%), Hop stunt viroid (HsVd, 100%), Grapevine yellow speckle viroid-1 (GYSVd-1, 100%), GYSVd-2 (87.9%) and AgVd (81.3%) genomes were reconstructed with indicated genome coverage rates.

This study was supported by TUBITAK-TOVAG project number 115O014 in the frame of COST-FA Action 1407.

Keywords: Grapevine, virus, viroid, NGS, RNA-Seq, de novo assemble, viral RefSeq, blastn

## P19:

EFFECTS OF *Ficus carica* LEAF EXTRACTS ON *Meloidogyne incognita* DEVELOPMENT IN TOMATO PLANTS

**Adem ÖZARSLANDAN.** Refik Bozbuga, Hülya Demirbas Pehlivan, Dilek Dinçer, Mustafa Imren

Mersin University, Applied Technology and Management School of Silifke, Mersin-Turkey

[ozarslandan2001@yahoo.com](mailto:ozarslandan2001@yahoo.com)

Plant parasitic nematodes cause damage to many cultivated plants, including vegetables, ornamentals and other horticultural plants. Among the plant parasitic nematodes, root knot nematodes are the most damaging group. One of the most common root knot nematode species, *Meloidogyne incognita*, causes significant damage to tomato roots. Plant extracts may decrease the damage to cultivated plants. In this study, the effects of leaf extracts of *Ficus carica* (Fc) on tomato plant development, root gall index and nematode reproduction rate were investigated. Extracts were diluted to different rates (1%, 5%, 15%, 30%, and 40%), and nematode, non-nematode and nematicide applications were added as other treatments. Results revealed that the tallest tomato plants were in 15% Fc extracts followed by the non-nematode treatment. There was not any difference among the dry weights and gall indexes of tomato plants. The nematode reproduction rate was the lowest with 15% Fc extracts. Consequently, this research revealed the various effects of different leaf extract dilutions on nematode and tomato development.



Keywords: Root knot nematode, *Ficus carica*, tomato, plant extract

## P20:

BIOLOGICAL CONTROL OF *Fusarium* spp. IN BELL PEPPER FRUIT USING *Gliocladium* species

**M. Frans**<sup>1</sup>, R. Moerkens, S. Van Laethem, S. Van Gool, R. Aerts<sup>2</sup>, J. Ceusters

Bioengineering Technology TC, Campus Geel, KU Leuven, Kleinhoefstraat 4, B-2440 Geel, Belgium

[mario.frans@kuleuven.be](mailto:mario.frans@kuleuven.be)

Despite the raising popularity for high quality coloured bell peppers, market growth is currently threatened due to internal fruit rot caused mainly by the fungus *Fusarium lactis* (FLASC), which causes yield losses of 5 % with seasonal peaks up to 50 %. Although the disease has emerged as a significant threat to bell pepper production; adequate chemical or biological control measures are lacking. Moreover, Belgian pepper production has an overall low impact on the environment regarding fungicidal use. Therefore, the need for new biocontrol agents (BCA) to tackle internal fruit rot is urgent. Hence, more than 100 strains of potential antagonistic fungi were screened for mycelial inhibition of FLASC by employment of an adapted dual culture *in vitro* selection. The main objectives for BCA selection involved at least 20 % inhibition of mycelial growth after two days of *in vitro* growth and sporulation quantities exceeding 10<sup>7</sup> spore per ml after one week of growth on potato dextrose medium. After screening, the best candidates were further evaluated in greenhouse trails during three consecutive years. Both screening methods resulted in the selection of two potential isolates of *Gliocladium roseum* which significantly reduced infections over the three years of field trials. Although these BCA's proved to be effective against internal fruit rot in bell pepper, further screenings should be carried on to investigate safety, environmental risks and ecological characteristics.

