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Keynote lectures

An orchard without fungicides: a promise or utopia of biotechnology?

Cesare Gessler, Giovanni A. L. Brogini 3-10

Abstract: Apple production in temperate climate with wet springs is hampered by diseases such as scab and fire blight. Producers need to apply frequently fungicides to control scab and may suffer severe losses through fire blight or apply antibiotics. Chemical treatments are currently questioned by retail sellers and consumers pushing for “zero residues”. Classical breeding has produced a large range of scab resistant cultivars; however none is currently substituting the highly susceptible but popular cultivars. Ten years ago the first scab resistance gene originated from the wild *Malus floribunda* 821 was cloned and demonstrated to incite full scab resistance inserted into a Gala apple under the control of a 35S promoter. Since technology developed so that cisgenic scab resistant Gala trees were developed and are currently tested in field trials. Also fire blight resistance candidate genes are described and functionality tested. This paper gives a short overview on the current situation.

Integrated Fruit Production: Potential, constraints and challenges in year 2012

Carlo Malavolta 11-12

Extended abstract

Integrated fruit protection studies in Turkey

Biröl Akbaş 13-15

No abstract

Session 1. Biological control of pests and diseases in fruit production

Reduction of fungicide use and risk in fruit production: are we ready for alternatives?

Ilaria Pertot 19-22

Abstract: The Directive 2009/128/EC establishes a framework for Community action to achieve the sustainable use of pesticides and implicitly calls for alternatives to chemical pesticides. Biofungicides based on microbial active ingredients may offer valid tools to accomplish the aim of the Directive. However a change in the mentality and new products are necessary for a successful implementation of biocontrol agents in fruit protection.

Biopesticides for integrated fruit production in Europe: obstacles and perspectives

Massimo Benuzzi, Edith Ladurner 23-29

Abstract: A general survey of the major biocontrol measures, commonly applied on pome and stone fruit in Italy and other European countries, is provided. Among the available biocontrol agents, special emphasis is put on microbial and botanical pesticides and beneficials. The major advantages and hurdles concerning their introduction into IPM strategies are examined. Suggestions on how to provide adequate technical support, an essential requirement for the development of these products, are made. The major problems that may be encountered in their commercial distribution are described. Finally, the role of supermarket chains and organized retail channels, stipulating their own and/or reduced Maximum Residue Levels, is discussed.

FresaProtect and BerryProtect: control of aphids through constant presence of complementary parasitoids

Thierry Thielemans, Nicolas Dassonville, Virginie Gosset, Viola Rosemeyer 31-35

Abstract: Viridaxis is a Belgian company which developed a new, plant-less way of mass-rearing aphid parasitoids. Due to its innovative and unique technology, Viridaxis has been able to develop and produce one new parasitoid species every year. A parasitoid is a wasp able to parasitize aphids in a host-specific way. These natural enemies of aphids are used in organic or integrated pest management strategies. In order to apply the matching parasitoid against a given aphid species, the latter one has to be (a) detected in the crop and (b) subsequently identified. By the time the aphids are spotted by the grower and then identified by himself or a specialized technician, it becomes increasingly difficult to gain control over an increasing aphid population. Viridaxis developed a new concept of aphid control, based not on the species identified but on the crop treated. For each crop, the expected aphids are well known. What was needed was a product controlling the largest possible variety of aphid species susceptible present in the crop. Viridaxis studied the aphids attacking strawberry and berry crops in various regions and over many years, and developed two unique cocktails of parasitoids species (FresaProtect and BerryProtect) parasitizing and controlling all aphids. FresaProtect and BerryProtect contain six or five different species of natural aphid enemies, respectively, and are able to control all commonly appearing aphids attacking strawberries, raspberries, blueberries, blackberries and currants. The fact of mixing of not only different species, but also different ages of different mummies allows to prolong hatching. The ready-to-use units contain an integrated feeding point which contributes to longevity and efficiency of the parasitoids. Their application in the crop is much faster than even any chemical treatment. Numerous field trial results and modeling of population dynamics data resulted in a protection scheme for soft fruit crops in which releases only every three weeks assure constant presence of fresh parasitoid adults and hence continuous and reliable aphid control.

Investigation on adulticide bait (Spintor-Fly[®]) to control the cherry fruit fly in Emilia-Romagna (North Italy). Trials 2010-2012

Stefano Caruso, Maria Grazia Tommasini, Giovanni Barbari 37-42

Abstract: In the Emilia-Romagna Region (Northern Italy) trials to develop new strategies for the control of cherry fruit fly have been carried out. The aim was to find an alternative to the active substances commonly used until recent years (e.g., dimethoate, phosmet) in Integrated Pest Management and to find an effective way to control cherry fruit fly in organic farming. For this reason field trials have been performed in 2010, 2011 and 2012 to evaluate the efficacy of a Spinosad-based adulticide bait (Spintor-Fly[®]) against *Rhagoletis cerasi* L. in cherry orchards. Together with trials to study the efficacy of the product in controlling cherry fruit fly, a demonstrative trial on 7.0 hectares with the use of a mechanical system of distribution to simplify the application of the product is described. The results obtained were positive in all years. Spintor-Fly proved to be very effective in controlling the pest. However, its use on a large scale could be limited by its low persistence (it must be applied at least weekly) and poor rainfastness. On the other hand the negative aspects are largely countered by the following positive advantages: high efficacy comparable to that of the best active ingredients available on the

market, very low dose (5 l/ha/application), according to new EU directive (128/09), possible reduction of the number of sprays in the orchards provided with cover for rain (no risk of wash off), possibility to mechanize the spraying on large cherry orchards. So far the official registration of Spintor-Fly against cherry fruit fly in Italy is pending in order to correctly apply the product in the open field.

Improving persistence of entomopathogenic nematodes in aboveground applications for pest control in apple orchards

Tim Belien, Stijn Huysecom, Nick Berkvens, Nicole Viaene,

Wannes Keulemans, Dany Bylemans 43-47

Abstract: Entomopathogenic nematodes (EPNs) are effective biological control agents of a range of soil-borne insect pests. However, to date the use of entomopathogenic nematodes against aboveground pests remains negligible. The main reason for this is the poor persistence of EPNs in environmental extreme conditions such as direct sunlight, rapid temperature fluctuations and desiccation. The main objective of this study was to determine how persistence of EPNs can be improved when applied as aboveground sprayings in an apple orchard. A field trial was conducted in a randomized block design in which 5 different substrates (straw pellets, paper mulch, hemp, flax and wood chips) were applied around the stems of apple trees. Infective juveniles of *Steinernema carpocapsae* were applied as aboveground sprayings using a motorized knapsack sprayer. By putting wax moth (*Galleria mellonella*) larvae as bait in the substrates not only the EPN survival but also their potential to infect a host, after being a few days aboveground, could be tested. Presence and quantities of EPNs able to infect insects during several days after aboveground application were checked with real time quantitative PCR. Significant differences in survival rates and infection potential of *S. carpocapsae* were obtained depending on the presence and type of substrate at the base of the apple trees. In particular the presence of straw pellets could keep EPN for several days in a good condition. Our results indicate that the persistence of aboveground applied EPNs can substantially be improved by adding specific substrates around the stem at the base of apple trees. This opens perspectives towards a more efficient biological control by aboveground applied EPNs of pests which migrate (e.g. woolly apple aphid, *Eriosoma lanigerum*) or hibernate (e.g. codling moth, *Cydia pomonella*) on the tree stem in apple orchards.

