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Abstract Book

INTEGRATED PROTECTION IN VITICULTURE

IOBC-WPRS
IOBC-WPRS Meeting of the Working Group

ADVID
Cluster da Vinha e do Vinho
Wine and Vine Cluster

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ORAL PRESENTATIONS

OP1 - ARE GRAPEVINE PLANTS RECOVERED FROM FLAVESCENCE DORÉE SUSCEPTIBLE TO NEW INFECTIONS OF THIS PHYTOPLASMA?

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Woody plants can eventually recover from phytoplasma infection; this phenomenon is of growing interest because it can be exploited for the management of phytoplasma diseases in fruit growing and viticulture. Moreover, in apricot trees, plants recovered from ESFY phytoplasmas, have shown a remarkable resistance to re-infections of this pathogen. Grapevine can be affected by several phytoplasma diseases and, among them, Flavescence dorée is probably the most epidemic and dangerous in Europe, where it affects many viticultural areas in several countries. The aim of this work was to ascertain if grapevine plants obtained from propagative material derived from FD-recovered plants show resistance/tolerance to new FD infections. To this purpose, potted grapevines of the cv Barbera and Glera (from FD-recovered or from healthy plants never infected) were exposed to FD-infected *Scaphoideus titanus* leafhoppers and then transplanted in the field. Their infection status was confirmed the following year by molecular detection and symptom observation. No difference in susceptibility to FD inoculation was recorded between grapevine cuttings derived from recovered and healthy plants of the same variety. More than 90% of Barbera plants exposed to vector inoculation, compared to 30% of Glera ones, became infected, showing a very high susceptibility of Barbera cv to FD. The relevance of these findings for FD management is discussed.

Keywords: Flavescence dorée, Scaphoideus titanus, recovery, phytoplasma transmission, Barbera, Glera

OP2 - SAME DISEASE, DIFFERENT RESPONSE: THE CASE OF FLAVESCENCE DORÉE PHYTOPLASMA AND DIVERSE GRAPEVINE CULTIVARS

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Flavescence dorée of grapevine (FD) is a phytoplasma-associated disease present in several European countries and transmitted by the nearctic leafhopper *Scaphoideus titanus* among plants of the genus *Vitis*. FD causes severe losses to viticulture and spreads through primary infections (from gone-wild vines surrounding the vineyard to cultivated grapevines) and secondary infections (from vine to vine within the vineyard). FD transmission experiments to the main Piedmontese grapevine cultivars (cvs) were carried out with the vector *S. titanus*, in order to screen for different levels of cv susceptibility to the phytoplasma. Transmission experiments were performed both using *ex-vitro* micropropagated grapevine plants under greenhouse conditions and on grafted cuttings under semi-field conditions. Susceptibility was estimated by measuring, for each cv, the proportion of infected plants and the phytoplasma load, as estimated by qPCR. The research is further developing by investigating the mechanisms underlying susceptibility/tolerance, that are possibly related to the vector fitness/feeding behaviour on the different grapevine genotypes and/or to the plant genetic characteristics.

Keywords: Flavescence dorée, FDp, Scaphoideus titanus, cultivar-dependent susceptibility, tolerance, phytoplasma transmission

OP3 - INVESTIGATIONS ON THE ABILITY OF PHLOGOTETTIX CYCLOPS TO TRANSMIT FLAVESCENCE DORÉE PHYTOPLASMA TO VITIS VINIFERA L.

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Flavescence dorée (FD) is an important grapevine yellows disease in Europe with epidemic disease outbreaks caused by phytoplasmas of the taxonomic subgroups 16SrV-C and 16SrV-D (FDp). The introduced Nearctic leafhopper *Scaphoideus titanus* (Ball) (Cicadellidae, Deltocephalinae) transmits FDp to grapevine by feeding on infected *Vitis* ssp. The epidemiology of FD is complicated by the presence of FDp in several wild plant species, especially in *Alnus* ssp. *Clematis vitalba* and *Ailanthus altissima* that constitute a reservoir for FDp. *S. titanus* does not feed on these host plants. Hence, surveys for potential vector species were conducted in different European countries and phytoplasmas of the taxonomic group 16SrV were detected in *Dictyophara europaea* (L.) and *Orientus ishidae* (Matsumura) that feed on grapevine amongst others and occasionally transmit FDp to grapevine.

In Austria, only one epidemic FD outbreak occurred in 2009 so far. FD incidence thereafter were restricted to few grapevine plants, in different regions in Styria and 2015 in Burgenland. The population size of the main vector *S. titanus* in all the demarcated focus zones was low through the mandatory application of plant protection measures.FD outbreak investigations showed that FDp infected *C. vitalba* and *Alnus glutinosa* occur in the surroundings of vineyards. In field monitorings for potential FD vectors in Austria, *Phlogotettix cyclops* (Mulsant & Rey) was detected to habour the 16SrV-C strain of FDp. This Asian leafhopper feeds on *C. vitalba* that grow closely together with gone wild Vitis next to cultivated grapevines at some places and act as refuge for *P. cyclops* and *S. titanus*.

In the frame of theEUPHRESCO project "Modelling the epidemiology of flavescence dorée in relation to its alternate host plants and vectors" (Flavid), acquisition and transmission experiments with *P. cyclops* were carried out in 2018 and 2019 in an insect-proof quarantine greenhouse at AGES, Vienna.

To test, if this species is a vector of FDp. *P. cyclops* nymphs were collected and placed on a clematis plant infected by 16SrV-C for phytoplasma acquisition. After the acquisition access period, *P. cyclops* nymphs or adults were placed on healthy *Vitis vinifera* cv. "Chardonnay" for FDp inoculation. DNA was extracted from clematis, Chardonnay and *P. cyclops* and PCR tests were performed to identify the presence of FDp. Material and methods, the test design of the acquisition and transmission trials as well as preliminary results will be presented. The results of the transmission trials and the potential role of *P. cyclops* as a vector of FDp in Austrian viticulture as well as an unexpected finding will be discussed.

Keywords: Auchenorrhyncha, epidemiology, grapevine yellows disease, potential vector, wild plant compartment, 16SrV

OP4 - A 2-YEAR MULTIVARIATE ANALYSIS OF MULTIPATHOGENS DAMAGE (DOWNY MILDEW AND POWDERY MILDEW) RELATED TO SOIL RESISTIVITY, GRAPEVINE VIGOR AND YIELD LOSS

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Our aim was to establish a viticultural zoning, based on precision viticulture techniques, and to investigate the relationships with grapevine susceptibility and epidemiological development of downy and powdery mildews. Two independent and key variables in the grapevine production system were used with a geographical information system (GIS): i) soil electrical resistivity and ii) the grapevine biomass index NDVI. In one Medoc estate "chateau", mapping of the whole vineyard allowed us to define different classes of a-priori homogeneous "Physiological Functioning Units" (PFU) by combining these two variables. Per cultivar (cv), Merlot noir and Cabernet sauvignon, 3 and 6 PFUs classes were studied, respectively. For each PFU, per cv, two experimental plots were repeated. Each plot consisted of two close groups, each of 5 adjacent vines, either untreated or protected by fungicides according to the chateau strategy. A weekly symptom monitoring for both pathogens was performed throughout the season. In addition, various other key viticultural variables were investigated focusing on a overall multipathogens indicator, the Assessment Indicator of Damage in Bunches, AIDB (Fermaud et al, Austral.J.G.W.Res., 2016). Different yield components were assessed and other topographic, fruit maturity and/or host-plant variables (altitude, distance to the Gironde river, vine age, rootstock, row orientation…). A Principal Component Analysis (PCA) was performed to show and visualize relationships between AIDB and the other variables. The results in 2015 and 2016, were based mostly on downy mildew epidemics as the major disease and, to a lesser extent, on powdery mildew. The two main PCA axes represented 49.8% of the relationships and variations within the whole dataset. The first axis represented the yield components, year of planting and production of grapevine biomass (NDVI) in both years, corresponding to younger and more vigorous grapevine plants. The second axis showed a clear negative correlation between the multipathogens pressure (AIDB) and soil resistivity.

Yield loss was correlated positively with the AIDB indicator. The altitude was closely related to the resistivity. An important distance to the Gironde estuary and a high soil resistivity were two variables reflecting a potential lower availability of soil water. Thus, it was rational to detect negative relationships between resistivity, altitude and distance to the river, on one side, opposite to the AIDB and the yield potential without any diease, on the other side. Results will be discussed to put forward hypotheses concerning key parameters for better explaining the plot susceptibility to these major diseases.

Keywords: precision viticulture, indicators of plot susceptibility to fungal diseases, IPM, epidemiology, crop loss, multipathogens risk indicators

OP5 - IMPROVEMENT OF COPPER EFFICACY AGAINST PLASMOPARA VITICOLA IN ORGANIC VITICULTURE BY ADDING ADJUVANTS

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The use of copper in viticulture – mainly against Plasmopara viticola – is controversial due to its known environmental toxicity. For organic viticulture, this is worsened by the fact that the efficacy of copper has always been insufficient, especially in years with strong Plasmopara epidemics or under suboptimal timing of the applications. Despite decades of intensive research, there is currently no copper substitute available for organic viticulture.

The active ingredient potassium phosphonate can considerably improve the efficay of copper against P. viticola and is already approved for integrated viticulture. Some representatives of organic viticulture, however, continue to controversially discuss its use and do not push the necessary listing in Annex IIB of the EU Regulation 2092/91.

Within the framework of efficacy studies in the vineyard according to EPPO guidelines, it was investigated whether the effect of copper-containing plant protection agents can at least be stabilised or even improved by the addition of adjuvants, sulphur or potassium hydrogen carbonate and, if so, which component is responsible for the improving effect.

It was demonstrated, that copper efficacy was improved mainly by adjuvants and not by sulphur or potassium hydrogen carbonate.

With regard to the desired increase of organic wine production in Europe, this approach can contribute to copper reduction in organic viticulture.

Keywords: Copper, Plasmopara viticola, organic viticulture, copper reduction, adjuvants, sulphur, potassium hydrogen carbonate

OP6 - EVALUATION OF INTER AND INTRACULTIVAR VARIABILITY IN THE DOWNY MILDEW RESISTANCE IN VITIS VINIFERA L

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Vineyards located in humid temperate areas are specially exposed to downy mildew infections. Control of the pathogen rely on multiple fungicide treatments, which is economically as well as environmentally nonviable. This has led to the development of restrict regulations for the use of phytosanitary products, as well as the removal of some active ingredients from the market. Over the last few years, the development of hibrid resistant cultivars has emerged as an alternative to the use of chemicals; however, these cultivars are still not competitive in terms of oenological value in comparison with traditional cultivars. Identifying and planting disease-resistant cultivars already available in germplasm collections is therefore a time-tested and sustainable approach to downy mildew disease management.

In this study, we evaluated 60 cultivars and 23 clones belonging to four major cultivars in Galicia (Albariño, Brancellao, Espadeiro and Sousón) from the EVEGA germplasm repositories, for identifying new sources of disease resistance. Inoculations were performed by using the leaf disc test in the laboratory. All cultivars were susceptible to fungal infection. The severity of necrosis caused by the fungus varied considerably amongst the cultivars and clones. Cultivars included or related with ¨Caiños¨ group, (i.e., Caiño Bravo, Caiño Tinto, Caíño Longo and Pedral), showed lower susceptibility to fungal infection. These cultivars represent around 1% of the Galician vineyard surface. Traditionally, they were grown in the most oriental part of the region, where climatic conditions tend to be more propicious to the pathogen development. Intravarietal differences found allowed classifying different clones according to varying sings to partial resistance to downy mildew. Identifying a set of resistant, existing grapevine cultivars and clones that can be directly planted by growers in high-risk infection areas would be an alternative to reduce the excesive use of agrochemicals in the vineyard.

Keywords: Plasmopara viticola, Vitis vinifera, North Spain, susceptibility, resistence, clones

OP7 - RESISTANCE OF ERYSIPHE NECATOR TO FUNGICIDES AND THE USE OF BIO-FUNGICIDES AND MACRO PLUS MICRO-NUTRIENTS IN GRAPE POWDERY MILDEW MANAGEMENT

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Powdery mildew caused by *Erysiphe necator* is one of the most destructive diseases of grapes worldwide. Since 2004, low efficacy of disease control was observed in Israel following sprays of demethylation inhibitors (DMI) fungicides. Since 2007, low efficacy of strobilurin (QoI) fungicides and reduced efficacy of quinoxyfen, an azanapthalene (AZN) fungicide were also observed. Resistance of *E. necator* to DMI, QoI and AZN fungicides is known worldwide, but phenotypic and genetic characterization, and seasonal dynamics of resistance in the Mediterranean basin need further investigation. Eight field experiments were conducted during 2017-19 in Israel. Percent of infected clusters (incidence) and percentage of the infected cluster area (severity) were evaluated in each experiment. Kresoxim-methyl (QoI), tebuconazole (DMI) and quinoxyfen (AZN) provided reduced efficacy, with 0-35%, 40-45% and 5-20% efficacy for disease incidence, respectively, relative to control. Kresoxim-methyl was ineffective presented as low as 10-30% efficacy, while tebuconazole and quinoxyfen presented 90-97% efficacy for disease severity. Isolates of *E. necator* were collected from the different treatments throughout the season, and their resistance to QoI, DMI and AZN was assessed by using leaf discs. LD50 values for the resistant isolates were 100-1000, 2-8 and >100 µg/mL for QoI, DMI and AZN, respectively, compared to 0.5-0.9, 0.04-0.4 and 0.002-0.09 µg/mL for sensitive non-sprayed wild type isolates. Isolates resistant to kresoxim-methyl carried the genetic mutation G143A in the *CYTB* gene, and isolates resistant to tebuconazole showed the genetic mutation Y136F in the *CYP51* gene. The fact that isolates resistant to kresoxim-methyl were detected in unsprayed vines for two consecutive years, indicates that there might be a limited cost of fitness to QoI resistance.