Keywords: FLASC, *Fusarium lactis*, *Gliocladium roseum*, *Clonostachis rosea*, *Gliocladium catenulatum*, Internal Fruit Rot

## P21:

EFFECTS OF ENVIRONMENTAL CONDITIONS ON GROWTH OF *Stagonosporopsis cucurbitacearum* CAUSING INTERNAL FRUIT ROT IN CUCURBITS

**S. Van Laethem**, M. Frans, R. Aerts, J. Ceusters

KU Leuven, Campus Geel, Faculty of Engineering Technology, Department of Microbial and Molecular Systems (M<sup>2</sup>S), Kleinhoefstraat 4, 2440 Geel, Belgium

[sofie.vanlaethem@kuleuven.be](mailto:sofie.vanlaethem@kuleuven.be)

The *Cucurbitaceae* are a large and diverse family containing several important commodity crops in many parts of the world. In the last decades, fruit rot caused by *Stagonosporopsis* spp. became a major disease in both field grown and greenhouse grown cucurbits. Yield losses due to *Stagonosporopsis* can show seasonal peaks up to 30%. Despite its economic importance, limited information is available about growth characteristics of *Stagonosporopsis cucurbitacearum*. A more profound understanding of the influence of individual environmental factors on growth of the fungus is a first step towards the development of sustainable management strategies to prevent outbreak of the disease. The pathogen showed optimal growth in the range from 20 to 25 °C. It was characterized to develop better in a neutral and acid environment (pH 4) than in a more alkaline one (pH 9). Although *S. cucurbitacearum* is described as an aerobic fungus, it still showed considerable mycelium growth at low oxygen concentrations.

Key words: *Didymella bryoniae*, fruit rot, *Cucurbitaceae*, mycelial growth, germination

## P22:

A REVIEW ON ASIAN WALNUT MOTH *erschoviella musculana* ERSHOV (LEPIDOPTERA: NOCTUIDAE)





**Vildan Bozkurt**, Mustafa Ozdemir, Erdogan Ayan, Ayse Ozdem

Plant Protection Central Research Institute, Ankara, Turkey

[vilb2002@yahoo.com](mailto:vilb2002@yahoo.com)

The Asian Walnut Moth *Erschoviella musculana* Ershov (Lepidoptera: Noctuidae) is an important pest of walnut. *E. musculana* attacks fruits and shoots of wild and cultivated varieties of *Juglans regia*. Young fruits damaged by the pest caterpillars. They feed inside young shoots and cause them to wilt. One caterpillar may destroy several fruits. In this way the pest considerably reduces the yield of walnuts up to 70-80% and causes direct economic damage in commercial walnut orchards. There is a major risk for infested walnut orchards. The most important damage is observed mostly on young walnut trees of shoots and their fruits. Eggs, larvae and pupae (cocoons) may be found on wood containing bark. All stages of the life cycle can be transported with walnut fruits (inside nuts) and on walnut plants moving in trade (inside shoots), particularly plants for planting and cutting for grafting. Pest entry with plants for planting and establishment, have high probability, but there is little trade in practice. Natural spreading is also possible with flights of adult moths. The pest has two to three generations per year. Asian walnut moth is present in Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Afghanistan and Iran. It is possible to establish in an area which has similar climatic conditions with the origin and can cause serious economic damage. Turkey has similar conditions with the infested countries and under at risk because of being neighboring country with Iran. In the World it is a quarantine pest and on the list of EPPO A2. In Turkey it is on the list of Annex -1A harmful organisms not known to occur in Turkey, that are subject to quarantine and that hinder importation. Phytosanitary measures should be taken carefully to prevent its introduction and distribution through the uninfested areas or countries. The aim of this review is to summarize global distribution of the pest, damage status, short biology, potential risks and required phytosanitary measures.

Key words: *Erschoviella musculana*, Asian walnut moth, walnut, quarantine

## P23:

INSECTICIDAL EFFECT OF PLANT EXTRACT OF LEMON-SCENTED TEA TREE (*Leptospermum petersonii* B.) ON *Leptinotarsa decemlineata* Say (Col.:Chrysomelidae)

**P. Erdogan**, E. Hassan

Plant Protection Central Research Institute, Ankara, Turkey

[pervin.erdogan@tarim.gov.tr](mailto:pervin.erdogan@tarim.gov.tr)

In this study, the efficacy of extracts obtained from *Leptospermum petersonii* Bailey (Myrtaceae) on (*Leptinotarsa decemlineata* Say (CPB, Coleoptera:Chrysomelidae) using two different methods was investigated. Bioassays were used to determine the effect of varying concentrations (0.05%, 0.1%, 0.3%; 0.4% and 0.5%) of extracts. Experiments were carried out using 3 cm diameter leaf disks of *Solanum tuberosum* L. (Solanaceae). Third instar larva of about 30-35 mg weight were used in leaf disc dipping and larvae dipping methods. In addition, the effects of extract on *L. decemlineata* reproductive capacity was investigated. For this purpose, 3-5 day old adults were used. The highest effect occurred at concentration 0.5% while the smallest effect was at 0.05%. In leaf dipping method, the extract of 0.5% concentration showed the highest mortality in the larval stage (92%). In the larva dipping method, mortality at the same concentrations was 88%. At the lowest concentration, females laid lower numbers of eggs compared to the untreated.