Effectiveness of entomopathogenic nematodes in the control of chestnut carpophagous Lepidoptera

Stefano Caruso, Alberto Reggiani, Nazareno Reggiani,

Massimo Bariselli, Giovanna Curto 49-52

Abstract: In 2010-2011, a monitoring and some experimental trials were carried out in productive chestnut groves, with the aim of describing the flight of the different moth species (*Cydia fagiglandana*, *Cydia splendana* and *Pammene fasciana*) and verifying the ability of *Heterorhabditis bacteriophora*, *Steinernema feltiae* and *Steinernema carpocapsae* to parasitize the juveniles and control the moth infestations. The results showed that the EPNs are highly effective biocontrol agents when applied against a susceptible host, with temperature ≥ 12 °C and high humidity in the substrate. At these conditions, the chestnut grove has proved to be a natural environment suitable for effective and practicable pest biocontrol, where the EPNs can be applied by common grower facilities.

Survival of potentially beneficial organisms: *Bacillus subtilis*, *Pseudomonas vranovensis* and *Cryptococcus albidus* in phyllosphere environment under laboratory conditions

Dorota Remlein-Starosta, Jolanta Kowalska 53-57

Abstract: Biological control is one of the most promising methods, however the success of commercialization of an antagonist depends on its ability to colonize the surface of host plant. The objective of this study was to investigate the survival capability of new antagonists *Bacillus subtilis*, *Pseudomonas vranovensis* and *Cryptococcus albidus* (Yield Plus) under greenhouse conditions. Tomato plants were sprayed with antagonists' suspension at 1×10^8 CFU/ml and then

inoculation tests were performed. Each of ten days the number of antagonist CFU per 1 cm² of leaf blade were calculated. It was concluded that: (i) *B. subtilis* can survive and colonize leaves under greenhouse condition for up to 10 days after the treatment, (ii) *B. subtilis* survival capability on leaves is comparable to that of *C. albidus*, (iii) *P. vranovensis* cannot survive on leaves for a period longer than three days.

Isolation of antagonistic fungi towards *Venturia inaequalis*
and preliminary applications in sanitation practice
reducing ascospore inoculum

Riccardo Fiaccadori, Ivan Portillo, Roberta Roberti, Agostino Brunelli 59-66

Abstract: The reduction of the rate of ascospore inoculum of *Venturia inaequalis* in apple cultivations can facilitate scab control and reduce the risk of selection of pathogen-resistant populations to fungicides. Potential candidate antagonistic fungi were isolated from apple leaves on the soil of several natural areas in Italy and tested against conidial germination and mycelial growth of *V. inaequalis*, *in vitro*. The most effective isolates were further assayed for their eradicant activity on ascospores of an apple orchard, both alone and in mixture with additive substances (glycerol and glucose) and applied at two different timings: at the end of leaf-fall or at the beginning of pseudothecia maturation. The antagonistic activity of these isolates was evaluated by assessing the number of ascospores extracted from leaves by a “wind tower”. Several fungal isolates (*Penicillium* spp., *Acremonium* spp. and *Verticillium* spp.) caused a reduction of the number of ascospores greater than 88%, in the first or in the second application time, and their effect was positively influenced by the additive substances. The eradicant activity of several antagonistic fungi is promising and further trials are in progress to confirm these results and to study their modes of action.

Session 2. What IFP can learn from the organic fruit production: case studies

What can integrated fruit production learn from organic?

Uygun Aksoy, Ahmet Altindisli 69-71

Extended abstract

The use of inorganic compounds to control apple scab in integrated fruit production

Davide Profaizer, Mario Baldessari, Graziano Giuliani, Gino Angeli 73-79

Abstract: Inorganic fungicides such as sulphur, lime sulphur and copper are used for apple diseases control since long time, but recently they became the backbone of disease control in organic farming. Taking advantage of the experience acquired in the organic apple production, innovative formulations of these active ingredients, such as Thiopron, Poltiglia Disperss, as well as traditional ones like Polisenio, could be used more than at present, even in integrated production. This approach will contribute to overcome present and probable future restrictions on the use of synthetic fungicides. In a field experiment conducted in Trentino region (Italy) the efficacy and phytotoxicity of these inorganic fungicides was evaluated. Results show that these products can be efficiently used to control apple scab infection. Lime sulphur is particularly effective when applied on wet vegetation within 300 degree hours from the beginning of the infection. No phytotoxic effect was detected on fruits. A control strategy that integrates these inorganic fungicides with synthetic active ingredients is possible and it will permit to reduce the dependence as well as the resistance selection pressure of synthetic fungicides.

Contrasting effects of codling moth exclusion netting on the natural control
of the rosy apple aphid

*Gaëlle Marliac, Sylvaine Simon, Amandine Fleury, Aude Alaphilippe,
Hazem Dib, Yvan Capowiez* 81-85

Abstract: Exclusion netting is developing in Southern France against *Cydia pomonella*, a major pest of apple. Most insecticides and therefore side-effects on natural enemies (NE) are avoided in

netted orchards. Conversely, nets can also exclude some NE and/or modify their access to prey in the tree canopy. The effect of nets on the beneficial complex associated to the rosy apple aphid (RAA) was studied in experimental and commercial orchards in 2009 and 2012 in South-Eastern France. RAA infestation was reduced or increased by nets depending on the orchard type (experimental vs. commercial) and the site and study year. NE were not (Syrphidae) to strongly (Coccinellidae) affected by nets in Avignon sites whereas the abundance of all NE groups was reduced under nets in Valence site. Such discrepancies are probably due to entangled processes related to site climate, type of orchard and/or the role of ants as commensalists of aphids. This outlines the complexity of multi-pest approaches and biocontrol processes as affected by cultural practices.

Organic soil management to prevent soil sickness during integrated fruit production

Davide Neri 87-99

Abstract: In temperate climates, increased soil fertility is strictly related to the accumulation of humified organic matter, with the creation of vegetal soil as the primary means of expanding biomass production per unit area. In the wild, Nature accomplishes this process efficiently, but in cultivated fields, humification is relatively neglected, which leads to impoverished soil quality. The reason for this is that the accumulation of residues from any single crop disrupts the humification process, which induces modified decomposition that delays the stabilisation and increases the release of toxic metabolites. These toxins, in turn, can induce specific allelopathic effects (dispathy) that can result in 'soil sickness' under repeated cultivation conditions. Root absorption, in particular, can become hindered by toxins from previous crop residues, which promotes dystrophies and root die-back. Thus, the sustainability of an agricultural system can be significantly improved through better control of the evolution of the soil organic matter through mimicking of the natural process of humification. To become truly effective, this process has the need for biodiversity, such as crop rotation or intercropping, use of organic amendments, and/or reduction in pesticide, fertiliser and tillage practices. The restoration of humification within soils also enhances the natural suppression of soil-borne diseases, plus induction of stronger and healthier plants that are less vulnerable to pathogens and parasites; furthermore, this also diminishes the needs for pesticide sprays.