In order to reduce fungicides usage and resistance risk, the efficacy of foliar sprays with fertilizers and a hybrid (bio+synthetic) fungicide was examined in the field. Foliar application of the fertilizer potassium phosphate, KP Plus (1-50-33 NKP) in mixtures with micronutrients like Boron (B) plus Zinc (Zn), or with the pre-mixture TruPhos Platinum (containing N, P_2O_5, K_2O, Mg, Fe, Mn, Zn, Cu, B, Mo and CO) reduced disease incidence and severity by 32-72% and 85-95%, respectively, compared to untreated vines. The hybrid fungicide Regev (containing the essential tea tree oil plus difenoconazole) reduced disease incidence and severity by 40-80% and 88-98%, respectively. Disease control by foliar sprays of either the hybrid fungicide or fertilizers was similar to that achieved by the synthetic fungicides quinoxyfen. The results of this study characterized fungicides resistance in Israeli vineyards, and suggests a limited cost of fitness to QoI fungicides. The integration of a hybrid fungicide and macro/micronutrients sprays in disease management may reduce fungicide usage and resistance risk.

Keywords: fertilizers, disease control, systemic fungicides, genetic mutations, hybrid fungicide

OP8 - APPLICATION OF TRICHODERMA ATROVIRIDE SC1 IN GRAPEVINE NURSERIES AND YOUNG VINEYARDS TO REDUCE FUNGAL GRAPEVINE TRUNK PATHOGENS INFECTIONS

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Fungal grapevine trunk diseases (GTD) represent a threat for viticulture, being responsible of important economic losses worldwide. Most of the research works dealing with the control of GTD in grapevine nurseries with Biocontrol Agents (BCA), have evaluated their efficacy in a short-term period, showing a disconnection between the development of management strategies in nurseries and the subsequent protection of the plants once they are planted in vineyards. In this research, nursery and vineyard experiments were set up to evaluate the ability of the BCA *Trichoderma atroviride* SC1 to reduce infections caused by GTD pathogens during the propagation process in a nursery, and to protect grapevine plants in young vineyards during two growing seasons. In the 2015 growing season, cuttings of 110 R rootstock subsequently grafted with Garnacha Tintorera cultivar were treated with a suspension of formulated *T. atroviride* SC1, which was applied during the nursery propagation process. Later, in 2016 and 2017, treatments with *T. atroviride* SC1 were applied to the same plants at planting moment in two different commercial vineyards (2016) and at the first pruning (2017). Untreated plants were used as controls. The effect of the treatments on treated and untreated plants was compared by fungal isolation followed by molecular identification of the colonies (2015, 2016 and 2017) and by measuring undried shoot weight (2016 and 2017). Results of this study showed that nursery application of *T. atroviride* SC1 was able to reduce GTD pathogens (Petri disease, Black-foot and Botryosphaeria dieback diseases) incidence and severity on grapevine propagation material after the grafting process. Moreover, additional *T. atroviride* SC1 treatments performed during two growing seasons in vineyards planted with these grafted plants also contributed to maintain reduced levels of GTD infections when compared with untreated plants. Our results demonstrate that treatments with *T. atroviride* SC1 can be useful to manage GTD in the grapevine propagation process and in young vineyards.

Keywords: Biocontrol agents, Black-foot, Botryosphaeria dieback, Disease management, Grafting process, Petri disease

OP9 - BACILLUS SUBTILIS PTA-271 COUNTERACTS BOTRYOSPHAERIA DIEBACK IN GRAPEVINE, TRIGGERING IMMUNE RESPONSES AND DETOXIFICATION OF FUNGAL PHYTOTOXINS

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Plant pathogens have evolved various strategies to enter hosts and cause diseases. Particularly *Neofusicoccum parvum*, a member of Botryosphaeria dieback consortium, can secrete the phytotoxins (-)-terremutin and (*R*)-mellein during grapevine colonization. The contribution of phytotoxins to Botryosphaeria dieback symptoms still remains unknown. Moreover, there are currently no efficient control strategies of this disease, and agro-environmental concerns have raised increasing interest in biocontrol strategies to limit disease spread in vineyards, especially by using some promising beneficial bacteria. Here, we first examined in planta the biocontrol capacity of *Bacillus subtilis*PTA-271 against *N. parvum*Np-Bt67 strain producing both (-)-terremutin and (*R*)-mellein. We then focused on the direct effects of PTA-271 on pathogen growth and the fate of pure phytotoxins, and explored the capacity of PTA-271 to induce or prime grapevine immunity upon pathogen infection or phytotoxin exposure. Results provided evidence that PTA-271 significantly protects grapevine cuttings against *N. parvum*and significantly primes the expression of *PR2*(encoding a β-1,3-glucanase) and *NCED2*(9-cis-epoxycarotenoid dioxygenase involved in abscisic acid biosynthesis) genes upon pathogen challenge. Using *in vitro*plantlets, we also showed that PTA-271 triggers the expression of salicylic acid- and jasmonic acid-responsive genes, including *GST1*(encoding a glutathione-S-transferase) involved in detoxification process. However, in PTA-271-pretreated plantlets, exogenous (-)-terremutin strongly lowered the expression of most of upregulated genes, except *GST1*. Data also indicated that PTA-271 can detoxify both (-)-terremutin and (*R*)-mellein and antagonize *N. parvum*under *in vitro*conditions. Our findings highlight (-)-terremutin and (*R*)-mellein as key aggressive molecules produced by *N. parvum*that may weaken grapevine immunity to promote Botryosphaeria dieback symptoms. However, PTA-271 can efficiently attenuate Botryosphaeria dieback by enhancing some host immune responses and detoxifying both phytotoxins produced by *N. parvum.*

Keywords: grapevine, biocontrol, Botryosphaeria dieback, Bacillus subtitles, Neofusicoccum parvum,phytotoxins

OP10 - FIELD EVALUATION OF BIOCONTROL AGENTS AGAINST BLACK-FOOT AND PETRI DISEASES

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Experimentally, most of the studies on biocontrol agents (BCAs) have been applied so far in vines under controlled conditions and little information is still available about the effectiveness of this strategy under field conditions. In this study, two field experiments were established to evaluate the effect of five BCAs (*Streptomyces*sp. E1+R4, *Pythium oligandrum* Po37, and commercial products containing *Trichoderma atroviride*SC1, *T. koningii* and *Pseudomonas florescens*+*Bacillus atrophaeus*) root treatments on black-foot and Petri disease fungal infection in one-year-old dormant grafted plants prior to dispatch. In April 2017, vines were hot-water treated at 53ºC for 30 min and roots were immediately soaked in BCAs suspensions for 24 h. Two additional applications of BCAs were applied by drip irrigation in May 2017 and 2018. In each field, 50% of the vines were evaluated in February 2018 and the remaining 50% in February 2019. The fungal incidence and severity in roots and at the base of the rootstock in all vines and the total root mass and shoot weight in 3-year-old vines were determined. The effectiveness of some BCAs in reducing the incidence and severity of both diseases was dependent on the plant zone analysed and the plant age. *Streptomyces*sp. E1+R4, *Pythium oligandrum*Po37 and *Trichoderma atroviride*SC1 were able to reduce significantly fungal incidence and severity in specific scenarios. BCA treatments had no effect on the shoot weight, and root weight was significantly lower in all BCA treatments with respect to the control. This study represents the first approach to evaluate the effectiveness of different antagonistic microorganisms (bacteria, fungi and oomycete) to control black-foot and Petri disease under field conditions. Investigation of BCA able to prevent or at least reduce the development of GTDs should be considered a research priority based on the restriction and difficulties that chemicals are facing in most countries around the world.

Keywords: biocontrol, grapevine, black-foot disease, Petri disease, field conditions

OP11 - PROTECTION OF GRAPEVINE ROOTSTOCK MOTHER VINE PRUNING WOUNDS AGAINST PHAEOMONIELLA CHLAMYDOSPORA ASSOCIATED WITH PETRI DISEASE AND ESCA

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Grapevine trunk diseases (GTD) is a serious problem in all countries where grapevines are grown. *Phaeomoniella chlamydospora*, associated with Petri disease and esca, can infect grapevines as early as the propagation process. The pathogen infects rootstock mother vines through susceptible pruning wounds, establish within the head where they are able to sporulate within the xylem tissue and consequently spread to rootstock canes which are harvested and supplied to nurseries as rootstock propagation material. The aim of the study was therefore to select and evaluate various fungicides, biological control agents and fungicide-biological control agent mixtures for efficacy to protect pruning wounds. *Trichoderma*-based biological control agents included Eco77 (*Trichoderma atroviride*, Plant Health Products, South Africa), UST1 (*Trichoderma atroviride*, Department of Plant Pathology, University of Stellenbosch) and USMT1 (a benzimidazole resistant mutant; Department of Plant Pathology, University of Stellenbosch). Carbendazim was included as positive control treatment and water as the negative control. Thiophanate-methyl, pyraclostrobin, kresoxim-methyl, tebuconazole and thiophanate-methyl + epiconazole were the other fungicides. The pruning wound protectant Tessior (boscalid + pyraclostrobin + polymer) was also included. USMT1 + carbendazim and USMT1 + thiophanate-methyl were included as fungicide-biological control agent mixtures. Four-year-old Ramsey and 101-14 Mgt rootstock mother vines were pruned in winter 2017 and 2018, where after the treatments were applied to the wounds within 1h of pruning. The treated wounds were then challenged with *Pa chlamydospora* (1000 spores/wound applied as a 50 µl pipet droplet)1 and 7 days after pruning. The trials were evaluated after 9 months by removing the treated stubs and conducting fungal isolations from the wounds. *Pa chlamydospora* incidences in the non-treated control wounds were 80% in both the 1 and 7 day challenged wounds. The fungicide-biological control agent mixtures USMT1 + carbendazim and USMT1 + thiophanate-methyl provided the most consistent results over the two seasons by reducing *Pa chlamydospora* incidences by 56% and 53%, respectively when the wounds were challenged after 1 day and 25% and 31%, respectively when challenged after 7 days. The biological control agents Eco77 and UST1 also showed potential, especially when the wounds were challenged after 7 days by reducing *Pa chlamydospora* incidences by 28% and 36%, respectively. The fact that several treatments provided significant reduction in pathogen incidence despite a high spore load highlights the potential of these formulations to be used in field conditions when exposed to natural infection. Furthermore, the potential of biological control agents based on *Trichoderma* species, to provide environmentally friendly protection of pruning wounds over a long susceptibility period is of cardinal importance to grapevine industries worldwide.

Keywords: Grapevine, rootstock mother vine, pruning wound protection, biological control agents

OP12 - SPORE TRAPPING OF ESCA DISEASE PATHOGENS IN ISRAELI VINEYARDS

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Esca phenomenon in vineyards poses a major threat to vine growers around the world. Recently infection rate is increasing in younger as well as older vineyards and the economic loss is accordingly. The phenomenon is characterized by specific leaf chlorosis known as "tiger stripes", berry scorches and trunk cankers. *Phaeoacremonium aleophilum* (PAL), *Phaeomoniella chlamydospora* (PCH) and *Fomitiporia mediterranea* (FOM) are the three main fungi associated with Esca, although other species were also reported. Pruning wounds are considered as primary sites for new infections and disease spread in the vineyards. Spore release and dispersion is usually monitored by various spore traps. Such a survey was conducted in order to study the temporal distribution of spores under Israeli conditions. For spore traps. microscope slides coated with petroleum jelly attached to the vine were used. To assure that there are no faults in the process, we simulated spore trapping by artificial spore sowing on slides followed by rinsing, filtering and plating on 1/4 PDA. The simulation confirmed that spores of PAL and PCH survived on the slides at least 10 days and were viable throughout the whole process. In the vineyard, spore traps were mounted year-round (more than 30 times), each time for ca.7 days on heavily infected 40 years old Sauvignon Blanc vines. PAL was never detected and PCH spores were detected only twice when identification was done by mycelium morphology of the germinating spores. However, PCR analyses with specific primers allowed the detection of the three main esca associated fungi from thetotal spores collected from the traps. PAL spores were detected mostly from winter to early summer months, but PCH spores were detected year-round. FOM was detected three times only in May-June. Heavy rain simulation in June showed higher percentage of PCH spores under wet conditions compared to dry conditions while PAL spores were detected similarly under both conditions. The results showed that spore dispersion occurred year round. Although, quantifying the amount of spores needs further study, it seems that under Israeli conditions esca spores are dispersed in rather small quantities. The implication of these results on field practices should be considered.

Keywords: Esca, Phaeoacremonium aleophilum, Phaeomoniella chlamydospora, Fomitiporia mediterranea, spore trap

OP13 - SUSCEPTIBILITY OF FOUR PORTUGUESE GRAPEVINE CULTIVARS TO LASIODIPLODIA SPP.: PRELIMINARY RESULTS.

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Botryosphaeriaceae species are associated worldwide with grapevine trunk diseases (GTDs), known as Botryosphaeria dieback, namely from genera *Neofusicoccum*, *Diplodia* and *Lasiodiplodia*. The genus *Lasiodiplodia* currently comprises more than 20 species of which eight were reported from grapevine: *L. theobromae*, *L. pseudothobromae*, *L. parva*, *L. crassispora*, *L. plurivora*, *L. missouriana*, *L. viticola* and *L. mediterranea*. *Lasiodiplodia theobromae* is a plurivorous pathogen with a worldwide distribution especially in tropical and subtropical regions. It occurs mainly on fruit and forest trees and is also the most commonly isolated from grapevines. Possibly due to climate changes, it has been increasingly recorded from grapevines not only in tropical and subtropical regions but also in regions with more temperate climates: Australia, Brazil, Bolivia, China, Italy, Mexico, Portugal, Spain, Turkey and USA. This is a clear evidence of the importance of *L. theobromae* as a grapevine emergent pathogen.