Key words: Plant extract, insecticidal effect, fecundite, Colorado potato beetle

## P24:

IMPLEMENTATION OF *Aureobasidium pullulans* APPLICATIONS AS A POTENTIAL GRAY MOLD CONTROL TOOL IN BERRY PRODUCTION

**Barbara Edler**, Christina Donat



Bio-ferm, Technopark, 3430 , Tulln, Austria

[barbara.edler@bio-ferm.com](mailto:barbara.edler@bio-ferm.com)

Gray mold decay, caused by *Botrytis cinerea*, can pose significant economic losses for soft fruit producers on pre-harvest, but also for packers and retailers on post-harvest level, worldwide. Although numerous botryticides are available, sufficient control still remain a challenge, especially in certain highly perishable crops, such as small berries. To control *Botrytis cinerea* efficiently and maintain a stable productivity, several plant protection treatments with site-specific fungicides per season are mandatory. In the last decades, extensively used chemical fungicides led to a botrytis resistance development against several chemical active substances e.g. fludioxonil. Resistances in soft fruit have so far been reported from France, Spain, Germany, and the United States. The steady emergence of resistances against chemical active ingredients emphasizes the importance of alternatives in resistance management strategies for gray mold control. A simple but effective method to maintain high efficiency in botrytis control is to implement biotechnological control agents. *Aureobasidium pullulans*, formulated as Botector inhibits the growth of the pathogen by antagonism for space and nutrients on the plant. Botector has been tested in several field trials in a number of situations in various countries and is demonstrating a high efficacy against gray mold decay on soft fruit. Results of some trials, the mode of action of the agent and application recommendations are clearly represented. Botector can be used as a significantly efficient stand-alone treatment, and implemented in strategy spraying programs, alternating with other chemical fungicides for control of gray mold. Furthermore, the product has no pre-harvest interval, it leads to a reduction of chemical residues on crops and it is harmless to pollinators and beneficials. Botector is therefore in line with the needs of a modern control strategy.

Keywords: *Botrytis cinerea*, *Aureobasidium pullulans*, soft fruits

## P25:

### THE SPECIES COMPOSITION OF PESTS OF PEACH GARDENS IN THE CRIMEA

Elena Balykina, Larisa Yagodinskaya, Dmitry Korzh, Sergei Tsiupka, **Vladimir Gerasimchuk**

Nikitsky Spusk, 52, 298648 Yalta, Russian Federation

[gerasimchuk\\_vova@mail.ru](mailto:gerasimchuk_vova@mail.ru)

In the Crimea, peach is the main stone fruit crop, occupying 2634 hectares at the beginning of 2016. The study purpose was to investigate species composition of phytophagans, which has changed in recent years, peach orchards of Crimea (Bakhchisaray district) during 2015-2017. The taxonomic structure of phytophagans was dominated by sucking pests: *Brachycaudus cardui* L., *Pterochloroides persicae* Chol., *Parthenolecanium corni* Bouche and *Tetranychus urticae* Koch. Lepidopterans were represented by two species: *Grapholitha molesta* Busck. and *Anarsia lineatella* Z. In spring, *Tropinota hirta* Poda and *Sciaphobus squalidus* Gyll. from the Coleoptera order caused significant damage to the plantings. It was established that *Pterochloroides persicae* Chol. and *Parthenolecanium corni* Bouche were dominant, affecting 21.5% and 18.0% respectively, of trees in 2016. In the summer of 2017, *Brachycaudus cardui* L. was dominant, with about 30% of the trees having 5 to 25 colonies per tree. Aphid damage affecting more than 50% of the leaf was observed in 10% of trees. *Tetranychus urticae* Koch damaged peach leaves annually, but the numbers did not exceed the threshold value. *Grapholitha molesta* Busck was the main species causing damage to fruits. The first and second generations of eastern fruit moth damaged 5-10% of shoots, with summer (July-August) generations affecting about 5% of fruits. The share for the second fruit damaging species, *Anarsia lineatella* Z, was about 10%. In young peach orchards, the beetle *Tropinota hirta* Poda damaged up to 50-70% of flowers, and for fruit-bearing trees under systematic protective measures, this figure was 5-20.0%.