The effect of different leaf removal systems and fungicide combinations on phytophagous pests and predatory mite populations, and yield of organic Sultani Cekirdeksiz grape variety

Fatma Özsemerci, F. Özlem Altindisli, Fadime Ates, Ahmet Altindisli, Cigdem Takma 101-109

Abstract: The effects of four different leaf removal (removal of 2 leaves at fruit set, removal of 4 leaves at veraison, removal of 6 leaves at fruit set and at beginning of ripening, untreated control) in combination with two different foliar applications (sulfur or sodium bicarbonate) against powdery mildew (*Erysiphe necator* Schwein.) have been investigated in terms of population densities of pests and predatory mites, and yield and quality of grape in organic and conventional plots between 2005 and 2007. The different levels of leaf removal generally had no significant effect on damage by European grapevine moth (*Lobesia botrana* Den. & Schiff.) and predatory mite populations. Only in 2005, lower infestation of *L. botrana* has occurred in the 2 leaf-removal treatment at fruit set. The highest populations of grape erineum mite (*Colomerus vitis* Pgst.) were counted when 6 leaves were removed at fruit set and at beginning of ripening in 2006. Although any statistical difference has not been determined among the treatments, population densities of the two-spotted spider mite (*Tetranychus urticae* Koch) in 2005 and 2006, and of grape leafhoppers (*Empoasca* spp.) in 2006 have been higher in sodium bicarbonate-applied plots than in those treated with sulfur. In Turkey, a registered plant protection product is unavailable against grape leafhoppers and two-spotted spider mites in organic agriculture. In some years, they can heavily attack the plants. Natural biological control needs longer time to suppress these pests. For this reason, it might be logical to recommend sulfur instead of sodium bicarbonate for the management of powdery mildew, the main disease. Predatory mites have generally been

observed in the plots from late-July or early-August, when sulfur sprayings against powdery mildew are completed. It has been found that the removal of 6 leaves at fruit set and veraison has partly increased the yield and quality of Sultani Cekirdeksiz grapes in organic vineyards. It has been concluded that leaf removal at different phenological stages have not statistically effected fresh grape yield (kg/vine tree).

The hail-nets against codling moth and their influence on the behavior of moth species harmful to the pear tree in Emilia-Romagna (Italy)

Edison Pasqualini, Stefano Caruso, Matteo Piccinini,

Fiorenzo Salvatorelli, Francesca Ventura, Stefano Maini 111-114

Abstract: The behavior of some species of Lepidoptera, frequently present and widespread on pear, is investigated. The main dangerous pests are: *Cydia pomonella* (L.), *Argyrotaenia ljungiana* (Thunberg), *Pandemis cerasana* (Hübner) and sometime *Grapholita molesta* (Busck). In previous experiments the ability of hail nets to reduce the *C. pomonella* and other species of Lepidoptera damages was demonstrated.

The purpose of this preliminary investigation was to understand the main reasons that led to those results, in particular to investigate the variations in the behavior of *C. pomonella* under the hail-net (i.e. interference on mating). Variation of temperature and radiation under the net, that could have a significant effect on the behavior of pests, were investigated.

Session 3. Integrated control of pome fruit arthropod pests

Importance of naturally occurring predators for pear sucker control

Michelle T. Fountain, Csaba Nagy, Adrian Harris, Jerry V. Cross. 117-125

Abstract: The pear psyllids *Cacopsylla pyri*, (L.) and *C. pyricola* (Foerster) are the most important pests in pear orchards throughout Europe because they have developed resistance to many insecticides and cannot be reliably managed in modern intensive orchards. Communities of insect predators can naturally regulate populations of these psyllids, but populations are often inadequate for effective biocontrol. Anthocorid predatory bugs, earwigs, ladybirds and spiders are considered to be among the key contributors. Anthocorids largely migrate out of pear orchards in autumn and return after flowering in spring. Spiders predate adult psyllids in their webs or actively hunt on the trees at night and ladybirds react by migrating into orchards when psyllid numbers rise and other food sources are scarce later in the season. Earwigs (*Forficula auricularia* L.) are less mobile, and overwinter in the soil within the orchard, but populations may decline to very low levels in pear orchards for a variety of reasons including the direct and indirect adverse effects of pesticides and/or lack of food. This paper focuses on 1) the remediation of predators in a pear orchard, 2) the comparison of pear sucker numbers to insecticide spray programmes in 8 orchards and 3) the findings of the first year of a project aimed at identifying insecticides that are harmful to earwigs in laboratory tests. We conclude that one of the key aspects of pear sucker management in orchards is to avoid the use of pesticides that harm key predators at key stages of the predators' lifecycle. This research has led to recommendations for pear sucker management with a new emphasis on using only the pesticides safest to important pear sucker predators.

Adaptation to exclusion netting of the codling moth (*Cydia pomonella* L.) in apple orchards

Myriam Siegwart, Mylène Pierrot, Jean-François Toubon,

Sandrine Maugin, Claire Lavigne 127-131

Abstract: Due to widespread insecticide resistance to granuloviruses, increasing economic losses due to the codling moth (*Cydia pomonella* L., Tortricidae, Olethreutinae) have been recorded in organic orchards in France. Exclusion netting of the tree canopies, using a net named Alt'Carpo, is used as an alternative to insecticides in southern France. Laboratory and field behavioural tests and observations in a network of commercial orchards have shown that the moths were able to

lay eggs through the nets and to escape. It was thus supposed that the efficacy of the nets results from altering the reproduction of the pest mainly by preventing it from flying over the canopy for reproductive encounters (Sauphanor, 2012). Despite the good efficacy of this method in commercial orchards, some cases of failures raised the question of the evolution of the pest towards a modified behaviour enabling reproduction under nets. We investigated this hypothesis by comparing the fecundities and fertilities in confined space of four codling moth populations two being collected in two orchards, covered either by single row or single plot nets, and two being control populations from orchards without nets. Further their fecundities and fertilities were compared to a reference lab strain.

All populations were collected as diapausing larvae, and analyzed in the following spring at adult emergence. To assess fertility and fecundity in confined space, individual pairs were confined in small boxes in the laboratory. Populations differed significantly from controls in terms of fecundity in the case of single plot netting, but not in single row netting. This may be the sign of adaptation in the case of single plot netting indicating that the second method could be the most sustainable.

Semantics and emergent web-3 technologies: modern challenges for Integrated Fruit Production systems towards internationalization

Petros Damos 133-142

Abstract: Worldwide crop systems are increasing their use of integrated production systems in response to consumer preferences and environmental imperatives. However, although several guidelines have been established and adopted by public or private cooperatives, certification organizations and authorities have seldom access to data and information in order to evaluate Integrated Fruit Production (IFP) and Integrated Pest Management systems at the farm level and over large areas. In most cases IFP related information is either not shared, or is exposed in non exploitable formats. In this context the scope of the current work is to popularize the emergent web-3 semantic technologies and to provide practical means to link IFP and IPM databases in a universal-international form. An IFP classification scheme – ontology architecture is proposed to describe the functional units of typical IFP systems. Several kinds of data (i.e. cultivation varieties, productivity, energy influxes, landscape properties), between arbitrary things (i.e. Certification authorities, cooperatives) are described and interlinked by resource description frameworks (RDF's) using ontology web language (OWL). In particular, by virtue of integrating facts from several datasets (cultivation type, productivity, pesticides applications) integrated crop production systems can be evaluated on a real basis.

Effects of amitrole (3-amino-1,2,4-triazole) on the common earwig

Forficula auricularia L. (Dermaptera: Forficulidae)

Herman Helsen, Kees Booij 143-146

Abstract: The common earwig *Forficula aricularia* L. (Dermaptera: Forficulidae) plays an important role in the natural control of orchard pests such as woolly apple aphid (*Eriosoma lanigerum* Hausmann) and pear sucker (*Psylla pyri* L.), but the use of pesticides may hinder its effectiveness. We therefore investigated the role of pesticides on the survival and reproduction of earwigs. In this paper the results are presented of laboratory tests with amitrole (3-amino-1,2,4-triazole), a herbicide that is used extensively in Dutch orchards. Females that were exposed to amitrole in autumn did not suffer extra mortality, but eggs that were laid in the following spring after the exposed females had overwintered did not hatch. So far it could not be shown that the same effect occurs in an orchard situation but the effects found show that we should be aware of the delayed impacts of pesticides on this predator.