Following this increase in the detection of this pathogen, this work aimed to understand how infection with *Lasiodiplodia* spp. isolates affects disease development in four Portuguese cultivars by inoculating, characterized *Lasiodiplodia* spp. isolates in one-year old grafted cuttings of cvs. Alvarinho, Aragonez, Touriga Nacional and Touriga Franca. Green shoots were inoculated with active growing mycelial discs. Both necrosis and canker size were recorded before shoots lignifications. Reisolations were performed from the edge of the lesions and isolates were identified. Re-isolations of the inoculated fungi were performed from symptomatic berries.

Highly significant differences of canker area and length of internal lesions were recorded among isolates for all isolate/cultivar when compared with control plants. The cultivars Touriga Nacional and Alvarinho presented the biggest canker and internal lesions sizes, therefore appearing to be somewhat more susceptible to *Lasiodiplodia* spp. For cultivar Aragonez, which appears to be the least susceptible, practically no differences could be found when comparing isolates, suggesting that, the cultivar reacts in a similar way to all the *Lasiodiplodia* isolates under study. In general, isolate Bt105 appeared to be the one that was able to produce, on average, the highest canker area and internal lesions length. The least agressive isolate for all the cultivars was, apparently isolate V15 which is originary from Peru. This result is not surprising since it was already previously considered an isolate with low agressiveness.

Keywords: Vitis vinifera, Botryosphaeria dieback, Lasiodiplodia spp., susceptibility, aggressiveness

OP14 - RESPONSE OF FOUR PORTUGUESE GRAPEVINE CULTIVARS TO INFECTION BY PHAEOMONIELLA CHLAMYDOSPORA

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Little is known of the response of Portuguese Dão wine appellation's most common grapevine cultivars to the causal agents of esca and Petri diseases, despite the high incidence of both diseases in the region and the consequent economic losses. *Phaeomoniella chlamydospora* has been considered one of the major causal agents of these diseases in that region. The present study evaluated the responses of four of the most propagated Dão's grapevine cultivars – Alfrocheiro, Aragonez, Jaen and Touriga Nacional – to infection by three different Portuguese isolates of *P. chlamydospora*. Field trials were conducted in 2012, 2013 and 2015. The cultivar Alfrocheiro was the most susceptible to *P. chlamydospora* while cv. Jaen was the least. Variation in parameters such as lesion length and pathogen recovery from infected spurs (within trial years) suggest relation of pathogenicity with weather data, particularly temperature. Differences in aggressiveness among isolates were also detected, with one, a non-native, being the most aggressive. These results provide valuable information for local winegrowers, identifying, for the first time, susceptibility differences among local cultivars to *P. chlamydospora*, and suggesting adjustments to recommended pruning strategies, specifically to leave long spurs and avoid late winter pruning, thus reducing grapevine trunk colonization by *P. chlamydospora.*

Keywords: esca, field infection, cultivar susceptibility, Vitis vinifera

OP15 - FUNCTIONAL BIODIVERSITY IN DOURO VINEYARDS (NORTHEAST OF PORTUGAL)

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Recognition of agrobiodiversity's importance in viticulture has led to increase interest for conservation biological control (CBC) strategies contributing for the reduction of pesticides use whilst promoting provisioning and cultural ecosystem services. While vineyards are among the most intensive forms of permanent crops, often resulting in simplified landscapes, in the Douro Demarcated Region (DDR), particularly in the 'Alto Douro Wine Region' (UNESCO World Heritage Site), the characteristics of the landscape offers great possibilities in terms of agrobiodiversity. This is because a lesser but significant part of this area is occupied with non-crop habitats (woodland remnants, grassy slopes, terraces with natural vegetation and dry-stone walls) which are very important from this standpoint. The objective of this study was to analyze the main determinants on functional agrobiodiversity at Quinta dos Murças, a vineyard estate located in the DDR (41° 9´11.17"N, 7°41´14.95"W), that started a process of conversion from IPM to Organic production in 2010. Considering differences in the "terroirs" identified and other vineyard features including the surroundings, a selection of 24 sampling points was set up and assessed both in May and October 2018 for flora and arthropods (COMBI traps, pitfall traps and Berlese-Tullgren funnels). Abundance, richness and Shannon index of plants and arthropods were calculated. Based on soil-living arthropods presented in the soil, the Soil Biological Quality-arthropod index (QBS-ar) was assessed. In October, soil biological activity was also evaluated using the bait-lamina assay. Landscape composition around each sampling point was calculated within a GIS database with a radius of 200 m, overlaying aerial photographs. Data were analyzed to evaluate the impact of landscape, flora, soil characteristics and vineyard management practices on the presence of functional groups (predators, parasitoids) and some bioindicators, including pollinators. Results indicate that there is a high heterogeneity of flora and arthropods at plot level, which is related with specific features of the vineyards concerning the practices implemented, soil fertility, microclimates and proximity to NCH. These results are discussed in terms of their potential use for promoting an ecosystem-management based on a CBC strategy.

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Keywords: functional agrobiodiversity, conservation biological control, vineyard, bioindicators, ecosystem management

OP16 - CRYPTOBLABES GNIDIELLA: A FEARED PRIMARY PEST OF GRAPEVINE IN THE MEDITERRANEAN AREA.

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Though in Brazil, Uruguay and in other countries of South America *Cryptoblabes gnidiella* (Pyralidae Phicitinae) has always been deemed the most important pest of grape for the substantial damage caused by its larvae to the ripening clusters, in European vineyards it was never considered a key pest for grapevine, probably because it usually occurred at low density and its presence in the grape clusters were referred to other pests. More recently, the great economic importance of this moth on grapes in Italy and France has been referred to specific climatic conditions as, for example, those occurring in coastal areas characterized by warm climate. In these environments, *C. gnidiella* develops mostly on ripening grapes, leading to a progressive cluster decay, jeopardizing the efforts made in the last decades to control other pests such as *Lobesia botrana* and *Planococcus ficus* with sustainable control methods.

Larval feeding of *C. gnidiella* leads to a progressive cluster decay, with appearance of dry and wilt berries, interspersed with a thick lattice of fine threads bearing faeces and larval and pupal exuviae.

Here we report on recent observations carried out in vineyards of Central and Southern Italy aimed at improving knowledge on biology, behaviour and harmfulness of *C. gnidiella*, discussing the available control strategies as well.

Keywords: honeydew moth; grapevine, Pyralidae, Phycitinae, integrated pest management.

OP17 - ERASMONEURA VULNERATA (HEMIPTERA CICADELIDAE) IS CHANGING ITS PEST STATUS IN EUROPE

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Erasmoneura vulnerata (Fitch) is a Nearctic leafhopper frequently reported in Northern and Central America as *Erythroneura vulnerata*. In American literature, this species is often mentioned within leafhopper communities associated with grapevines, but its pest status seems to be lower compared to that of other leafhopper species. *Erasmoneura vulnerata* was detected for the first time in Europe in 2004 (Northern Italy) and was considered for many years as a minor pest. It was frequently encountered in untreated rather than in commercial vineyards. In 2016, the first outbreaks of *E. vulnerata* were reported in several vineyards located in the Veneto region (North-eastern Italy).

Interestingly high population densities and severe leaf symptoms were observed both in organic and in conventional vineyards despite the use of fungicides and insecticides (mainly pyrethrins in the former and organophosphates in the latter). Detailed investigations carried out in 2017 and 2018 showed that *E. vulnerata* could develop three generations per year, reaching high densities (exceeding ten motile stages per leaf) in spring and summer. Vineyard colonisation by overwintered females starts in early spring coming from natural borders or rural buildings. High populations in spring are associated with a decline of native leafhoppers (e.g. *Empoasca vitis* and *Zygina rhamni*). The impact of natural enemies, in particular of egg parasitoids, proved to be moderate to low. At the same time, organophosphates and pyrethrins did not provide satisfactory control. The number of vineyards involved in outbreaks is increasing, and the use of insecticides is currently the main control measure.

Keywords: grapevine, leafhoppers, phenology, distribution, control

OP18 - CHARACTERIZING SYMPATRIC LEAFHOPPER SPECIES OF THE "GREEN LEAFHOPPER" COMPLEX (TYPHLOCYBINAE) BY NICHE CHOICES

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Pests monitoring is essential for effective IPM. Knowing where, when and the magnitude of a potential damage inflicted by the pests may optimize pesticide treatments. Sympatric "green leafhopper" (Typhlocybinae) species are polyphagous pests. Different combinations of species may occur depending on the weather, competition for food, developmental rate and pesticides tolerance of the field population. However, monitoring each species independently is difficult because they cannot be identified visually in the field.

We identified morphologically three leafhoppers species that reside in Israeli vineyards: *Asymmetrasca decedens*, *Jacobiasca lybica* (Tribe Empoascini) and *Zygina rhamni* (Tribe Erythroneurini) (V. Mazzoni and R. Sharon, unpublished). For those species we developed species-specific primers that enabled molecular identification of nymphs and adults without being solely dependent on male genitalia.

We conducted lab and field experiments in two vine cultivars, Cabernet sauvignon and Merlot, to study the seasonal activity, developmental rate of each species, their potential damage and the effect of pesticides.

On potted plants in the lab, *Z. rhamni* had more offspring than the other two species, though generation length did not differ. Symptoms on leaves differed- white dotes/spots in plants inoculated by *Z. rhamni* and reddish leaf margins in plants inoculated by *A. decedens* and *J. lybica*.
In the field trial we found that though all species are found in all plots, *A. decedens* was the dominant species in Merlot, appearing, mainly during spring and early summer. *Z. rhamni* was dominant in Cabernet sauvignon and appears, later in the season with some overlapping of the two species. The 3rd species, *J. lybica* appears at mid-summer, is more sporadic and had the lowest population. The symptom inflicted by *Z. rhamni* was the only one seen in Cabernet sauvignon whereas in merlot we could detect both types of symptoms. *Z. rhamni* seems less affected by insecticides.

The combination of *Z. rhamni* higher developmental rate due to higher number of offspring and the possible developing of tolerance to insecticides may contributed to the increased population during the summer in Cabernet sauvignon. The low population of this species on merlot in the field is yet to be explained.

Thus, this complex of sympatric species can be differentiated in vineyards by damage pattern, dominancy in different cultivars, time of appearance and population developmental rate.

Keywords: pest monitoring, Leafhoppers, sympatric species, population dynamic, molecular identification, niche choices

OP19 - THE GRAPE PHYLLOXERA IN TUSCANY: AN OLD OR A NEW PROBLEM?

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The resurgence of *Daktulosphaira vitifoliae* (Fitch) as a vineyard pest is a quite great problem and a challenge for many world researchers. As a matter of fact, one century after its introduction into Europe the grape phylloxera still arises issues on basic knowledge. During the last 30 years new investigations have been developed in different countries in several topics such as the genetic structure of several populations evolved worldwide, the life cycle of the aphid, and the possible impact of its infestations on the vine, grape and wine. In Italy an increasing number of leaf-galling infestations was recorded in important wine areas. A three-years survey (2017-2019) on the biology and population dynamic of the grape phylloxera, has been carried out in some vineyards in Tuscany (Central Italy). Observations concerned mainly the distribution pattern of the species in the most relevant wine districts of the region, the relationship between leaf and root populations, and the effects of the leaf-galling population density on the plant physiology and grape qualitative parameters. Lastly in the current year, a field trial to control leaf-galling population is bein performed comparing different treatments such as: a) topping (control); b) topping + acetamiprid (Epik); c) topping + essential oil of sweet orange (Prev-AM); d) topping + potassium salts of fatty acids (Flipper). In Tuscany *D. vitifoliae* showed, as expected, a noticeable variability in the population density in relation to the microclimatic factors, seasonal trends, grapevine varieties, training system, and planting density, whereas the leaf-galling population density does not seem to be related to the root population. Furthermore, preliminary results showed how some important physiological parameters can be affected by different leaf-galling population densities. Concerning the control trial, no significant differences have been highlighted between treatments, allowing to stress the importance of agronomic practices such as the removal of the infested leaves.

Keywords: Daktulosphaira vitifoliae, distribution, life cycle, Sangiovese variety, damage assessment, integrated control

OP20 - TESTING THE USE OF MATING DISRUPTION IN THE MANAGEMENT OF VINE MEALYBUG POPULATIONS IN ALENTEJO VINEYARDS

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The vine mealybug (VM), *Planococcus ficus* (Signoret) (Hemiptera, Pseudococcidae) has been increasing its importance in some areas, in Portugal. Chemical control is still the most common management tactic used against VM. However, it is often ineffective due to mealybug cryptic behaviour, waxy body cover, and clumped spatial distribution pattern. Also, the use of insecticides may be unsustainable, due to resistance, low selectivity, human toxicity, or risk or hazard assessment. Furthermore, the use of synthetic insecticides is not allowed in organic vineyards. Therefore, there is a need to find sustainable control tactics. Mating disruption experiments were carried out in three vineyards of Alentejo region, in 1-2ha plots, between 2017 and 2019, to test its effectiveness against VM. In mating disruption plots, 500 Isonet PF dispensers/ha were installed in early May. Male-flight activity was monitored weekly, using pheromone traps. Mealybug infestation was evaluated in June and July by visual observation, in 30 vines/plot. The level of infestation was determined using the index: 0- no mealybugs; 1- isolated individuals; 2- few mealybug colonies; and 3- several to many colonies. At harvest, the percentage of infested grape bunches and the number of mealybugs per bunch were determined, by sampling at least 50 bunches per plot. In the two first years, mean male captures within control plots were significantly higher (4.7 times) those in mating disruption. The disruption index varied between 20% and 86%, in 2017, and between 77% and 80%, in 2018. The mean level of infestation in vine canopy in control plots was about 1.4 times higher but not significantly different from that in mating disruption. At harvest, the mean grape infestation, in mating disruption was significantly lower than in control plots. The 2019 experiment will be completed in September. The global results of the three-year's experiments will be presented and discussed.