Keywords: peach, species composition, taxonomic structure, pest

## P26:

### INTEGRATED CONTROL OF *Penicillium expansum* AND *Botrytis cinerea* OF APPLES USING POTASSIUM SILICATE, YEAST ANTAGONISTS AND YIELDPLUS®



**Nokwazi Carol Mbili**, Mark Laing, Kwasi Sackey Yobo

Discipline of Plant Pathology, University of KwaZulu-Natal, Private Bag X01, Scottsville 3201, South Africa

[mbilin@ukzn.ac.za](mailto:mbilin@ukzn.ac.za)

The use of potassium silicate ( $K_2SiO_3$ ), YieldPlus<sup>®</sup> and yeast antagonists treatments, alone or in combination, was investigated for the control of grey and blue moulds of “Golden Delicious” apples. *In vitro* studies indicated that yeast Isolates YP25 and YP26 were compatible with  $K_2SiO_3$  postharvest treatments.  $K_2SiO_3$  alone or in combination with yeast antagonists and YieldPlus<sup>®</sup> reduced postharvest grey and blue moulds on apples. YieldPlus<sup>®</sup> and Imazalil<sup>®</sup> treatments alone were more effective in reducing grey and blue moulds than yeast Isolates YP25 and YP60. The combination of  $K_2SiO_3$  with an antagonist mixture of YP25+YP60 provided the best control (95%) of grey mould, while the combination of  $K_2SiO_3$  and YieldPlus<sup>®</sup> provided the best control (85%) of blue mould. The use of potassium silicate and yeasts antagonists in combination resulted in 95% and 77.5% control of *B. cinerea* and *P. expansum*, respectively, in “Golden Delicious” apples compared to 62.5% and 65% on Imazalil<sup>®</sup> fungicide treated fruits.

Keywords: Biological control, blue mould, grey mould, yeast, potassium silicate, YieldPlus<sup>®</sup>

## P27:

### EFFECTS OF THREE POTASSIUM SALTS FOR THE CONTROL OF *Penicillium expansum* AND *Botrytis cinerea* ON APPLES

**Nokwazi Carol Mbili**, Mark Laing, Kwasi Sackey Yobo

Discipline of Plant Pathology, University of KwaZulu-Natal, Private Bag X01, Scottsville 3201, South Africa

[mbilin@ukzn.ac.za](mailto:mbilin@ukzn.ac.za)

the effects of potassium silicate, potassium chloride and potassium hydroxide for the control of postharvest grey and blue moulds were tested on ‘Golden Delicious’ apples. The incidence of grey mould and blue mould was significantly ( $P \leq 0.001$ ) reduced by the application of potassium silicate, potassium chloride and potassium hydroxide on wounds of apple fruit. Fruit treated with potassium silicate at a concentration of 100,000 mgL<sup>-1</sup> had the lowest incidence of grey and blue moulds (77.5% and 65% respectively) when it was applied as a preventative treatment (24 h before inoculation with either *Penicillium expansum* or *Botrytis cinerea*). Scanning electron microscopy studies confirmed that potassium silicate applications to apple wounds stopped germination of conidia of both *B. cinerea* and *P. expansum*. Curative treatment (inoculated with either *P. expansum* or *B. cinerea* 4 h before treatment) of apples with potassium silicate at a concentration of 100,000 mgL<sup>-1</sup> resulted in reduced incidence of grey and blue moulds (52.5% and 55%, respectively). Both potassium chloride and potassium hydroxide reduced the incidence of blue mould (77.5% and 70%, respectively) and grey mould (65% and 62.5%, respectively) on ‘Golden Delicious’ apples when applied as a preventative treatment (24 hours before inoculation with either *P. expansum* or *B. cinerea*).