Residual toxicity of six reduced-risk insecticides to codling moth eggs and neonate larvae

Daniel Cormier, Francine Pelletier, Gérald Chouinard 147-151

Abstract: New classes of insecticides with novel modes of action have become available for codling moth control. To help growers better use these reduce-risk insecticides in their

management programs, residual activities of six insecticides to codling moth eggs and larvae were evaluated with field-aged residue bioassays on apple leaves and fruit. Novaluron exhibited the highest and the longest residual activity on eggs laid on treated fruit or leaves. Methoxyfenoxide also demonstrated high levels of ovicidal activity but only for residue on fruit. For all insecticides evaluated, except novaluron, residues produced high levels of mortality of *Cydia pomonella* neonates for at least 14 days. Spinetoram was the most toxic followed by methoxyfenozide and chlorantraniliprole. Better knowledge of the relative toxicity of these new insecticides to various life stages will help determining optimal timing for application of these compounds.

Life table demography and population growth of dusky-veined walnut aphid,
Panaphis juglandis (Goeze) (Hem., Callaphididae)
on different walnut cultivars

Evin Polat Akköprü, Remzi Atlıhan 153-154

Abstract: The effect of five cultivars of walnut on the life table demography and population growth of dusky-veined walnut aphid were tested at 25 ± 1 °C, $60 \pm 10\%$ r.h. and 16 L:8 D photoperiod in a controlled temperature room. Experiments were carried out using potted walnut plants and plexiglas clip-cells (20 x 10 mm) with their upper side covered by muslin. Developmental time, survival and fecundity data were analyzed based on the age-stage, two-sex life table. Results showed that aphids had the lowest performance on the Fernor cultivar.

Applied chemical ecology; filling the volatile gap

*Marco Tasin, Anders Aak, Mario Porcel Vilchez,
Hans Ragnar Norli, Geir K. Knudsen* 155-157

Abstract: The use of plant volatiles in integrated pest management (IPM) programs is a challenging topic. Often, much of the knowledge on the mechanisms behind insect host-plant location via volatiles remains confined to the laboratory. A gap is reported when transferring the knowledge gained in laboratory into a natural setting. Our talk offers an example of a combined approach with laboratory and field bioassays to develop an IPM system based on plant volatiles. We predicted that the background odour of the crop and the way of delivery of plant volatiles could be key factors in closing this gap. We tested this hypothesis on the system of *Argyresthia conjugella*, the apple fruit moth, and its host-plants (*Sorbus aucuparia* and *Malus domestica*). Results showed that the delivery system as well as the volatile background had a great influence on attraction of plant volatile lures. Both were relevant to successfully transfer the preliminary data obtained in the laboratory into a field setting. By taking these factors into consideration, a monitoring lure to track the apple fruit moth migration from rowan to apple was developed.

Susceptibility to spirotetramat and abamectin of pear psylla

Cacopsylla pyri L. (Hemiptera: Psyllidae) in Northern Italy

Stefano Civolani, Mauro Boselli, Alda Butturini, Stefano Cassanelli 159-163

Abstract: Spirotetramat may be considered a valuable tool for the control of *C. pyri* as a component of an IPM programme. Given the high efficiency on *C. pyri* populations in field test this active ingredient could represent a valuable alternative to abamectin in order to manage the risks of occurrence of resistance in *C. pyri* control. Overall, the bioassays data indicate that no apparent resistance to abamectin has yet been developed in *C. pyri* populations of Emilia-Romagna. Nevertheless, the pear orchards in which *C. pyri* outbreaks recently occurred are under close investigation and careful survey.

Garden chafer (*Phyllopertha horticola*) and European cockchafer
(*Melolontha melolontha*) monitoring of beetles and white grubs
in the orchard

Zofia Płuciennik, Barbara H. Łabanowska 165-168

Abstract: The experiments were conducted in 2010-2011. The biological activity of traps with attractants (three types) and identification of adult flight period of the garden chafer

(*Phyllopertha horticola* L.) and European cockchafer (*Melolontha melolontha* L.) were evaluated. The number of beetles attracted to traps depended on the trap location in the orchard as well as on the type of dispenser used. Beetle flight period varied depending on the season. The main flight of garden chafer occurred during the first half of June and European cockchafer in first half of May.

Coragen 200 SC – selective insecticide for the control of codling moth (*Cydia pomonella* L.)

Zofia Pluciennik 169-171

Abstract: Effectiveness of a new chemical – rynaxypyr (as Coragen 200 SC) in the control of codling moth (*Cydia pomonella* L.) was evaluated during two seasons (2006 and 2007). The product was applied in various doses in the period of codling moth mass flight and laying eggs. In all conducted experiments tested product significantly reduced number of fruits damaged by codling moth larvae. Very good results in codling moth control were obtained after application of tested product at a dose of 0.125 l/ha and higher.

On the track of insects responsible for misshaped apples

Patrik Kehrlí, Denis Pasquier 173-174

Abstract: With the broad use of specific control strategies against primary apple pests, secondary pest species such as fruit piercing insects gained importance. Although some of the species misshaping apples such as the apple fruit weevil (*Tatianaerhynchites aequatus*) or the forest bug (*Pentatoma rufipes*) are well known, we nevertheless suspect that a whole complex of insects might provoke similar fruit deformations. We tried to unravel this complex by weekly beating samples in young, mature and old apple orchards. 15 times more apples were pierced on untreated cider trees than in conventional orchards. Moreover, the number of misshaped fruits was correlated with the number of phytophagous Heteroptera as well as the number of folivorous weevils of the genus *Phyllobius*. In order to study these weevils' ability to pierce fruits, adults of *Phyllobius betulinus* and *P. oblongus* were each released inside of sleeve cages enwrapping apple inflorescences. Contrary to our expectations, no indications of misshaped apples were observed in these sleeve cages. This indicates that these two *Phyllobius* species do not directly feed on apples and that their presence within attacked orchards is probably associated with a moderate use of pesticides. However, our exposure experiment also highlighted that the apple fruit weevil *T. aequatus* is able to misshape apples heavily. Overall, these investigations will help to unravel the complex of fruit piercing insects in order to identify the principal species responsible for misshaped fruits and to adapt IPM control strategies against these secondary apple pests.

Species variation and abundance of thrips (Thysanoptera) and their natural enemy species in chemically treated and untreated vineyards

Fatma Özsemerci, İrfan Tunc, Tulin Aksit 175-184

Abstract: Thysanoptera species variation, their population densities, and their natural enemies in chemically treated and untreated vineyards in Alaşehir district Manisa province, the most important grape production center in Turkey, were determined in 2004 and 2005. Among the phytophagous species, *Myceothrips albidicornis* (Knechtel) and *M. tschirkunae* (Jachontov), *Rubiothrips vitis* (Priesner), *Thrips tabaci* Lindeman, *Frankliniella occidentalis* (Pergande), and *Tenothrips frici* (Uzel) were the most frequent. *M. albidicornis*, *M. tschirkunae*, and *T. frici* populations were found in untreated vineyards, while *R. vitis* and *F. occidentalis* populations, which are the most important species in Turkish vineyards, were found to be more abundant in the chemically treated vineyards. It was observed that the *T. tabaci* population can be present at high population densities in the chemically treated as well as in the untreated vineyards, depending on the year. When the total numbers of all of the thrips species obtained in the two years were compared for four experimental vineyards, it was determined that the thrips populations in the chemically treated vineyards were higher than in the untreated ones. The population densities of their natural enemies – some species of spiders, *Chrysoperla carnea*

(Stephens) (Chrysopidae), the mite *Anystis baccharum* (L.) and, the entomophagous thrips *Scolothrips longicornis* Priesner, *Aeolothrips collaris* Bagnall and *A. intermedius* Priesner were found. The Araneidae spiders, *S. longicornis*, *A. collaris*, *A. intermedius* and *A. baccharum* (Anystidae) were found more often in the chemically treated vineyards, while *C. carnea* was more frequently found in the untreated vineyards.