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Keywords: Planococcus ficus, mealybugs, grapevine, pheromones, mating disruption, IPM

OP21 - ALTERNATIVE HOST PLANTS AS POTENTIAL TRAP CROPS AGAINST DROSOPHILA SUZUKII IN VINEYARDS

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Since a decade, the polyphagous invasive vinegar fly Drosophila suzukii has rapidly spread worldwide affecting stone fruit, berry and grape production. The European CORE Organic project Biovine (www.biovine.eu) aims to develop natural solutions based on plant diversity to control pests and reduce pesticide dependence in vineyards. In this framework, we explore the potential application of trap crops for diverting D. suzukii from attacking grapes. Trap crops are defined as plants that attract pests away from nearby crops and that protect them from economic damage. However, to avoid an infestation source in the vicinity of the cultivated crop, the development of the pest in the trap crop should ideally be low, so-called dead-end trap crops, and the phenology of the cultivated and the trap crop should be coupled. To find plant species more attractive than grapes on which D. suzukii development is reduced, we have set up preference and development experiments in the laboratory for 63 plant species. Drosophila suzukii's preference was significantly higher for 32 of the alternative hosts tested than for grape and between 0 to 85% of the deposited eggs were able to develop to adults. This first screening allowed us to select nine candidate trap crop species and their potential to protect grapes from D. suzukii infestation is now tested under semi-field conditions. We intend to identify 1 to 2 trap crop species that could be planted in vineyard margins in order to lower damage on sensitive grape cultivars and in consequence reduce the use of plant protection products.

Keywords: Dead-end trap crop, spotted wing drosophila, grape production, pest control, laboratory experiments, plant diversity

OP22 - POPULATION ABUNDANCE AND IMPACT OF BROWN MARMORATED STINK BUG HALYOMORPHA HALYS (STÅL) ON GRAPEVINE IN NORTHEASTERN ITALY

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The Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae) is an invasive species in Europe. It is frequently observed in vineyards, feeding on berries of European grapevine, *Vitis vinifera* L., but little information is available on the impact of BMSB on this crop in Europe. The aims of this study are: (1) to investigate the population abundance of *H. halys* in vineyards on different cultivars in northeastern Italy, and (2) to evaluate the impact of BMSB infestation on grapevine production. Population abundance was studied by sampling different multi-cultivar vineyards using visual and beat sampling. The distribution within vineyards (edge vs. center of the vineyards) was also considered. The impact of BMSB on grapevine was studied on Cabernet Franc, Glera, Merlot and Pinot gris cultivars, with a cage experiment and controlled infestations (infestation levels: 0, 0.5, 1 and 2 BMSB adults per cluster, on two clusters in each cage) established at different grape berry phenological stages. Direct and indirect damage (i.e., *Botrytis cinerea* infection) and must quality were assessed at harvesting time. Higher number of BMSB were found on the border of the vineyards compared with the center, and more bugs were found on Cabernet Franc and Merlot compared to other cultivars. Red cultivars were generally more infested than white ones; higher infestations were also observed on cultivars harvested late in the season than the ones harvested early. The cage experiment study showed a correlation between the number of berries with feeding damage and infestation density. Higher incidence of damaged fruits were observed on infestation settled at 50% of veraison stage compared to others. No effect on fruit weight at harvest and must quality was detected. The number of berry bearing signs of *B. cinerea* was associated with BMSB infestation.

Keywords: Brown Marmorated Stink Bug, Halyomorpha halys, population abundance, impact, grapevine, cultivar

OP23 - IMPACT OF PROCESSED HALYOMORPHA HALYS ON THE TASTE OF PROCESSED GRAPES

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Native to East Asia, the invasive brown marmorated stink bug (*Halyomorpha halys*) was accidentally introduced into Switzerland around 2004 and is now spreading all over Europe. This very polyphagous pentatomid can feed on more than 200 different host plant species and it thereby attacks a multitude of agricultural crops. *Halyomorpha halys* is thus an economically important insect pest in field crops, vegetables, pome fruits, stone fruits and soft fruits. Moreover, all development stages of *H. halys* can be found in vineyards, suggesting that it can also develop on grapevines. Nonetheless, its actual importance for grape production remains unclear. Here we studied the impact of processed *H. halys* on the aroma and taste of grape juice and wines. We therefore artificially contaminated ´Chardonnay´ and ´Merlot´ grapes with different quantities of *H. halys* nymphs and adults directly before grapes were destemmed and crushed. In the freshly pressed must, the addition of one living bug/kg grapes did not affect the olfactory sensation of the ´Chardonnay´ juice. However, the aroma and taste of ´Chardonnay´ and ´Merlot´ musts contaminated with three to ten *H. halys* individuals/kg grapes could be distinguished from the uncontaminated control juices and they were perceived as vegetal and woody. These differences disappeared, however, during the fermentation process and bottled wines could not any longer be differentiated from each other. Thus, it seems that the molecules responsible for the "bug taint" in contaminated musts volatilised during the fermentation process. Our results therefore indicate that a contamination of the vintage with *H. halys* has the potential to alter the quality of grape juice but that there is little risk for influencing the taste of processed wines. Nonetheless, we recommend monitoring the evolution of *H. halys* in vineyards in order to anticipate quantitative and qualitative problems in the harvest.

Keywords: Pentatomidae, Hemiptera, Vitis vinifera, wine making, sensory analyses, organoleptic tests

OP24 - ENTOMOPATHOGENIC FUNGI, SOLITARY BEES AND SPIDERS IN VINEYARDS: HOW TO PROMOTE THEIR DIVERSITY AND ABUNDANCE FOR A SUSTAINABLE VITICULTURE

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The interaction between biodiversity and ecosystem services is a key factor for a productive and sustainable agriculture. Vineyards can provide habitats for a range of organisms, however, grapevine is an extremely intensively managed crop, with high frequencies of plant protection treatments both in conventional and organic (without applications of synthetic pesticides) viticulture.

Here we assessed the effects of vineyard management system (conventional or organic viticulture) and the area of semi-natural habitats (hedges, forest patches, herbaceous habitats) surrounding respective vineyards on diversity of soil entomopathogenic fungi (EPF), solitary bees and ground-dwelling spiders. Three taxa of EPF could be verified with Metarhizium spp. being the most abundant one. Presence of EPF was enhanced by a high C:N-ratio in vineyard soils. Differences between management systems were minor, with Metarhizium spp. being more abundant in conventional than in organic vineyards. We could not detect a negative effect of fungicides on the presence of EPF. Hence, EPF are able to persist even in intensively managed vineyard systems.

Overall, 918 nesting tubes of 15 solitary bee species were found. Organic management enhanced flower availability, however, this was only partially beneficial for abundances of cavity-nesting bees. Instead, diversity and abundance of solitary bees was strongly related to the proximity to the next woody habitat. Accordingly, vineyards can help to sustain pollinator abundances, given that landscapes are managed accordingly. A total of 3505 spiders comprising 62 species from 17 families were caught in pitfall traps.

Organic management only moderately enhanced species richness of spiders compared to conventional vineyards. Due to high densities of the dominant species Pardosa agrestis, spider abundance was highest in landscapes with high vineyard cover. Densities of spiders other than P. agrestis increased with proximity to semi-natural habitats.

Taken together, both the presence and proximity to semi-natural habitats in viticultural landscapes as well as organic management enhance bee and spider fauna in vineyards. Diversification of viticultural landscapes by introducing hedgerows, woodlots and permanent grassland as well as promoting organic viticulture can help to maintain biodiversity of potentially beneficial organisms and may thus serve as a basis for a future sustainable viticulture.

Keywords: biodiversity, landscape, entomopathogenic fungi, solitary bees, spiders, organic viticulture

OP25 - SIDE EFFECTS OF PLANT PROTECTION PRODUCTS ON SCALE INSECTS AND ITS NATURAL ENEMIES

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Scale insects (Hemiptera: Coccoidea) are important insects pest on grapevines. High population densities may cause feeding damages and reduced growth. In addition they are able to transmit Grapevine leafroll- associated viruses GLRaV-1 and -3. Virus infected grapevines show lowered sugar content and their yield can decrease dramatically depending on the variety. Since a few years, an increasing population of the Apple Mealybug (Phenacoccus aceris), one of the most relevant vectors of GLRaVs in temperate viticultural regions, was observed in German vineyards. The intensive use of pesticides in viticulture is assumed to be the main reason for the high populations of P. aceris. Hence, we aimed to analyze the side effects of different plant protection products (fungicides and insecticides) on scale insects (direct effect) and their natural enemies (indirect effect) under laboratory conditions. For these examinations we used the obscure mealybug Pseudococcus viburni and the parasitic wasp Anagyrus pseudococci as model organisms. In order to reflect mortality from oral uptake and contact with the pesticides, we have prepared an oral and a contact test for both model organisms. In order to simulate the contact effect of pesticides, we treated the insects with a precision laboratory sprayer (company Schachtner). The effects of 25 pesticides (16 fungicides and 9 insecticides) on P. viburni and A. pseudococci were investigated. All tested plant protection products did not control P. viburni sufficiently under laboratory conditions but some tested pesticides cause high mortality in A. pseudococci. As a result, it is assumed that, the natural regulation of the scale insects by the natural enemies in viticulture might strongly be reduced by some pesticides.

Keywords: Pesticides, Side effect, efficacy, Pseudococcus viburni, Anagyrus pesudococc, Coccina

OP26 - BIOOTWIN L: NEW BIODEGRADABLE DISPENSERS FOR THE CONTROL OF LOBESIA BOTRANA (LEPIDOPTERA, TORTRICIDAE)

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The development of environmentally sustainable control strategies to manage insect pests is a key challenge nowadays. Pheromone-mediated mating disruption (MD) is based on the release of synthetic sex attractants into a crop, interfering with mate finding of a given pest. A limited number of researches have been published on the optimization of MD strategies against the European grapevine moth, Lobesia botrana, as well as on the use of biodegradable dispensers to reduce waste production in vineyards, despite the high economic importance of this moth pest. The present study evaluated the efficacy of the biodegradable BIOOTWIN L, applied at various densities, in reducing L. botrana damage on grapevine in comparison to an untreated control and the reference MD product Isonet® L TT. Experiments were conducted in three different areas of grapevine cultivation, located in Central and Northern Italy, over three study years. The performances of biodegradable BIOOTWIN L did not differ in terms of infested flower clusters/bunches from the reference product Isonet® L TT, allowing a reliable control of the three generations of L. botrana during the whole grape growing season. This was confirmed in all experimental sites over three years of field experiments. Overall, the present research provides useful information for the optimization of MD programs against L. botrana, highlighting the interesting potential of biodegradable pheromone dispensers that can be easily applied at low densities in vineyards, in reducing the use of chemical pesticides to control this pest.

Keywords: Integrated Pest Management; European grapevine moth; mating disruption; sex pheromone

OP27 - DROSOPHILA SUZUKII AND D. MELANOGASTER AND THEIR IMPACT ON SOUR ROT DISEASE DEVELOPMENT IN VITICULTURE

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Sour rot disease is a serious disease complex in viticulture causing economic losses in years with humid conditions. It is associated with the common fruit fly, *Drosophila melanogaster*, which is a well-known amplifier of this disease. However, *D. melanogaster* is able to infest only overripe, decaying or in other way damaged fruit (for example cracked grapes after rain or insect feeding). In contrast, *Drosophila suzukii* (Matsumara), an invasive fruit fly species from Asia, is able to infest also healthy, undamaged fruit, because of its serrated ovipositor. In viticulture, it is debated, if *D. suzukii* is able to induce sour rot in healthy undamaged vineyards that way facilitating *D. melanogaster* oviposition and enforcing the disease. In our study, we used manipulative experiments in three subsequent years to investigate the influence of *D. suzukii*, *D. melanogaster*, both species together and no fly as control on sour rot development under natural conditions in the vineyard and under controlled climate in the laboratory. Sour rot damage was determined by measuring the volatile acid levels.

In 2017, *D. suzukii* and *D. melanogaster* increased sour rot development in a similar rate in semi-field experiments. In 2018, sour rot levels stayed far below the legal limits in winemaking, showing only marginal effects of both species on sour rot development in one of four repetitions. Under more favorable laboratory conditions, the presence of *D. suzukii*, but not *D. melanogaster* triggered sour rot emergence. In both years, a facilitating effect of *D. suzukii* infestation for *D. melanogaster* was not detectable.

Overall, previous results showed that *D. suzukii* has the potential to trigger sour rot under favorable conditions of laboratory, but will probably rarely do so under field conditions in the vineyard, at least in the studied region. Additionally, we reveal that dependent on grape condition, *D. melanogaster* can have a similar impact on sour rot development as *D. suzukii*, emphasizing the need of comparative studies.