Keywords: Apples; Blue mould; Grey mould; Postharvest treatment

## P28:

### PURE CUCURBITACIN A CAUSE IRREVERSIBLE IMMOBILITY OF *Meloidogyne incognita* JUVENILES

**Zakheleni Dube**, Phatu Mashela

University of Limpopo, 0727 Limpopo Sovenga, South Africa

[zakheleni.dube@ul.ac.za](mailto:zakheleni.dube@ul.ac.za)



After the withdrawal of highly effective synthetic chemical nematicides focus in the management of plant-parasitic nematodes has shifted to environment-friendly alternatives. Nematicidal extracts from plants had received a lot of research attention. Cucurbitacin-containing phytonematicides had been researched and developed for the management of nematodes on a variety of crops under different environments. The mechanism of nematode suppression of cucurbitacin-containing phytonematicides has not been established. The objective of this study was to determine whether pure cucurbitacin A cause immobility of *Meloidogyne incognita* second stage juvenile (J2) under in vitro conditions. Approximately, 450 freshly hatched *M. incognita* J2 were exposed to pure cucurbitacin A concentrations of 0.00, 0.25, 0.50, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25 and 2.50 µg.mL<sup>-1</sup> distilled water in 9-cm-diameter petri dishes. The treatments were replicated three times and arranged in a completely randomised design in an incubator set at 25 ± 2 °C for 12, 24, 48 and 72 h. Three independent experiments were conducted for validation. After the pre-allotted time intervals, each petri dish was emptied into a counting chamber, the immobile nematodes were counted using a stereomicroscope. Nematodes were considered immobile when no movement is observed during two seconds even after mechanical prodding with a bristle. Pure cucurbitacin A concentration effects on J2 immobility of *M. incognita* were highly significant for all exposure times. At 12-, 24-, 48- and 72-h the cucurbitacin A contributed 84 99, 99 and 99% in total treatment variation (TTV) of J2 immobility, respectively. Relative to untreated control, J2 immobility increased with increase in cucurbitacin A concentration and exposure time. Relative impact values of J2 immobility when plotted against cucurbitacin A concentrations showed density-dependent growth (DDG) patterns characterised by stimulation and neutral effects on J2 immobility. In conclusion, the juvenile immobility effects of pure cucurbitacin on *M. incognita* J2 was concentration and exposure dependent with immobility effects being irreversible.

Keywords: Cucumin, leptodermin, paralysis, phytonematicides, triterpenoids

## P29:

### EXPLORING THE EFFECTS OF GASEOUS OZONE AND 1-METHYLCYCLOPROPENE TREATMENTS ON BLUE AND GRAY MOLD OF PROTEIN FRUIT AT PROTEOMIC LEVEL

**Athanassios Molassiotis**, Stefanos Testempasis, Georgia Tanou, Anastasios Samaras, Athanassios Molassiotis, George Karaoglanidis

Pomology lab, Faculty of Agriculture, AUTH, 54 124 Thessaloniki, Greece

[amolasio@agro.auth.gr](mailto:amolasio@agro.auth.gr)

Gray mold (*Botrytis cinerea*) and Blue mold (*Penicillium expansum*) are the most important postharvest rots of apple fruit, while the latter is the agent of fruit contamination by the mycotoxin patulin. Disease control is achieved by fungicides. However, development of fungicide resistance and social concerns regarding pesticides, necessitate research for alternative control methods. In this study the effects of fruit exposure to gaseous ozone (O<sub>3</sub>) and/or 1-methylcyclopropene (1-MCP) treatments on the development of the both diseases were investigated. Artificially inoculated fruit (cv. Granny Smith), treated or not with 1-MCP, were subjected for 2 and 4 months to cold storage either in the presence or absence of O<sub>3</sub>. Exposure to ozone resulted in a reduction of gray mold severity by more than 50%, both on 1-MCP-treated and untreated fruit, while exposure to ozone of both MCP-treated and MCP-untreated fruit contributed to an increase in blue mold severity. Furthermore, fruit exposure to ozone and 1-MCP contributed to an increased patulin production in fruit inoculated with *P. expansum*, that was found to be associated with overexpression of *idh*, *peab1* and *p450-1* genes. Using 2-DE analysis, we compared the proteomic signatures of MCP and/or ozone-treated fruit and inoculated or non-inoculated with *B. cinerea*. Proteomic analysis revealed that, among all the treatments, 98 protein spots were significantly modulated. Inoculation with *B. cinerea* illustrated the higher proteomic effect. More specifically, O<sub>3</sub> treated fruit, showed a great number of up-regulated disease/defense proteins. In contrast, on 1-MCP treated fruit a higher number of down-regulated disease/defense proteins was observed. Such results provide evidence that 1-MCP treatments contribute to an increase of apple fruit susceptibility to blue mold and to an increased patulin production in the infected tissues, while ozone treatments have variable effects depending on the pathogen under investigation.