Influence of hail-nets against Codling moth on the main adversities of pears:
first observations carried out in Emilia-Romagna (Northern Italy)
during the years 2011 and 2012

Stefano Vergnani, Stefano Caruso, Edison Pasqualini 185-188

Abstract: In Emilia-Romagna (Northern Italy) the codling moth control in pear and apple orchards has been very difficult over the last 10 years. Modern IPM strategies provide for the integration between chemical and biotechnological options (e.g.: CpGV, MD), mainly used in organic farming. The control costs are high and success is not always guaranteed. For this reason, for some years, experiments with anti-insect nets for codling moth control have been ongoing. The system, was developed in the south of France in 2005 and is called "Alt'Carpo". The results obtained in Italy in the period 2011-2012 confirm the power of the nets to control the codling moth. The *Cydia pomonella* damage is so high that its complete control, without the use of insecticides, is a very interesting result. The hail-nets against codling moth also seem to give additional advantages in the suppression of many other adversities excluding metcalfa and, secondly, pear psylla and Tingidae. The observations reported are preliminary, and further studies are needed to confirm the results obtained up to now.

Determination of the susceptibility level of the predatory mite
Neoseiulus californicus (Acari: Phytoseiidae) populations
collected from the apple orchards in Isparta to etoxazole
by using bioassay, synergists and detoxification enzymes levels

Sibel Yorulmaz Salman, Recep Ay 189-190

Abstract: This study aimed to determine the susceptibility levels of *Neoseiulus californicus* (McGregor) (Acari: Phytoseiidae) populations collected from the apple orchards in Isparta in 2011 to etoxazole by using bioassay and detoxification enzyme levels. LC₅₀ value of *N. californicus* populations were determined by using a spray tower with the leaf disk method. In 2011, six *N. californicus* populations were collected from the apple orchards. Moreover, the effect of the piperonyl butoxide (PBO), S-benzyl-O,O-diisopropyl phosphorothioate (IBP) and diethyl maleate (DEM) synergists on pesticides was examined. Esterase, glutathione S-transferases (GST), cytochrome P450 monooxygenases (P450) and asetilkolinesterase (AChE) in the populations were determined by using the kinetic method; and the enzyme of esterase was determined by using the electrophoresis and kinetic methods. According to LC₅₀ values, compared susceptible populations, resistance ratio of Atabey-1, Atabey-2, Agilkoy-1, Agilkoy-2, Gonen and Yalvac populations collected from the orchard is determined to be 10.14, 11.34, 11.75, 14.41, 9.85 and 9.66 fold to etoxazole respectively. Etoxazole with synergistic effect rates for Atabey-1, Atabey-2, Agilkoy-1, Agilkoy-2, Gonen and Yalvac populations were determined to be 3.18, 3.13, 2.42, 2.45, 2.44 and 2.31 fold for PBO; 1.61, 2.50, 1.20, 2.61, 1.15 and 0.93 fold for IBP; 1.50, 1.25, 1.31, 1.63, 1.65 and 1.08 fold for DEM, respectively. The determined enzyme activity ranges of esterase, GST, P450 and AChE were between from 7.130 to 11.788, from 2.07 to 3.47, from 0.0223 to 0.0695 and from 0.0211 to 0.0243 mOD/min/mg proteins, respectively.

Resistance of *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) to thiacloprid
and activities of some detoxification enzymes
collected from an apple orchard in Isparta

Mesut İsci, Recep Ay 191-192

Abstract: Codling moth is the most important pest of apple on world. The codling moth *Cydia pomonella* L. is controlled mostly with chemical insecticides in Turkey. In this study it was

aimed to evaluate *C. pomonella* populations resistance to thiacloprid which were collected from an apple orchard in Isparta. Resistance was evaluated by bioassay and biochemical methods. Chemical concentrations in 6 different dosages had been prepared. The synergistic activity between thiacloprid and piperonyl butoxide (PBO; monooxygenases inhibitor of cytochrome P450), diethyl maleate (DEM; inhibitor of glutathione-S-transferase GST), and S,S,S, tributyl phosphorotrithioate (DEF; inhibitor of esterase) was studied. Activities of esterase and GST of codling moth were determined by photometric methods. The substrates 1-naphthyl acetate and 1-chloro-2,4-dinitrobenzene (CDNB) were used for esterase and GST, respectively. Thiacloprid resistance levels in Isparta populations were 14.99-fold compared to a susceptible laboratory population. Application of thiacloprid with synergists DEM, PBO and DEF resulted in 1.53-, 1.51-, 1.33- fold synergistic ratios, respectively. While esterase enzyme activity in Isparta populations was higher than SV population (1.55 fold), GST enzyme activities didn't show a significant difference between Isparta and SV populations.

Session 4. Behavior modifying chemicals: prospects and constraints in IFP

Semiochemicals: the essence of green pest control

Marco Tasin, Orkun Baris Kovanci 195-197

No abstract

Evaluation of Puffer[®] CM, a release device of pheromone to control codling moth on apple in Italy

Mario Baldessari, Claudio Ioriatti, Gino Angeli 199-204

Abstract: Different techniques have been developed to disrupt mating (MD) of codling moth (CM) by treating orchards with synthetic pheromone. For this purpose synthetic pheromone is applied to the crop as a formulation that is designed to protect these generally labile compounds from degradation while gradually releasing pheromone into the atmosphere. In Trentino South Tyrol MD has been adopted successfully (22,000 ha, i.e. 70% of the apple area) to control CM in heavily infested areas; while in areas with low pest pressure, less pesticides are usually applied and, as a consequence, pheromone mating disruption is not considered economically convenient. Hand applied sealed plastic tubes and plastic ampoules are the two pheromone formulations more widely used. A new pheromone-based control technique, called Puffer[®], has been recently proposed. Puffers are battery-powered devices that release pheromone from pressurized aerosol cans every 15 minutes for 12 hours (or 30 min for 24 hours). During each puff a quantity of 6.95 mg a.i. is emitted. The high release rate of pheromone per puff from aerosol dispensers is thought to compensate for their low application densities (2 puffer/hectare). Results of two year field trials carried out in Trentino-South Tyrol demonstrated the reliability of Puffer as effective tool to control CM.

Four years of mating disruption for the control of plum fruit moth *Cydia funebrana* (Treitschke), in plum orchard in Emilia-Romagna region (North Italy)

Marco Ardizzoni, Andrea Iodice, Stefano Caruso 205-208

Abstract: In Italy there are 14,200 ha of plums, 5,100 located in Emilia-Romagna and 950 in Modena province. The main characteristics of the plum orchards in this area is their relatively small surface (on average 1.5 ha) with many varieties, with different harvesting time (from mid June until mid September) and very high pest populations. Plum fruit moth, *Cydia funebrana*, is the most common Lepidoptera species in Italian plum orchards. After the European insecticide review few active ingredients are now allowed to be used on plum. In Emilia-Romagna regional 2012 IPM guideline only 6 active ingredients are permitted: Chlorantraniprole (max 2/yr), Etofenprox (max 2/yr), Fosmet (max 4/yr), Spinosad (max 3/yr), Thiacloprid (max 1/yr), and Emamectina benzoate (max 2/yr).