Keywords: Spotted wing drosophila, sour rot, invasive pest insect, viticulture, volatile acid, fruit fly

OP28 - USE OF ENVIRONMENTAL NICHES TO UNDERSTAND INTERACTIONS AMONG BOTRYTIS CINEREA, BIOCONTROL AGENTS, AND THE ENVIRONMENT

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The use of Integrated Pest Management (IPM) and of alternative approaches or techniques, such as non-chemical alternatives to pesticides, are promoted by Directive 2009/128/EC. Alternatives to chemical pesticides include biological control agents (BCA). Some commercial BCAs are available for the control of Botrytis bunch rot (BBR) on grapevines, caused by Botrytis cinerea, but their practical use is still limited. One likely reason is the inconsistent efficacy of BCAs under field conditions, which may be related to several factors, including the variability of the environmental conditions affecting both, BCA fitness and B. cinereadevelopment. The colonization rate and the efficacy of a specific BCA, as well as B. cinereagrowth and infection, are all influenced by weather conditions, such as temperature and moisture. To achieve an effective integration of BCAs in a disease management program is then relevant to know: i) the life cycle of both, the pathogen and the BCA; ii) the mode of action of the BCA against the target pathogen; and iii) how the two are influenced by the environment. The concept of "environmental niches" is proposed to understand how the environment influence the BCA-pathogen interaction. Environmental niches are defined as the environmental conditions necessary for the presence of a species and the maintenance of its population. In this work, this concept was used to study the temperature and humidity conditions under which different commercially BCA-based products prevails over B. cinerea, and to define the extent of environmental niche sharing between each BCA and the target pathogen.

Keywords: Biological control, Botrytis cinerea, Botrytis bunch rot

OP29 - MINIMAL VS. INTENSIVE PRUNING: DOES THE TRAINING SYSTEM INFLUENCE OCCURRENCE OF FUNGAL GRAPEVINE DISEASES?

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Semi minimal pruned hedge (SMPH) is a novel and innovative grapevine training system, which is economically beneficial, environmental friendly and climate change adapted. The use of mechanical harvester for pruning related works, which are usually done by hand, reduces the working hours per hectare and makes wine production more economical, compared to the traditional, intensive pruning system, i.e. vertical shoot positioning (VSP). However, the way the grapevine stocks are trained has an enormous effect on the physiology of the plant. In comparison with VSP, grapevine stocks trained in SMPH show more woody canes, a wider leave canopy and more bunches carrying less berries.

In the present study the specific susceptibility of SMPH against fungal diseases, such as Downy Mildew (DM) or Botrytis Bunch Rot (BR), but also grapevine trunk diseases, e.g.grapevine leaf stripe disease(GLSD), was investigated. For this purpose, a comprehensive monitoring of selected vineyards, representing different cultivars and different age, has been performed from 2015 through 2018.

The results demonstrate that SMPH vines are more susceptible against Downy Mildew, but more tolerant against BR compared to intensively pruned (VSP) vines. For DM assessments were only possible in 2016; incidence rate was 35.0% for SMPH and 22.2% for VSP, incidence level 9.3% for SMPH and 3.4% for VSP. In the years 2015, 2017 and 2018 no incidence of DM was observed, probably caused by hot and dry weather conditions.

Regarding BR, in three out of four years both incidence rate and level were higher for VSP compared to SMPH. Only in 2016 no significant differences between the training systems were found. The highest difference was noted in 2015 with an incidence rate of 62.3% for VSP and 15.5% for SMPH. The incidence level was 22.4% for VSP and 2.8% for SMPH.

As for GLSD, no differences between minimally pruned (1.8%) and intensively pruned (1.9%) vines were found in 2015. However, in the following year minimally pruned vines (6.9%) expressed significantly more symptoms than intensively pruned vines (4.9%). In the years 2017 and 2018, the opposite was the case: 2.6% and 2.4%, respectively, of the minimally pruned vines showed GLSD symptoms, while for the intensively pruned vines the mean values were 4.5% and 3.6%, respectively.

As a future prospect, a plant protection scheme specifically adapted to SMPH shall be designed.

OP30 - THE INTERACTION BETWEEN LIGHT EXPOSURE, GRAPE BERRIES AND POWDERY MILDEW

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Powdery mildew (PM) of grapes is a world-wide problem as the pathogen thrives under a wide range of temperature and humidity. Still, big differences are seen among vineyard plots as a result of differences in canopy characteristics. Light is known to reduce *Erysiphe necator* (EN) viability and training systems and light exposure were shown to affect disease levels. From another perspective fruit exposure, by different training systems or by canopy mangement is used by growers to alter fruit composition with the extent of the effects differing between varieties, the region´s climatic conditions and the timing of the treatment. To date there is no data on whether the chemical changes affect the berries susceptibility to diseases. Our aims are: 1) To test if early leaf-pulling reduces berries susceptibility 2) Develop methods to inoculate berries in the Lab. and 3) Look for physical, biochemical and molecular differences between exposed and shaded berries that might explain those differences. To test the effect of early leaf-pulling on PM levels on berries, a field experiments in two grape varieties, Shiraz and Cabernet-sauvignon was conducted. Early leaf-pulling up to 2 leaves above the top cluster at the onset of bloom was compared to un-defoliated control. Disease level was evaluated in the field and clusters were collected 4 times in each plot at weekly intervals for lab inoculations experiments and berries physical and biochemical characterizations. Our results show that in the vineyard, disease level was higher in control vines compared to defoliated vines. We did not succeed in inoculations of young clusters before stage 27 (setting, >2mm size) as they desiccated or rotted after 4-5 days before PM developed. After this stage, berries from defoliated vines were less susceptible to artificial inoculation under control conditions as compared to non-defoliated vines. Conidia infectivity in water suspension was reduced by 50 percent after 30 minutes and more as time went by. Apart from repeating the inoculations next year we shall measure skin thickness of the berries from the clusters we collected this year during the month after bloom. Beside, we shall examine them using GC and LCMS for metabolites and RT-PCR for gene expression to find possible explanations for the reduced susceptibility.

Keywords: Powdery mildew, Erysiphe necator, Ontogenic resistance

OP31 - PROTECTION IN VITICULTURE: INNOVATION NEEDS AND PERCEPTION OF THE SOCIETY

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The EIP AGRI network, set up in 2013 in the frame of the European Network for Rural Development through the Rural Network Assembly (according to Regulation EU 1305/2013), includes, among its objectives, the analysis of critical points of the food, agriculture and forestry sectors, the support to the dissemination of knowledge and innovative solutions, and the transfer of the innovation potential to the enterprises. The EIP AGRI contact point in Italy is set up within the National Rural Network, that in 2018 gave rise to a focus group on "Protection in viticulture".

The activities of the group are focused on: i) phytosanitary protection in viticulture; ii) communication of phytosanitary protection to the citizens.

The aims of the first action are to identify and discuss the major problems and the innovation needs of the sector. This shall result in finding out new solutions, implementing innovations into practice, and identifying new research guidelines and needs for the future.

The second action aims to identify the reasons of the difficulties encountered in the communication between grape growers and citizens related to grapevine phytosanitary products, which seem to be a major theme of conflict. This shall result in identifying guidelines and tools and providing them to grape growers, in order for them to improve the communication with the citizens.

The activities carried out so far include:

1. Three focus groups with the representatives of grape and wine sector: technicians, researchers, phytosanitary services, grape growers' associations, etc;
2. Interviews to grape growers to better understand how interactions between grape growers and citizens happen;
3. Interviews to citizens to identify their perception of phytosanitary products used in viticulture and their interactions with the human health.

The preliminary results showed that the innovation needs identified by the representatives of the grape and wine sector do not always coincide with those listed by the grape growers themselves. Most of the growers are seriously worried for the difficult interactions with citizens, especially when the vineyards are close to urban areas. On the other hand, citizens are generally worried for the chemical products used in viticulture; however, most of them do not know what the phytosanitary products are, and this gives room to the dissemination of wrong information about their dangerousness, increasing as a consequence conflicts with producers.

Keywords: viticulture, grapevine, protection, sustainability, society, phytosanitary products

OP32 - THE EFFECT OF DIFFERENT MANAGEMENT PRACTICES ON SOIL QUALITY: A CONTRIBUTION TO EVALUATE THE SUSTAINABILITY OF DOURO VINEYARDS SOILS

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Soil ecological functions are fundamental to ensure the sustainability of the agroecosystems at to promote their resilience. Nevertheless, soil functions may be adversely affected by agricultural activities, and particularly vineyard soils are normally degraded (e.g.: loss of biodiversity, low fertility and organic carbon content, accumulation of contaminants, compaction). This may have a marked impact on vine growth, grape quality, production costs, and soil erosion. Thus, safeguarding this resource and minimizing the ecological footprint of viticulture are important tasks. Despite the production mode (integrated, IPM, or organic, OPM), agrochemicals are always used in viticulture. This results in the accumulation of contaminants and their metabolites in soils and may have negative effects on their quality. Considering this, the present study aims at evaluate the resilience of vineyards ecosystems under different management practices and their ability to deliver the expected services, through the evaluation of a set of physical-chemical and biological indicators.

To reach this aim, three areas with similar age vines, but where different practices are implemented, were selected: two areas under IPM but with different grape varieties, and one under organic production mode (OPM). Sampling took place prior to the pesticide application period (January). Several physical-chemical indicators of soil quality (pH, conductivity, organic matter, carbon and nitrogen content, trace and major elements) as well as biological indicators (enzymatic activity, potential nitrification and mineralization of N) were measured. The potential effects of the use of agrochemicals on terrestrial and aquatic organisms were also evaluated.

For the indicators studied, differences were observed among the vineyard soils, however, it's not clear which production mode is most beneficial for the maintenance of soil quality. On OPM, the level of organic matter and enzymatic activity was lower than in the IPM. Besides that, no benefits of the OPM were observed in the ecotoxicological assays, when comparing the other areas. The reasons may be related to the age of the vineyards (about 15 years old) or to the fact that sampling took place just prior to the pesticide application period (January), which may indicate that the systems had enough time to recover. In addition, the nature of the soils and their geological background have also proved to play an important role.

Keywords: organic farming, integrated production, agrochemicals, sustainable agriculture, soil quality indicators

OP33 - BIO-POTENTIAL OF COMPOSTED AGRO-FOOD WASTES AS NATURAL FUNGICIDES AGAINST BOTRYTIS AND FUSARIUM WILT DISEASES

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The increasing public concern about environmental protection and human health has prompted researchers to look for ways, such as composting, of recycling and reusing agro-food wastes. Besides their use as soil amendments, composts are actively being studied for their fungicidal activities.

The aim of this study was to test the suppressive potential of four composts obtained from chestnut shells, grape marc, coffee grounds and olive leaves against *Fusarium sp*. and *Botrytis sp*. The compost suppressiveness against several soilborne fungi was evaluated in in vitro and in vivo bioassays.

In vitro tests were performed using the macrodilution broth method, which allowed the determination of the Minimum Inhibitory Concentration (MIC) and Minimum Lethal Concentration (MLC) of composts' water extracts . For *in vivo* experiments, the composts were applied to potted soil in two doses (5% and 10%), followed by inoculation with *Botrytis cinerea* or *Fusarium oxysporum*before lettuce transplantation. The compost effecetiveness was evaluated in relation to the disease incidence (DI), the disease severity (DS) and the dry weight of leaves and roots after one month of plant growth.

MIC and MLC data showed that none of the composts inhibited the mycelium growth of the tested fungi.Througt the *in vivo* experimentsa suppressive effect was observed for the chestnut- and olive-based composts, with disease incidences of 0% and disease severity indexes of 1; moreover, highest total dry matter yields were measured for plants grown on the abovementioned composts, with no differences found between the results obtained using 5% and 10% doses. Plants grown on the coffee- and grape-based composts were severely affected by *Botrytis* and *Fusarium* wilt diseases, and exhibited leaf yellowing, stem wilting, and some even died.

These results indicate the fertilizing and fungicidal potential of the olive and chestnut-based composts. Thus, these composts could be explored in strategies for managing agrofood wastes and reducing the use of synthetic chemicals in agriculture.

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Keywords: suppressive effect, biological control, macrodillution assay, soil-borne diseases, composting, agrofood-wastes

OP34 - IMPACT OF WATER SUPPLY, BERRY HEALTH AND INSECTS IN THE DEVELOPMENT OF SOUR ROT IN VINEYARDS

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Sour rot is poorly understood disease that can be found in temperate vineyards. In the past, it has frequently been confused with the last stage of gray mold since of its similar symptoms (e.g., brown discoloration of the berry skin, loss of skin integrity and pulp oozing with a strong smell of acetic acid).

In order that sour rot can develop, grape health must be impaired and microclimate must allow for the development of the responsible microorganisms such as yeasts and acetic acid bacteria, which are commonly catalyzed by insect vectors such as vinegar flies. Grape health can be impaired by hail, extensive water supply of berries that provoke cracks, poor plant protection and insects such as wasps, katydids and *Drosophila suzukii*. Besides, it is commonly accepted that warm and wet conditions after veraison favour the development of sour rot. In order to better understand the importance of these different factors we manipulated them in two different field trials. In a completely randomized block experiment, we first interfered with the three factors access of insects, skin integrity and microclimate. In a vineyard of the cultivar Chasselas in Nyon (Switzerland), we therefore protected grapes with nets in order to inhibit the contact with insects, we wounded berries with a scalpel to impair berry health and we sprayed water on grapes to create a favorable microclimate for the development of microorganisms. Our data show that a wounded skin and the contact with insects are preconditions for the development of sour rot. In the second field trial, we aimed to determinate the impact of water supply on the health of berries and skin integrity. Vines of the cultivar Chasselas were therefore provided with an extensive amount of water by either sol irrigation, fogging, both or none. With the appearance of micro-cracks, berry health was primarily impaired in the treatments with sol irrigation. These first observations allow us to conclude that an excess of water weakens berry health and favors micro-cracks. Such berries might therefore be more susceptible for the development of sour rot when insects transmit and catalyze the responsible microorganisms.