Keywords: 1-methylcyclopropene, apple fruit, ozone, proteomic





## P30:

### ANTAGONISM ACTIVITY OF BACILLUS STRAINS AGAINST *Fusarium oxysporum* f. sp. cubense

**Andreia Hansen Oster**, Christiana Bruce da Silva, Francisco H. Alves, João E. Santos, Naomi Freitas, Mary Anne Lima

Rua Dra Sara Mesquita 2270, Fortaleza-Ceará, Brazil

[andreia.hansen@embrapa.br](mailto:andreia.hansen@embrapa.br)

Banana cropping is an activity of great economic importance throughout the tropical and subtropical world. Panama disease, caused by *Fusarium oxysporum* f. sp. cubense (FOC), is one of the significant problems of banana producing regions, and areas where this disease is endemic, commercial exploitation of banana farming is unfeasible. The soil bacteria *Bacillus* are one of the most widely used and commercialized biological control agents in the world. Due to their high rhizospheric competence, they guarantee competitive success against other microorganisms. In this context, the objective of the present work was to select strains of the genus *Bacillus*, that present potential antagonist for control of FOC. For this, 50 strains of *Bacillus* spp. obtained from the rhizosphere of banana plants were submitted to in vitro tests against FOC. In total, 23 bacterial strains showed a capacity to inhibit mycelial growth, reducing up to 61.95% of pathogen growth. We also evaluated the volatile compounds production capacity of the strains that stood out the most in the antagonism test. Of the five strains (44, 59, 71, 99 and 186) of *Bacillus* spp. tested for the production of volatile organic compounds, four (59, 71, 99 and 186) had the best inhibitions of FOC mycelial growth. The strains that stood out the most were submitted to tests of inhibition against multiple pathogens. Only the pathogens *Rhizoctonia solani*, the causal agent of melon rhizoctoniosis; *Lasiodiplodia theobromae*, the causal agent of cashew gummosis and *L. theobromae*, the causal agent of rot in melon were not inhibited by bacterial strains. It was concluded that the most promising strains, considering the in vitro mechanisms of antagonism, were the isolates 44, 59, 71, 99 and 186, especially the isolate 186 that presented good antagonistic activity in all tests conducted.

Keywords: Antibiose, Volatile compounds, Panama disease, Biological control

## P31:

### FLASHES OF UV-C LIGHT ARE MORE EFFICIENT THAN CONVENTIONAL EXPOSURES FOR STIMULATING PLANT DEFENCES AGAINST FUNGAL DISEASES IN LETTUCE, PEPPER AND GRAPEVINE

**Laurent Urban**, Dounyazade Chabane Sari, Bernard Orsal, Jawad Aarouf

Campus Agroparc, 301 rue Baruch de Spinoza, BP 21 239, 84916 Avignon, France

[laurent.urban@univ-avignon.fr](mailto:laurent.urban@univ-avignon.fr)

UV-B light (280-320 nm) has often been reported to increase plant resistance to pathogens. However, UV-B light generally requires relatively lengthy periods of exposure to be effective, typically several hours or days. Hence the idea of using UV-C light which is capable of supplying large amounts of energy in a very short period of time. To study the effect of UV-C light on plant defenses, we designed and developed an innovative lamp based on refrigerated LEDs (262 and 265 nm) placed in an integrating sphere, allowing to compare 1 s vs. 1 mn treatments while maintaining doses and wavelengths constant. We also used xenon lamps generating UV-C-rich pulsed light, PL (200-1100 nm, 300 ms). Using the LED-based lamp, we observed after 5 days that necrotic surfaces were decreased by 13 % in lettuce plants single-treated for 1 mn and then inoculated with *Botrytis cinerea*, and by 21 % when the same dose was applied for 1 s. When treatments were repeated 4 times prior to inoculation, the reduction in necrotic surface reached 26 % for 1 mn treatments and 29 % for 1 s treatments. Using the same LED-based lamp, we observed after 4 days that necrotic surfaces were decreased by 38 % in pepper plants single-treated for 1 mn and then inoculated with *Phytophthora capsici*, and by 69 % when the same dose was applied for 1 s. In another trial we observed that necrotic surfaces were decreased by 73 % in grapevine plants treated by PL and then inoculated with *Plasmopara viticola*. Altogether our observations suggest that UV-





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C light under the form of flashes has a strong potential for stimulating plant natural defenses. Scientific and agronomic prospects are discussed.

Keywords: fungal diseases, LEDs, plant resistance, pulsed light, UV-C light