This fact combined with particular pest habit to lay eggs directly on fruits with very quick larvae penetration after hatching, determines difficulties in its control. The aim of the trial,

carried out in the four years 2009-2012 in a plum orchard in the North of Italy (Modena province) of total surface of 2 ha, was to verify if the application of MD (Mating Disruption) with the product Isomate® OFM rosso, in these particular field conditions could be helpful to reduce the infestation at harvest. Results show that a combined application of mating disruption with Shin-Etsu product and chemical treatments for the control of Plum fruit moth on plum produced optimum insect control, better than the one obtained with standard control strategies alone.

Control of oriental fruit moth, *Cydia molesta*, in the peach orchards of South-Eastern Bulgaria, using CIDETRAK® OFM-L dispensers

Hristina Kutinkova, Vasiliy Dzhuvinov, Bill Lingren 209-213

Abstract: Oriental fruit moth (OFM), *Cydia molesta* (Busck) (Lepidoptera: Tortricidae), is an economically important pest of peach, nectarine and apricot in Bulgaria. Its larvae cause damage, infesting shoots and fruits. The aim of this study was to test the effectiveness of mating disruption (MD) in control of OFM in peach orchards, using CIDETRAK® OFM-L dispensers of Trécé Inc., USA. The trials were carried out in South-East Bulgaria in 2009–2011. The trial (MD) plots were located in three different 2-ha orchard blocks in the Sliven district. The damage of shoots was evaluated during the first generation of OFM on 20 trees, randomly selected within the central area of each block. The fruit damage was recorded accordingly, on 100 fruits per each selected tree; so, 2,000 fruits were inspected for damage in each block. The rate of damage in the trial plots was compared with that in the reference orchard, located in the vicinity, treated with conventional pesticides. CIDETRAK® OFM-L dispensers completely inhibited OFM captures in the pheromone traps, installed in the trial plots, indicating a high level of disruption. The percentage of shoots infested by OFM larvae was nil in the MD plots. The three-year data of fruit damage rate were subjected to the analysis of variance, considering successive years of study as replications. The rate of damage in the MD plots was low, below 1%. The difference in the percentage of damaged fruits between the reference orchard and the trial plots was highly significant for all cultivars under study; it was, however, greater in late than in early or mid-season cultivars. The considerable fruit damage noted in the reference orchard, in spite of many chemical treatments applied, indicates that commonly used organophosphates and pyrethroids have become ineffective against OFM. Probably OFM developed resistance to the insecticides used. On the other hand, the present results do confirm that mating disruption, using CIDETRAK® OFM-L dispensers, can provide a more effective control of oriental fruit moth. Implementation of this method in the commercial peach production in Bulgaria would be helpful in preservation of sound environment and in avoiding any risk of pollution of fruit products with pesticides.

General situation of Sumitomo registered pheromone dispensers against fruit insect pests

Turkan Koclu, Orhan Akin, Meksen Yagmur, Rahmi Temirtas, Mehmet Coskun, Gokhan Tunali, Ibrahim Fidanci, Huseyin Gunduz 215-218

Abstract: In Turkey, generally the insecticides are preferred for the agricultural protection against the main harmful pests of Lepidoptera family in the orchards. Because of the fact that some producers don't observe the rules of use while they are using pesticide, residue and environmental health problems sometimes occur. These problems have brought about the necessity of different methods on the control of the pests. In order to reduce the use of insecticides, the studies of mating disruption technique began in 1997. On the purpose of controlling the major pests on apple and grape which have very important production areas in Turkey, the studies have been made. After the successful results on these fruits, some studies have been made on apricots. In each of three studies in the testing orchards, by decreasing the population of other pests especially the spider mites within the years, it has reached the level that doesn't require the spraying. When the use of area has been expanded, the success of the method has increased. According to the count, the beneficial insects was rare in the orchards in the first years, but it has been determined that the population of beneficial insects has increased within the next years and the natural balance has been founded. The dispensers Isomate C and Isonet L have

been approved and registered by the Ministry of Food, Agriculture and Livestock in Turkey. They have been used in extensive areas successfully for almost six years. The registration application of Isonet A has been done in 2011 and accomplished in 2012. Commercially use of Isonet A in apricot orchards is planned in the 2013 vegetation period.

Efficacy evaluation of RAK 2 PRO dispensers against *Lobesia botrana* on Sultani Cekirdeksiz grapes in Turkey

F. Özlem Altindisli, Fatma Özsemerci 219-225

Abstract: The efficacy of RAK 2 PRO has been tested against the European grapevine moth (EGVM), *Lobesia botrana* (Den. & Schiff.), the key pest of grape, in comparison with Isonet L dispensers registered in Manisa, Turkey. By the emergence of the first EGVM adult, 600 RAK 2 PRO and 650 Isonet L dispensers/ha -including borders- were installed once a year. One chemically treated vineyard was used to compare infestation levels in the same location. EGVM adults have been monitored in all plots by pheromone traps from the beginning of the flight until harvest. Infestation rates were compared. We indicated that only 7 ha-border part of RAK 2 PRO test area showed an infestation rate of 6-7% and needed an insecticide treatment in 2009 due to later dispenser installation in the buffer area. RAK 2 PRO dispensers showed sufficient efficacy against the pest without additional treatment in 2010, since the population density of the pest has been taken under control by two year-successive mating disruption applications. Average infestation rates of EGVM have been 1.6 and 1.78% at harvest in 2009 and 2010, respectively. Comparison treatment by Isonet L had an excellent performance both in 2009 and 2010 with no infestation and no complementary treatment in its plot. EGVM infestation has been maintained at zero level by sprayings five and seven times in the conventional vineyard in 2009 and 2010, respectively. In RAK 2 PRO dispensers, 334 mg of pheromone has been released until 6 August 2009, whereas 304 mg of pheromone has been released until 9 August 2010.

Session 5. Pest and disease monitoring and forecasting

PREMISE, a prototype of an empirical model of the epidemiology of apple scab for economic assessment of IPM tools

Bart Heijne, Wil Hennen, Jan Buurma 229-234

Abstract: A prototype of an empirical model was made to assess the economic effects of IPM tools used against apple scab (*Venturia inaequalis*). The model, called PREMISE, is built with three different stages of the scab epidemic. These are the quiescence stage, the primary season and the secondary season. The outcome of one stage influences the next stage. Specific conditions and measures taken by the fruit grower result in indicators of the economic effects of the apple scab management for this farm. As an example, a realistic Dutch situation is described, in which leaf removal and urea application was performed during winter time as an improved IPM situation. On top of that, the very innovative use of antagonists against conidia is described as an advanced IPM situation. The model showed equally good economic results for the improved situation, but the economic impact in the advanced situation was bad. Next step is to validate the economic assessment model with data from different practical situations in different European countries.

Past and current situation of forecasting system in Turkey

N. Mukerrem Celiker, Ayse Özdem, Ercan Canihos, Cevdet Kaplan, Nursen Ustun, Naim Öztürk, F. Özlem Altindisli 235-241

Abstract: Grape, apple and pear production are of great importance in Turkey. However, certain insect pests and diseases cause crop losses by impacting quality of fruits. Vine and fruit trees are protected against harmful organisms according to the timing of forecasting systems or phenological growth stages of plant. Modified Verderevsky and Popov (1975) models are used in the vineyards as a decision tool of chemical applications against downy mildew (*Plasmopara viticola* Berk. et M. A. Curtis) and European grapevine moth (*Lobesia botrana* Den.-Schiff.),

respectively. In apple orchards, application times against apple scab [*Venturia inaequalis* (Cke.) Wint.] and codling moth [*Cydia pomonella* (L.)] are decided according to Mills and Laplante (1954) Table and day-degree model, respectively. Mary Blight model is the decision tool that determines application times most accurately in the control of fire blight (*Erwinia amylovora* Burril Winslow *et al.*) in pear orchards. Section of the forecasting studies carried between 1993 and 2010 against the pests and diseases mentioned above has been considered in this article. Models tested and decided, short description of equipments providing necessary data and the increase in data collecting stations and protected areas have been summarized as well as success and application numbers of pesticides according to forecasting models and plant phenology have been compared. Transition from mechanical equipments to computer-based systems has been given.