Keywords: sour rot, micro-cracks, microorganisms, viticulture, skin integrity, filed trials

OP35 - MODELLING GRAPEVINE PHENOLOGY FOR CV. TOURIGA FRANCA AND TOURIGA NACIONAL IN THE DOURO REGION

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Projections of grapevine phenophases under future climate change scenarios are strategic decision support tools for viticulturists and wine producers. Several phenological models are tested for the three more important grapevine phenophases, namely budburst, flowering, and veraison and also for two main grapevine varieties (cv. *Touriga Franca* and *Touriga Nacional*) growing in the Douro Demarcated Region. Four forcing models (Growing degree-days, Richardson, Sigmoid, and Wang) and three dormancy models (Bidabe, Smoothed Utah and Chuine), with different parameterizations and combinations, are used. New datasets, combing phenology with weather station data, widespread over the Douro wine region, were used for this purpose. The eight best performing models and parameterizations were selected for each phenophase and variety, based on performance metrics. For both cultivars, results revealed moderate performances ($0.4 < R^2 < 0.7$) for budburst, while high performances ($R^2 > 0.7$) were found for flowering and veraison, particularly when Growing degree-days or Sigmoid models are used, respectively. Climate change projections were based on a two-member climate model ensemble from the EURO-CORDEX project under RCP4.5. Projections depicted an anticipation of phenophase timings by 6, 8 or 10–12 days until the end of the century for budburst, flowering, and veraison, respectively. The inter-model variability is of approximately 2–4 days for flowering and veraison and 4–6 days for budburst. These results establish grounds for the implementation of a decision support system for monitoring and short-term prediction of grapevine phenology, thus promoting a more efficient viticulture.

Funding

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Keywords: grapevine, phenology modelling platform, climate change, RCP4.5, EURO-CORDEX, Douro region

OP36 - INNOVATIVE AND INTERACTIVE TOOL FOR IMPROVING SOIL ECOSYSTEM SERVICES IN VITICULTURE

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The LIFE+ project SOIL4WINE "Innovative approach to soil management in viticultural landscapes" aims to develop new viticultural systems focused on achieving better soil management through providing cost-effective solutions improving soil ecosystem services.

The proposed solutions focus on: i) cover crops in the mid-row and in headlands around vineyard to prevent erosion, increase biodiversity and control relevant fungal pathogens (i.e., reduce the dispersal by rain splashes of primary inoculum of downy mildew present on leaf litter), ii) permanent organic mulching in the vine row, obtained by moving the sward of a permanent seeded grass, for sustainable weed management, iii) superficial water control or underground drainage system to regulate excess of water; iv) change of soil management equipment to reduce compaction and remove hardpan.

To successfully transfer the knowledge acquired within the project, an innovative ICT tool was developed. The tool supports grape growers in implementing and maintaining the best solutions (i.e., soil management practices) for mitigation of threats affecting soil health in each specific situation. It is a stand-alone tool, meaning that it does not require the intervention of external experts (consultants, specialists, etc.), yet it allows farmers to self-evaluate their specific treath(s), take right decisions about the necessary mitigation measure(s), implement them following good agricultural practices and, finally, check the success of the intervention; it can therefore be considered a DSS. A first checklist allows the user to describe the site and a computing engine provides synthetic numerical indexes and ratings related to soil potential threats of the site. Vineyards' monitoring protocols and related input data user interfaces are proposed to the user to verify whether the potential risk provided by the computing engine are real or not. Successively a decision engine suggests best practices to be implemented in vineyard to decrease the risk of soil threats and a registration module allows the user to register in the tool the activities performed in the vineyard. Finally, a third checklist enables to perform an objective evaluation of the soil´s threats changes after the mitigation solution's implementation and understand if corrective or maintenance actions are required.

Keywords: oil threats mitigation solutions, decision support system, LIFE+ project, cover crops in mid-row, ICT tool for agriculture

OP37 - LEVELS OF GLYPHOSATE IN VINEYARD SOILS AND POTENTIAL ADVERSE EFFECTS TO THE ENVIRONMENT

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Glyphosate is a broad-spectrum herbicide and is the most used worldwide, accounting for around 25% of the global herbicide market. Recently, the use of this herbicide become one of the hottest debates between scientific community and national/international authorities, especially within EU. The European Food Safety Authority (EFSA) classified glyphosate as safe, however there are several studies that suggest it is toxic to aquatic and terrestrial organisms. Therefore, it is crucial to understand the effects of agrochemicals to terrestrial organisms, since soil biota play a key role in several functions and services such as: mineralization of organic matter, soil structure, retention and cycling of nutrients, and symbiotic relationships with plants. Thus, this work intends to contribute to the knowledge about the behavior and toxicity of glyphosate in the terrestrial environment. For this purpose, the levels of this herbicide were monitored in two different vineyards over one year, and at the same time the potential adverse effects to the environment, by performing an ecotoxicological characterization of soil samples, including both soil and aquatic organisms, was performed.

Preliminary results showed that, the maximum mean concentrations of glyphosate were, as expected, observed during the application period (in February) for both vineyards, and levels decreased in the following months. For AMPA (the major metabolite), the behavior is slightly different in the two vineyards, probably due to difference on soil properties. Ecotoxicological assays performed showed that despite the adverse effects that may occur during the application period for some species, the system is able to recover demonstrating the resilience of the ecosystems when properly managed.

Keywords: Soil Quality; Integrated Production; Agrochemicals; sustainable agriculture

POSTER PRESENTATIONS

PP1 - EXPLORATION OF GRAPE SKIN PENETRATION FORCE AND OTHER PHYSICAL AND CHEMICAL PROPERTIES OF GRAPES

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Drosophila suzukii has become a pest of economic importance ever since it has spread around the world through the soft fruit trade. In vineyards, it is thought that the risk of infestation is correlated with the strength of the grape's skin. There is an idea that there might be a common threshold in skin strength when a grape transits from being safe from infestation to being susceptible to infestation. The relationships between *D. suzukii* infestation rate and other grape properties were explored. Also the relationships with grape skin strength (=penetration force) and other grape properties related to total soluble solids, acidity, nitrogen content, and grape seed color were compared at a single site and across different sites. Cultivars were found to be infested by *D. suzukii* across a wide range of penetration forces. Therefore the idea of a common threshold is not supported by our study. Factors relating to grape maturity were overall more successful in predicting risk of infestation. Penetration force was not able to be successfully correlated with any single tested grape property or with a statistical combination of them. Moreover, cultivars behaved quite differently depending on their location. Thus, the study was not able to discover any general relationships that might be used to indicate a grapevine's susceptibility to *D. suzukii* infestation.

Keywords: Sour rot, sugar content, pH, acidity, nitrogen, ammonia

PP2 - INFLUENCE OF GRAPEVINE CULTIVAR ON DIFFERENT GENERATIONS OF LOBESIA BOTRANA (LEPIDOPTERA: TORTRICIDAE)

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The European grapevine moth, Lobesia botrana (Denis & Schiffermüller) (Lepidoptera: Tortricidae), is a key grapevine pest in southern European countries, including the Douro Demarcated Region (DDR), Portugal, where it develops three to four annual generations. The control of L. botrana is typically achieved with synthetic insecticides, but concern about environmental and health problems has aroused interest in the development of alternative control strategies against the pest. One of the more promising of these strategies is mating disruption (MD), an environmentally friendly method, widely recommended in the context of integrated pest management (IPM). Although MD has been successfully applied in many European countries, the results have not always proved satisfactory in DDR,where this method has been used since 2000. Under this condition, the project "CSinDouro_Mating disruption (MD) against the European grapevine moth Lobesia botrana (Denn. & Schiff.), in mountain viticulture: the particular case of Douro Demarcated Region (DDR)", aims at identifying the constraints to the use of MD in DDR and to introduce the improvements considered necessary to overcome them, in order to make the best of this use in the region. As it is known that grapevine cultivars may differ in their susceptibility to L. botrana with important implications for control strategies, a study is in course to evaluate the susceptibility to the pest of a set of grapevine cultivars with economic importance in DDR, namely Touriga Nacional, Touriga Franca, Tinta Barroca e Sousão. More specifically it is intended: (i) to compare the larval population density of the pest during its first and second generations, on the studied grapevine cultivars; (ii) to assess if there is a cultivar influence on the larval age composition; (iii) to test wether some inflorescence or bunch traits can influence age composition of L. botrana larvae; and (iv) to verify whether exists any correlation between population data collected during the first and second generations.The importance of the results for the improvement of MD strategy against L. botrana in DDR is discussed.

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Keywords: pest control, European grapevine moth, cultivar susceptibility, larval infestation

PP3 - ON THE OCCURRENCE OF DROSOPHILA SUZUKII (MATSUMURA, 1931) IN THE VINEYARD ECOSYSTEM FROM DOURO DEMARCATED REGION

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Drosophila suzukii (Matsumura) (Diptera: Drosophilidae), commonly known as spotted wing drosophila or Asian vinegar fly, is an invasive species, native to Southeast Asia, which since 2008 has been expanded its range to other countries around the world. In Portugal, it was detected for the first time in 2012, and has been causing significant losses mainly in small fruits such as blueberries, raspberries and cherries. However, D. suzukii has the capacity of infest a high number of other cultivated crops, including grapevine, and wild and ornamental plants. This feature, together with the fast generation turnover (high reproductive rate and short generation time) are good reasons for its success. Unlike most other Drosophila species, the female of D. suzukii, provided with a strong and sclerotized ovipositor, is able to lay eggs under the skin of undamaged ripening fruits. The larva, feed on the fresh mesocarp, causing a depressed and soft area in it. In addition, the injuries caused by D. suzukii, could facilitates the closely related species D. melanogaster infestations and, consequently, favours the development of sour rots, a disease which makes grapes unusable for consumption and wine production. D. suzukii is already present in Douro Demarcated Region (DDR), however till our knowledge there are no information about its occurrence in vineyards nor about the dimension of its importance as a grapevine pest. In this sense, surveys are being conducted in two vine farms from DDR aimed to evaluate the presence of D. suzukii and characterize it population spatio-temporal dynamics in the vineyard ecosystem (including vineyard plots and neighbouring non-crop habitats). Thus, by using food traps baited with wine, adults of D. suzukii are being monitored. To understand how D. suzukii behaves in vineyards, is of great importance to implement sustainable control strategies against pests, many of them already in course in DDR, such as conservation biological control. The obtained results are expected to contribute for the improvement of such strategy.

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Keywords: spotted wing drosophila, monitoring food traps, wine bait, sour rots

PP4 - BROWN MARMORATED STINK BUG HALYOMORPHA HALYS (STÅL) EFFECTS ON THE QUALITY OF PROSECCO WINE

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The Brown Marmorated Stink Bug, Halyomorpha halys (Stål) (Hemiptera: Pentatomidae), a polyphagous pest native of eastern Asia, is an invasive species in Europe and the Americas. This pest is also known to feed on European grapes, Vitis vinifera L., causing direct damage on clusters in case of high infestations. Halyomorpha halys infestation on grape clusters at harvest may contaminate the juice and then the wine with unpleasant taste induced by stinking molecules. This work aims to evaluate the quality of Prosecco sparkling wine after H. halys infestations. Grape clusters of the cultivar Glera collected in a vineyard located in the Veneto region (northern Italy) at harvest time were infested during cluster pressing with 6, 3, 1, 0.5 or 0 (control) H. halys adults per cluster. Chemical analyses and wine-tasting panel test assessed the quality of must during the fermentation phases, and of wine. Results showed the highest content of acetaldehyde on must obtained from clusters infested with 6 H. halys. Wine-tasting by expert panel test reported a significant presence of negative odours in wine having high H. halys infestations, with a perception of a vegetative flavour as negative smell. The implications of H. halys infestation on Prosecco wine quality are discussed.

Keywords: Halyomorpha halys, invasive pest, wine quality, Prosecco, must quality, must contamination

PP5 - EFFECT OF HOT-WATER TREATMENT AND TRICHODERMA ATROVIRIDE SC1 ON FUNGAL TRUNK DISEASE PATHOGEN INFECTIONS IN GRAPEVINE NURSERIES

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Grapevine propagation material taken from apparently healthy mother vines can already be infected by fungal trunk pathogens prior to grafting or become infected during the different nursery processes. The use of hot-water treatment (HWT) and biocontrol agents have been proposed by researchers as promising alternatives to the application of chemicals in order to reduce the fungal infection in grapevine planting material. The aim of this study was to compare 3 treatment regimes applied to rootstock cuttings before grafting in grapevine nurseries in order to eradicate trunk pathogens and to evaluate their effect on the quality of eight cultivars grafted onto 110 Richter rootstock. Treatments included: HWT at 53ºC for 30 min (T1), *Trichoderma atroviride* strain SC1 applied at the hydration stage (T2), and HWT followed by *T. atroviride* treatment (T3). Two months after planting, the number of grafted plants that emerged from dormancy and the shoot length were evaluated. At the end of the season, plants were uprooted and fungal isolations were made from roots and the basal part of the rootstock. T3 consistently reduced the incidence and severity of black-foot and Petri disease fungi at the basal part of the rootstock. *Trichoderma* alone or in combination with HWT significantly reduced the incidence and severity of both diseases in roots. Colonization of the wood by *T. atroviride* was higher at the basal part of the rootstock than in roots. None of the treatments consistently affected the number of certifiable vines produced. However, T1 and T3 decreased the percentage of sprouting as well as the shoot vigour compared to T2 and the non-treated plants.