Decision support for sustainable management of the main orchard pests with the Swiss forecasting system SOPRA

Jörg Samietz, Heinrich Höhn, Elisabeth Razavi, Lukas Schaub, Benno Graf 243-251

Abstract: Crop protection in innovative and sustainable orchard management relies on precise timing of surveillance and control of pest populations. The system SOPRA has been developed as forecasting tool in order to optimize timing of monitoring, management, and control measures of insect pests in fruit orchards. Applying time-varying distributed delay approaches, phenology-models were developed driven by solar radiation, air temperature and soil temperature on hourly basis. Up to now, relationships between temperature and stage specific development rates for the relevant stages of the life cycles were established under controlled laboratory conditions for major pests of apple, pear, cherry and plum: Rosy apple aphid (*Dysaphis plantaginea*), apple sawfly (*Hoplocampa testudinea*), codling moth (*Cydia pomonella*), smaller fruit tortrix (*Grapholita lobarzewskii*), apple blossom weevil (*Anthonomus pomorum*), summer tortrix (*Adoxophyes orana*), pear psylla (*Cacopsylla pyri*), European cherry fly (*Rhagoletis cerasi*), red spider mite (*Panonychus ulmi*), and plum fruit tortrix (*Grapholita funebrana*). Insect body temperatures in the models are based on studies of habitat selection of relevant developmental stages and according simulations using the three driving variables and structural orchard features. For validation, model predictions were compared with independent field observations from several years. On base of local weather data, age structure of the pest populations is simulated and crucial events for management activities are predicted by the SOPRA system. Through a web-interface, the simulation results are made available to consultants and growers (www.sopra.info). As exemplified here, phenology is directly linked to a detailed decision support and to extended information about the pest insects as well as to the registered plant protection products. Fourteen climatic regions cover all fruit growing regions of Switzerland. SOPRA is applied as decision support system for the ten major insect pests of fruit orchards on local and regional scale in Switzerland and southern Germany and has a wide range of possible applications across Europe.

Real time pest modeling through the World Wide Web: decision making from theory to praxis

Petros Damos, Sotiris Karabatakis 253-258

Abstract: In this work we present the way in which information technology can be used to support Integrated Pest Management (IPM). In particular we have developed simple handling software that crawls through the *www* and performs weather data mining and storage. In a second stage we extend the already developed software and develop a forecasting system to perform real time pest forecast through the *www*. At the current stage of development the system performs trial predictions for three fruit orchard key pests in 100 distinct geographical regions distributed all over Greece. The software and the related forecast system can virtually extend its functionality for any pest of interest given its species specific temperature thresholds for development. Functionality of the data mining software can potentially extend and mine open weather data at any location globally through the *www* and further stores them for any use (*i.e.* crop, pest and disease modeling and forecasting, precise farming etc.). The system was launched on January 2012 and its prediction performance passes currently an evaluation phase.

Biology of grape thrips [*Rubiothrips vitis* (Priesner) (Thysanoptera: Thripidae)]
and their damage to the Sultani Cekirdeksiz (*Vitis vinifera* L.) vineyards
of Manisa, Turkey

Fatma Özsemerci, Tulin Aksit, Irfan Tunc 259-267

Abstract: The damage caused by grape thrips *Rubiothrips vitis* (Priesner) (Thysanoptera, Thripidae) to the Sultani Cekirdeksiz (*Vitis vinifera* L.) grape variety and the fluctuations in the thrips population were evaluated in the Alaşehir district of Manisa province in two untreated vineyards. The biology of *R. vitis* was examined under laboratory conditions in 2004 and 2006. It was described by population fluctuation, by examination of grapevine organs and by counting the number of individuals detached from the grapevine by the shaking method. The duration of each life phase (larva, prepupa, pupa, preoviposition, oviposition, and postoviposition) and the longevity of *R. vitis* were determined at 25 ± 1 °C, $60 \pm 10\%$ relative humidity (RH), and 16 hour of light, at an illumination of 4000 lux. *R. vitis* was first observed on grapevines in April a time corresponding with bud burst. Their population reached its highest level in April-May. The thrips preferred the newly emerged buds and young shoots of the grapevine. At the end of May, the thrips population decreased and continued at a low intensity until the grape harvest. *R. vitis* individuals were collected in the vineyard by the shaking method from the following organs: bud + young shoot (10-15 cm), bud + flower/fruit bunches, and the leaves on shoots with 5-6 leaves. The pest entered the grapevine buds, feeding and laying eggs. As the young leaves in these buds grew, it was observed that the damaged tissues tore and desiccated from the sides. The duration of the life phases in *R. vitis* were as follows: embryonic development 5.5 ± 0.3 days; larval stage 5.4 ± 0.4 days; prepupa stage 1.4 ± 0.11 days; and the pupa stage 2.3 ± 0.14 days. The preoviposition period was 1.7 ± 0.15 days, the oviposition period 16.9 ± 1.17 days, and the post oviposition period 5.8 ± 0.32 days. Females of *R. vitis* laid an average of 12.45 ± 0.81 eggs and the longevity of the female was 22.4 ± 1.92 days while that of the males was 13.15 ± 1.19 days.

DNA barcoding: an innovative tool to identify internal lepidopterans in apples

Annabelle Firlej, Jean-Philippe Légaré, Jean-François Landry,

Richard Hogue, Gérald Chouinard, Daniel Cormier 269-271

Abstract: The identification of Lepidoptera larvae can be problematic when different species occur at the same time in crops and when their identification requires dissection or laboratory rearing. In Quebec, this is the case for three Tortricidae that feed synchronously in apples: the codling moth [*Cydia pomonella* (L.)], the lesser appleworm [*Grapholita prunivora* (Walsh)] and the oriental fruit moth [*Grapholita molesta* (Busck)]. Codling moth larvae can usually be distinguished from the two other species by their larger size and the absence of anal comb, but larvae of the lesser appleworm and oriental fruit moth are nearly indistinguishable.

The objective of our study is to validate DNA barcoding as a method for identifying major lepidopteran larval pest insects occurring in apple orchards in Quebec. This molecular method uses primers common to all Lepidoptera that target a 658 bp gene fragment coding for cytochrome oxidase I, which are specific to each lepidopteran species. 140 adult moths of the three species were collected in 2011 from six apple-producing regions in Quebec to establish a DNA sequence library that would be included in the “Barcode of Life Data Systems”. Lepidoptera larvae were sampled in the 2012 summer season in orchards of Quebec to assess the effectiveness of the molecular method for larval identification. When validated, this method will become a useful identification tool for laboratories specialized in plant pest identification.

Present status of olive knot disease caused by *Pseudomonas savastanoi*
pv. *savastanoi* in Aegean region of Turkey

Nursen Üstün, Neziha Arslan 273-277

Abstract: In recent years olive knot caused by *Pseudomonas savastanoi* pv. *savastanoi* has triggered so many new infections threatening trees with killing in Aegean Region of Turkey. Survey has been carried out in 2009-2010 to determine the status of the disease in the Region. Olive plantations with the disease symptoms in Balıkesir (Bandırma, Burhaniye, Edremit, Erdek), Çanakkale (Ayvacık, Geyikli, Ezine, Küçükuyu, Gökçeada), İzmir (Karaburun) and Manisa

(Akhisar) provinces were visited during the end of the summer and the beginning of the autumn. The disease incidence and disease severity index per orchard/location/area were estimated. Totally 80 strains were isolated from olive knot samples collected. Isolated strains were identified on the basis of biochemical and pathogenicity tests. As a result the differences in the incidence and severity of olive knot disease between localities and areas were determined. Variation of climatic conditions (frost, wind and hailstorms) and harvesting practices were concluded to effect directly the incidence and severity of the disease.