Keywords: grapevine, hot-water treatment, biocontrol, black-foot disease, Petri disease

PP6 - XYLEM AND PHLOEM MODIFICATIONS IN GRAPEVINE (VITIS VINIFERA) INDUCED BY FLAVESCENCE DORÉE

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Anatomical effects of Flavescence dorée (FD) were first observed fifty years ago, but never further studied and quantified. In this paper, we study the impact of FD on xylem and phloem tissues and their anatomical properties. We took 8 symptomatic and 8 asymptomatic shoots from infected (FD+) grapevine plants (*Vitis vinifera*) for a tolerant (Merlot) and a susceptible (Chardonnay) cultivar and compared them to 8 shoots sampled from healthy (FD-) plants. Different anatomical parameters were measured in 1-year xylem and phloem on thin sections from the base of the shoots. Results show an inhibition of xylem growth and an overproduction of phloem tissue in symptomatic shoots (FD+), with a deconstruction of phloem and cell arrangement, irrespectively of cultivar. Merlot symptomatic shoots decrease vessel diameter but they compensate conductivity with a higher cell density. Moreover, the tolerant Merlot responded to phytoplasma infection by sap flux compartmentation induced by tylosis. This study confirms the detrimental effect of FD on conductive and reserve tissues and confirms differences in anatomical responses to the infection according to the susceptibility of the grapevine cultivar.

Keywords: Flavescence dorée, phloem, Vitis vinifera, wood anatomy, xylem

PP7 - MATE LOCATION IN PSEUDOCOCCUS CALCEOLARIAE, A PRIMARY PEST OF GRAPE IN NEW ZEALAND

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Pseudococcus calceolariae (Hemiptera Pseudococcidae), commonly known as the citrophilous mealybug, attacks various crops, with special reference to grape, leading to severe direct and indirect damages, mainly represented by honeydew production with subsequent sooty mold development and vectoring closteroviruses, respectively. The identification of *P. calceolariae* sex pheromone has opened new routes for monitoring and control with pheromone-based control strategies, as in the cases of *Planococcus ficus* and *P. citri*. In this paper we focused on the capability of males to fertilize multiple females and on the mate location strategy carried out by *P. calceolariae* males to find the females. Our results highlighted that a *P. calceolariae* male can successfully mate and fertilize up to 13 females; the copulation time in subsequent mating events and the time between copulations did not change over time, but the number of matings per day significantly decreased over time. Furthermore, we tested the attractiveness of different loadings of female sex pheromone on males in flight tunnel conditions. Males constantly exposed to 16 rubber septa loaded with the female sex pheromone showed a significant decrease in female detection at 1 and 30 µg loadings. Moreover in the control about 9.2-fold more of the released males successfully detected the female in the center of the array of septa without pheromone. Detection of females in the control was significantly higher than in the arrays with surrounding pheromone. Mating only occurred in the control arrays. Our findings can contribute to the development of pheromone-based approaches for managing *P. calceolariae*.

Keywords: Sex pheromone, biological control, flight tunnel, Integrated Pest Management, mealybug monitoring

PP8 - CAN WE GET A PESTICIDE REDUCTION BY INTEGRATING DEFENCE INDUCERS IN GRAPEVINE PROTECTION?

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LIFE GREEN GRAPES is a three-yearLIFE+project that fits within the context of sustainable production. Viticultureneeds a high input of pesticides for diseaseand pestcontrol, representing a good candidate for a sustainable strategy. The aim of this project is to compare different crop protection protocols along the grapevine production chain, from propagation material production in the nursery towine production in Tuscany, and table grape production in Apulia and Cyprus. Reduction in plant protection products can be obtained by integrating cover crop management (cultural practices), defence inducers, and good timing for the application of treatments by following a Decision Support System for powdery anddowny mildew, grey mould and black rot infections. Five different approaches were compared: 1) Integrated strategy; 2) Integrated strategy with reduction of phytosanitary treatments; 3) Organic strategy; 4) Organic strategy with 50% reduction of copper applications; 5) Organic strategy with 100% reduction of copper applications. Progressive reductions in fungicide input are supported by defence inducers, biocontrol agents and natural substances acting as plant strengtheners. Critical steps in this strategy are constant field monitoring, as well as a careful and daily usage of the disease development model. With a lower disease pressure even the lowest input strategy gave complete protection with an increase in the quality and quantity of productionas well as higher profitability. Environmental impact indicators also confirm a promising positive outcome of the protocols.

This work was included in the framework of the project "LIFE GREEN GRAPES, New approaches for protection in a modern sustainable viticulture: from nursery to harvesting".

Keywords: grapevine, defense inducers, cover crop, disease control, DSS, grapevine production chain

PP9 - PARASITOIDS OF LOBESIA BOTRANA IN DOURO DEMARCATED REGION VINEYARDS AND PROSPECTS FOR ENHANCING CONSERVATION BIOLOGICAL CONTROL

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Considering the increased regulation of pesticides in Europe and concerns about environmental impacts of viticulture, research about conservation biological control (CBC) of pests has grown in the last two decades. However, little attention has been addressed to main determinants of parasitism of *Lobesia botrana*, a major pest of vineyards in Southern Europe. The Douro Demarcated Region (DDR) landscape and the management practiced on terraced vineyards offers scope for the implementation of an effective CBC strategy against the pest. This study aimed at: (i) identifying parasitoids associated with each generation of *L. botrana* and estimating their relative abundance in DDR; (ii) evaluating the effect of neighbouring non-crop habitats and management practices (chemical treatments and soil cover) on the parasitism of *L. botrana*. A total of 3,226 larvae/pupa of *L. botrana* were collected, out of which 485 parasitoids emerged. Fourteen parasitoids were identified: *Eurystaea scutellaris* (Tachinidae), *Baryscapus* sp., *Elachertus* sp., *Elasmus* cf *bistrigatus*, *Elasmus* cf *steffani, Elasmus* sp. (Eulophidae), *Campoplex capitator, Itoplectis maculator* (Ichneumonidae), *Brachymeria tibialis, Hockeria* sp. (Chalcididae), *Dibrachys cavus* (Pteromalidae), *Ascogaster quadridentata* (Braconidae), *Goniozus gallicola* and *Goniozus claripennis (*Bethylidae). *Elachertus* sp. which is widely distributed from Portugal to France, was responsible for the highest rates of parasitism (up to 62%) recorded in *L. botrana´s* first generation. *C. capitator* and *B. tibialis* were found to have a complementary role, in the first and second generations of the pest, respectively. Moreover, it was found that the parasitism rate was positively related with ground cover management and negatively related with chemical treatments.

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Keywords: Elachertus sp., ecological infrastructures, landscape, ground cover, chemical treatments

PP10 - IMPACT OF LEAF REMOVAL ON CLUSTER DISEASE PRESSURE FOR COLD-HARDY HYBRID CULTIVARS UNDER CLIMATIC CONDITIONS OF EASTERN CANADA.

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There is a general agreement among scientists and grape specialists that proper canopy and fruit zone management are essential practices to obtain good grape quality. Canopy management (CM) involves pruning, shoot thinning, sucker removal, shoot positionning, leaf and lateral removal, hedging and any other practices that manipulates canopy structure. Fruit zone management (FZM) involves de-leafing around grape clusters and thinning clusters. The ultimate objective of both CM and FZM is to improve grape aroma, flavour and pigment profiles, favour earlier maturity and reduce diseases. Despite the obvious advantages of CM and FZM on grape quality, the precise impact on disease development is poorly documented. Likewise, the impacts of leaf removal on the occurrence of fungal diseases, berry ripening and overall grape quality of cold-hardy hybrids is not well understood, particularly in cold climate viticulture. The effects of canopy and fruit zone management on disease management are expected to be variable and depend on timing of CM, cultivars, and climate. The aim of this project was to examine the influence of fruit zone management on disease development and disease management decisions under climatic conditions of eastern Canada. There are gaps in the understanding of when and how the practices should be applied and what effect they have on the development of grape diseases. During the first part of the project, we evaluated the impact of leaf removal timing on the occurrence of fungal grape diseases (grey mold, downy and powdery mildew), on yield, and on berry chemistry at harvest. An experimental design including three levels of leaf removal (70% on one side of rows and 70% on both sides of rows, and 100%)) and leaf removal at two separate times (at berry set; during veraison) was implemented in the experimental vineyard at Frelighsburg (Quebec, Canada). Preliminary results showed that leaf removal had few effects on diseases occurrence for cold-hardy hybrids. However, the period of leaf removal may slightly affect yield and grape berry chemistry. Results will be included in a comprehensive strategy developed to reduce disease occurrence and fungicide resistance development under northeastern conditions. This research will provide a better understanding of the best fruit zone management practice and the benefits for grape and wine producers.

Keywords: leaf removal, cold-hardy hybrid, fruit zone management

PP11 - EXPLOIT BIODIVERSITY IN VITICULTURAL SYSTEMS TO REDUCE PEST DAMAGE AND PESTICIDE USE, AND INCREASE ECOSYSTEMS SERVICES PROVISION: THE BIOVINE PROJECT

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Organic vineyards still rely on large external inputs to control harmful organisms (i.e., pests). The BIO- VINE project aims to develop natural solutions based on plant diversity to control pests and reduce pesticide dependence. The capability of plants of increasing the ecosystem resistance to pests and inva- sive species is a well-known ecosystem service. However, monocultures (including vineyards) do not exploit the potential of plant diversity. BIOVINE aims to develop new viticultural systems based on in- creased plant diversity within (e.g., cover crops) and/or around (e.g., hedges, vegetation spots, edgings) vineyards by planting selected plant species for the control of arthropods, soil-borne pests (oomycetes,fungi, nematodes), and foliar pathogens. Candidate plants will be identified by a literature review, andthe selected ones will be tested in controlled environment or small-scale experiments. The ability of theselected plants to: i) attract or repel target arthropod pests; ii) conserve/promote beneficials; iii) control soil-borne pests by means of biofumigation; iv) carry mycorrhizal fungi to the vine root system to in- crease plant health (growth and resistance); and v) control foliar pathogens by reducing the inoculum spread from soil, will be investigated. New viticultural systems able to exploit plant diversity will then be designed based on results of BIOVINE activities, following a design-assessment-adjustment cycle, which will then be tested by in-vineyard experiments in France, Italy, Romania, Slovenia, Spain andSwitzerland for a 2-year period. Innovative viticultural systems should represent an improved way forpest control in organic viticulture, meanwhile they should positively affect functional biodiversity andecosystem services. New control strategies may provide financial opportunities to vine growers andlower their reliance on pesticides.

Keywords: Mycorrhizal fungi, cover crops, soil borne pathogens, arthropods, sustainability

PP12 - THE EXPERIENCE OF APPLICATION OF A WEB-BASED DECISION SUPPORT SYSTEM IN THE IBERIAN PENINSULA FOR THE SUSTAINABLE MANAGEMENT OF VINEYARDS

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Directive 128/2009/EC on the Sustainable Use of Pesticides makes mandatory the adoption of integrated pest management (IPM) across Europe. IPM promotes low pesticide control of harmful organisms based on crop monitoring and decision support tools. Vite.net® is a Decision Support System (DSS) developed by Horta (www.horta-srl.com), a spin-off company of the Università Cattolica del Sacro Cuore, in Italy. The DSS is a web-based tool able to: i) collect multiple information/data in real-time about different vineyard components (air, soil, plants, pests, and diseases) by using IoT technologies; ii) analyze these data by advanced modelling and bigdata solutions; and iii) make up-to-date information, alerts and decision supports for vineyard management. The DSS considers grapevine growth and development, risk for diseases (downy and powdery mildews, black-rot and Botrytis bunch rot) and pests (berry moth, American leafhopper and mealybugs), protection dynamics of fungicide applications, and abiotic stresses (drought, low and high temperatures).

The DSS is available for Italian growers since 2013 and it is used by hundreds of farmers. Since 2015, the DSS is available also in Spain and Portugal. In this work, we show the results of two pilot runs developed in Spain and Portugal to evaluate the use of vite.net, primarily for the management of downy mildew in vineyards. In Spain, the DSS was evaluated in the Penedès region (Nort-East Spain) by the regional service of plant health (SISTEMIO project). The evaluation was performed in 18 vineyards in 2016 and 2017, by comparing the DSS output concerning primary and secondary infections of *Plasmopara viticola*, fungicide treatments performed by the growers, and the disease development. In Portugal, the DSS was evaluated in the Alto Douro region (North Portugal) by the Association for the Development of Viticulture in the Douro Region (ADVID). In this case, the evaluation was performed in two vineyards from 2016 to 2018, by comparing the DSS output with disease observations in the vineyards; additional validations are still on going on 4 vineyards in 2019. Results of both pilot runs show a substantial agreement between the DSS output and vineyards' observations.

Keywords: sustainable viticulture, integrated pest management, downy mildew, Spain, Portugal

PP13 - REDUCED PESTICIDE APPLICATION PROMOTES NATURAL PEST CONTROL IN VINEYARDS

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Agricultural intensification is a major driver of biodiversity decline including arthropods. This may also affect important ecosystem services such as natural pest regulation. With more than ten fungicide applications per season, grapevine is one of the most intensively sprayed crops in Central Europe. Spraying can be reduced by up to 90% in novel fungus resistant cultivars. We investigated herbivorous mites and their natural enemies in the Palatinate region (Germany). The study was carried out in 32 vineyards of organic and conventional wineries, half of which were planted with fungus resistant cultivars and treated with reduced plant protection regimes. Predatory mites were significantly enhanced by reduced fungicide applications. Correspondingly, phytophagous mites were significantly reduced in vineyards with reduced fungicide applications. Highest densities of pest mites were observed on susceptible grape varieties under organic management. We conclude that in addition to other advantages, the cultivation of fungus resistant grape varieties under reduced spraying intensity can improve the natural control of pest mites in viticulture.

Keywords: fungicides, fungus-resistant varieties, predatory mites, pest mites, organic and conventional viticulture

PP14 - AUDISENS (AUTOMATED DISEASE SENSING) – IMPROVING THE EARLY-DIAGNOSIS OF GRAPEVINE DOWNY MILDEW TO REDUCE THE APPLICATION OF PLANT PROTECTION PRODUCTS

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Developing a sensor-based early-diagnosis system to detect grapevine downy mildew (DM) (*Plasmopara viticola*) prior to visible symptoms aims to reduce the application of plant protection products (PPPs).

In viticulture, vast amounts of PPPs are frequently applied due to traditional cultivar's susceptibility to DM. Prognosis systems (PS) are used to improve disease control and reduce redundant applications of PPPs. However, prediction of DM secondary infections is challenging since symptoms are not easily visible. Thus, PPPs are often applied preventatively without need. PS are also not adjusted to local conditions in vineyards such as planted grapevine cultivars. New grapevine cultivars with different resistance levels against fungal pathogens are especially popular in organic viticulture in Germany due to their lower need for fungicides. Incorporating the resistant level of cultivars into PS constitutes one possibility to adjust plant protection recommendations to the local scale. The present three year-study aims to improve the early-diagnosis of DM prior to visible symptoms for a better risk assessment of secondary infections. Implementation of the new diagnostic tool follows a three-step-procedure, from the laboratory to the greenhouse and, eventually, the vineyard. A pilot study under field conditions will be conducted by using mobile hyper-spectral sensors that are able to differentiate between diseased and healthy leaves and generate an early-diagnosis of DM.

Reference data for the sensors will be established by infection tests performed with leaf discs and potted grapevines in the greenhouse. The time points of early detectable infections will be compared between traditional and resistant cultivars. Staining techniques will be carried out to visualize early fungal infection structures under the microscope and molecular detection will be performed by using a sensitive PCR.

Further, defined spraying regimes for organic viticulture are conducted in a field study. Application will take place in organic vineyards following either the local PS (VitiMeteo), a periodic time table with weekly application, or only around the flowering stage. DM assessments following EPPO guidelines will be performed and the disease severity and incidence compared between traditional and resistant cultivars, as well as PPPs application regimes.

As a future prospect, results are thought to serve as basis for the local-scale application of PPPs by incorporation into PS.

Keywords: Downy mildew, Plasmopara viticola, organic viticulture, prognosis systems, early-diagnosis, sensors

PP15 - OPTIMISATION OF THE METHOD TO ASSESS DROSOPHILA SUZUKII INFESTATION ON GRAPES

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Drosophila suzukii is a very polyphagous species that has become a major pest ever since it has spread around the world. Although past experiences indicate that grapes have to be considered as a secondary host plant, eggs can be laid in a great variety of cultivars. These eggs might thereafter trigger the development of sour rot when suitable weather conditions allow for the development of the responsible yeasts and acetic acid bacteria. To prevent economic damage, it is therefore important to detect D. suzukii infestation on grapes early in order to intervene in time. In this study, we compared three different methods to assess egg laying in vineyards (e.g. "Swiss method", "South Tyrolian method" and "cluster method"). The traditional "Swiss method" is thereby based on the visual inspection of 50 randomly sampled grape berries in order to calculate the proportion of berries infested with D. suzukii eggs. In the widely used "South Tyrolian method", around 25 grape cluster parts of 5 to 20 berries are randomly collected per plot of which 50 berries are visually checked. In the novel "cluster method", only 5 grape clusters per plot are randomly collected, however 5 berries from the inner and 5 berries from the outer part of each cluster are thereafter inspected (totalling likewise 50 checked berries). In 2018, we compared the three methods with each other 80-times in 43 overall vineyards. The labour costs of the three methods is about the same and yield loss is the lowest with the "Swiss method". However, the "cluster method" is by far the most sensitive sampling method since also berries from the inner of clusters are inspected. Its mean infestation rate over the 80 samples was therefore 1.4-times and 2.3-times higher than the "South Tyrolian method" and "Swiss method", respectively. Moreover, the "cluster method" detected D. suzukii infestation in more samples than any of the other two. Finally, it detected D. suzukii eggs first in eight cases versus three cases for the "South Tyrolian method" and only one case for the "Swiss method". We therefore believe that the sensitive "cluster method" is currently the most adapted method to assess D. suzukii infestation in commercial vineyards. Thus, from this year on, the national monitoring regime for D. suzukii in Swiss vineyards is based upon this novel sampling method.

Keywords: Spotted wing drosophila, viticulture, Vitis vinifera, survey, pest detection, IPM

PP16 - EFFECT EVALUATION ON TERRESTRIAL SPECIES OF COMMERCIAL FORMULATIONS CONTAINING LAMBDA-CYHALOTHRIN: A COMPARISON OF NANOPESTICIDE AND ITS CONVENTIONAL

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The global increasing demand for food makes the use of pesticides inescapable to guaranty food security, despite the extremely harmful effects of these agents.Numerous problems and concerns associated with the widespread use of agrochemicals have been highlighted by the society and by the scientific community, such as, contamination of soil, water surface, groundwater and air; ; loss of pesticide efficacy due to pest resistance; decrease in biodiversity of aquatic and terrestrial ecosystems and bioaccumulation of pesticides and/or their respective residues in the food chain. In a general way, the risks to the ecosystems and human health are well perceived. To overcome such limitations, the development and commercialization of nanomaterials as components of pesticide formulations (nanopesticides) has attracted great attention in the agriculture scenario, since they are described as being more sustainable and efficient than conventional formulations.However, the highest safety of these compounds to non-target species is still largely unknown, particularly for terrestrial ecosystems. Therefore, based on the previous considerations, the aim of the present work was to perform a comparative analysis of the toxicity of the conventional formulation of the lambda-cyhalothrin insecticide (Karate, Syngenta) and the formulation of the nanoencapsulated insecticide (Karate Zeon, Syngenta) onsoil invertebrates (*Falsomia candida*and *Eisenia fetida*) and terrestrial plants (*Zea mays*, *Lactuca sativa*and *Solanum lycopersicum*). In this context, several standardized toxicity assays were carried out in an artificial soil contaminated with different concentrations (5.8 to 68.0 mg $_{(\text{lambda-cihalothrin})}$ $kg^{-1}{}_{(\text{soil dw})}$) of selected pesticides separately, following protocols of the Organization for Economic Cooperation and Development (OECD) and ISO (International Organization for Standardization). The results showed a high toxicity of both formulations in the reproduction of the *E. fetida*species, whereas only the formulation containing the nanoencapsulated lambda-cyhalothrin inhibited the reproduction and caused a high mortality in the species *F. candida*. In addition, nanoencapsulated insecticide induced inhibition of *S. lycopersicum*germination. No toxic effects on germination and growth of *Z. mays* and *L. sativa* were recorded. Although the use of nanopesticides can contribute for a more sustainable production of food, it is of utmost importance to perform more detailed and accurate toxicological assessments of pesticide-containing nanomaterials to predict and ensure the safety of these new chemical entities for the environment and human health.

Keywords: lambda cyhalothrin; pesticides; nanopesticides; toxicity; soil invertebrates; terrestrial plants

PP17 - ENHANCING IPM IMPLEMENTATION PERSPECTIVES IN MONTENEGRO AND ITALY BY MEANS OF A DYNAMIC MECHANISTIC MODEL FOR PHOMOPSIS VITICOLA INFECTIONS: VITISUST

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Phomopsis cane and leaf spot disease is one of the most important grapevine diseases in Montenegro. It occurs every year and causes considerable damage. At the beginning of growing season, the disease leads to unequal opening of buds and often causes their destruction. Recently a bilateral project for 'Italy–Montenegro Joint Science And Technology Cooperation' in the area Agriculture and Food Sciences was settled up in order to develop and calibrate a new model for Phomopsis cane and leaf spot disease (PCLS), which is widespread in Montenegro and of increasing importance in Italy.

The VITISUST Project is supported by Foreign Affairs Ministry and Ministry of Science in both Countries. In 2018 studies about overwintering structures of the pathogen were carried out, then a model prototype was developed and in 2019 specific trials for monitoring disease dynamic and starting the model evaluation have been carried out. The disease assessment was performed on typical varieties Barbera and Vranac in Italy and Montenegro, respectively, both trained at double guyot by mean of a visual assessment at dormant stage (i.e. presence and type of symptoms on canes) and during the growing season (i.e. symptoms appearance on leaves and shoots).

First symptoms were observed 22 and 19 days after bud break in Montenegro and Italy, respectively, and the disease incidence reached 54,3% and 50,5% of the observed canes, respectively. The highest disease severity was observed on shoots at the beginning and at the end of the old cane (curved down) while the shoots developed from the buds located on the top of the cane curve resulted not affected. This could be explained with the stem-flow effect caused by rainfall that floods pycnidia at the top cane positions and spread the pycnidiospores.

Keywords: modelling, Phomopsis cane and leaf spot disease, integrated disease management

PP18 - AN IDENTIFICATION WEBSITE TO ARTHROPODS ASSOCIATED WITH DOURO REGION VINEYARD AGROECOSYSTEM

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Arthropods are the most diverse and successful multi-cellular group in the planet, belonging to this group organisms of great economic importance that directly or indirectly affect several aspects of human life. Some species of arthropods can cause crop damage, others perform important ecosystem services such as control of crop pests, pollination and recycling of soil organic matter. Due to their beauty and / or rarity, several other species provide cultural services, currently highly valued by society. In spite of the identification of arthropods in a given agricultural ecosystem be of great importance, it faces several difficulties such as: the enormous amount of tiny species, the lack of both biological and morphological information on them, the complexity of the available identification keys and the difficulty in interpreting the technical terms used. Thus, this work, aimed to construct a website where information regarding the morphology, biology and photographic documentation of arthropods associated with the vineyard ecosystem of the Douro Demarcated Region could be available in a simple and objective way, in order to be easily used by non- skilled public. The identification keys are organized in 137 families belonging to 7 classes of arthropods, namely: Arachnida, Malacostraca, Entognatha, Insecta, Chilopoda, Diplopoda and Symphyla. Thus, users have at their disposal key information for a good management of the ecosystem namely concerning the aspects related to pests, including possible invasive species, beneficial organisms and other species considered of sociocultural interest, such as endemic species. This information will be available on the website *www.artropodesvinha.utad.pt*.

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Keywords: arthropods, vineyard agroecosystem, vinegrower, website, identification keys, Douro Demarcated Region

PP19 - STUDY ON THE USE OF FOOD TRAPS TO EVALUATE THE EFFICACY OF MATING DISRUPTION AGAINST LOBESIA BOTRANA IN DOURO DEMARCATED REGION

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In the Douro Demarcated Region (DDR), the use of mating disruption (MD) against the European grapevine moth, *Lobesia botrana,* has been increasing considerably since 2000. However, the results obtained have not always been satisfactory due to several constrains, such as the orography and the fragmented landscape of the DDR, the high summer temperatures, the long life cycle and the high biotic potential of the insect, and the higher susceptibility of some grapevine cultivars to the pest. Further, the pest monitoring system, traditionally based on pheromone traps and in male captures, have some limitations in giving good indications about the pest evolution in plots where *L. botrana* is managed by using MD. The assumption to the use of these traps is that, if males cannot find them, they will not be able to locate the females either and no offspring is produced. However, damages are often observed in plots where catches are not recorded. Three phenomena may be implicated in this fact: (i) the immigration of fertilized *L. botrana* females from neighbouring plots in which MD is not being used; (ii) the occurrence of casual encounters between males and females of *L. botrana*; (iii) and the accounting of damages caused by other pests that presents the same symptomatology. Under these circumstances, the use of food traps to monitor *L. botrana* using wine as bait may be advantageous. Thus, these traps: (i) do not interfere with and are not affected by the pheromone cloud; ii) also capture females, being useful for fertility studies and to predict the beginning of the oviposition period; and (iii) are not specific to *L. botrana*, allowing to monitor other moth species, such as *Ephestia unicolorella* subsp. *woodiella* and *Cadra figulilella,* which were recently found infesting grapevine clusters in DDR and whose damages are easily confused with those of *L. botrana*. Under these conditions, a study is in course in two vine farms from DDR aimed, firstly, at evaluating the usefulness of food traps to monitor *L. botrana* populations in plots where MD is being used. Additionally, it is intended to evaluate the possibility of using them in *E. unicolorella* subsp. *woodiella* and *C. figulilella* monitoring. The obtained results are expected to contribute for the improvement of MD strategy against *L. botrana* in DDR.

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Keywords: European grapevine moth, monitoring food traps, wine bait, mating disruption

PP20 - THE BEHAVIOUR OF GRAPEVINE GROWERS IN THE DECISION-MAKING OF USING PESTICIDES FROM PALMELA REGION

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In current days, the major challenges for farmers are the impact of pesticides on the public health, environment protection, residues reduction, bees and non-target organisms, the withdrawal of many active ingredients and climate changes. Given the current situation, sustainable use pesticides is a main objective and priority.
The pesticides usage in 235 winegrowers from Palmela region, which do not have regular technical assistance, were assessed during 2016 until 2019. The data analysed included the number of applications, the dosages used and the compliance of pre-harvest interval (PHI). For each year, it was observed that, on average, farmers sprayed seven treatments, although the tendency is a decreasing. The pesticides most used belong to the groups 3 (Triazoles), M02 (Inorganic) and M04 + 4 (Phthalimides + Phenyl Amides), according to FRAC Code.

Regardless of the climatic conditions and the disease pressure in the vineyard, the winegrowers sprayed every 14 days. Fear and "empiric experience" sometimes overtake knowledge and technology. That could only be changed with trust between technical assistance and farmers. That could be the solution to face the mentioned challenges and to offer sustainable wines from Palmela region.

Keywords: Plant Protection Products (PPP); Sustainability; Winegrowers; Technical assistance; Palmela

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