Session 6. Integrated control in soft fruits

The possibility to control the big bud mite (*Cecidophyopsis ribis* Westw.) on blackcurrant in Poland with a new active ingredient spirotetramat (Movento 100 SC)

Barbara H. Łabanowska, Mirosław Korzeniowski 281-286

Abstract: Blackcurrant is commonly grown horticultural crop in Poland. The most important pest of this crop in many regions of the country is big bud mite *Cecidophyopsis ribis*. This pest can harm numerous buds, on some plantation even more than 50-60% may become damaged. The pest was noted on almost all grown cultivars, but currently some new resistant varieties came up on the polish market. At present, big bud mite is a pest which needs to be controlled on most blackcurrant plantations in the country, however there are no registered acaricides. Previous experiments with the use of sulphur (Siarkol 80 WP), fenpiroximate (Ortus 05 SC) and propargite (Omite 570 EW) have shown good efficacy in the control of mites. For the last years the efficiency of new product, Movento 100 SC (spirotetramat) in big bud mite control was studied. Movento 100 SC was used once at the rate 0.6 l/ha and at the rate 0.7 l/ha about 2 weeks before expecting blossom as well as applied twice at the two mentioned rates (0.6 and 0.7 l/ha) 2 weeks before expecting blossom and just after blossom. In all treatments times Movento 100 SC showed promising results in the reduction of the number of buds affected by the big bud mite. Based on newest ecotox profile of Movento 100 SC, product will be registered as 1-2 applications after blossom. This product will be helpful to control the big bud mite in integrated fruit production.

Evaluation of integrated strawberry production field recording process in Atibaia, São Paulo State, Brazil

Fagoni Fayer Calegario, Maria Carolina Pezzo Kmit,

Antonio Luiz Cerdeira 287-291

Abstract: Integrated strawberry production (ISP) is a system that optimizes planting techniques, management, harvest and post harvest to ensure high quality and food safety. It is a voluntary program coordinated by Ministry of Agriculture, Livestock and Supply in Brazil and by Embrapa Environment in São Paulo state. In order to reach ISP certification, growers must follow ISP rules and keep traceability notes of several procedures. The objective of this paper was to evaluate the mandatory requirements of the recording process in four ISP Demonstration Units (DU) conducted in Atibaia, São Paulo state, Brazil, in 2010 growing season as a management tool to help the growers to improve their performance. Each ISP DU, including a Central one, was conducted by a grower who attended the trainings and received technical assistance by the ISP program. At the end of the 2010 growing season, the field notebooks from March to December were collected and analyzed. The ISP field notebooks were evaluated with respect to compliance with the mandatory requirements of 15 tables related to registration of plant general information; diseases, mite pests, insect pests and natural enemies monitoring; pesticide application; soil and plant tissue analysis; correction and maintenance fertilization; irrigation and fertigation records; weather registration; harvest; machinery and implements list and revision; monthly visits of the technical manager. Each of the 15 evaluated items received a score according to the adequacy of the recording, where: 0 = no information (blank), 1 = incomplete information, 2 = complete information. Average and standard deviation were calculated for each evaluated item. The

average score achieved by the growers ranged from 0.9 to 1.3 (close to 1), which represents incomplete information. Although growers were not completely able to take the necessary notes, they surpassed their previous practice of not making any record. Central DU reached the highest average score among all of ISP DUs. The constant presence of the technical manager and the practical trainings in this area resulted in this higher score. All growers were able to complete (average 2) plant general information and pesticide application tables. Correction and maintenance fertilization tables were almost completed (average 1.8 and 1.5, respectively) for all growers. Machinery and implements list and revision tables had major problems in being completed (average 0), followed by weather registration (average 0.3) and harvest (average 0.5) tables, indicating necessity of improvement. Diseases, mite pests, insect pests, natural enemies, irrigation and fertigation records achieved average scores from 1 to 1.3 (incomplete). These results were presented to the growers, in order to carry out corrective actions for the next harvest season. They could improve their performance and reached ISP certification in December 2011. This evaluation provided a useful tool to indicate the critical points in the records of the ISP field notebooks. In the 2010 growing season, growers in general, were not quite able to take the necessary notes, but could receive orientation to improve their performance and achieve ISP certification in 2011.

Impact of the methods of cultivation on the size of pest population in raspberry plantations in Latvia

Apenīte Ilze, Ciematnieks Rinalds 293-296

Abstract: Over the vegetation seasons of 2011 and 2012, trials were carried out in Latvian State Fruit-Growing Institute (LSFGIL) to observe raspberry pests and their population levels in raspberry plantations under FGV (3 sections, up to ground) and Haygrove (3 sections, above ground 1 m) type high tunnels as well as under opened-field cultivation. Five economically significant pests were detected under FGV and Haygrove type high tunnels - strawberry blossom weevil *Anthonomus rubi* Hbst., raspberry beetle *Byturus tomentosus* Fabr., raspberry cane midge *Resseliella theobaldi* Barnes., two-spotted spider mite *Tetranychus urticae* Koch and thrips Thripidae gen. sp. There were no significant differences in pest level and damage by *A. rubi* neither under FGV and Haygrove type high tunnels nor in the opened-field cultivation. The highest levels of damage on raspberry sprouts (8-10%) under FGV type high tunnels were caused by *R. theobaldi*, however this was not statistically significant. The highest levels of *T. urticae* population were seen under FGV and Haygrove (on average 2.4-2.5 individuals per leaf), in comparison with opened-field cultivation where no two-spotted spider mites were not statistically significant. After assessing raspberry yield in LVAI, it was established that the highest levels of damage by *B. tomentosus* were seen under FGV type high tunnels, where raspberry beetle had damaged 12.4% of the yield. Also, thrips (Thripidae gen.sp.), pests currently rarely seen in raspberry plantations of Europe and Latvia, were detected in the field trials, damaging from 0.4 to 3.4% of the yield. Further studies on the importance of thrips on raspberry yield should be carried out.

Movento 100 SC – efficacy in the control of aphids on blackcurrant plantations in Poland

Barbara H. Łabanowska, Tomasz Gasparski, Mirosław Korzeniowski 297-300

Abstract: Serious damages to the youngest leaves and shoots of black- and red currant are often caused by aphids (Aphididae). Nowadays the control of these pests in Poland is possible as several insecticides are registered and recommended to use in blackcurrant crop: thiacloprid (Calypso 480 SC) and pirimicarb (Pirimor 500 WG). For the past few years also the efficacy of new insecticide containing spirotetramat – Movento 100 SC was tested in the control of aphids occurring on blackcurrant crops. The insecticide Movento 100 SC applied at dose rates: 0.7 and 1.0 l/ha once after blossom showed a very high reduction of aphids (Aphididae - *Hyperomyzus lactucae* L. – Currant-sowthistle aphid) on blackcurrant. The results obtained with Movento 100 SC applied once at both tested dose rates: 0.7 and 1.0 l/ha were similar: 98.7-100% efficacy 21 days after one treatment. The efficacy of Movento 100 SC at 7 days after treatment was similar (in 2010) or slightly poorer (in 2011) compared to standard insecticides, but 21 days after

treatment Movento 100 SC showed a higher (not always with statistically difference) reduction of aphids than standard insecticides such: Pirimor 500 WG (pirimicarb) at the rate 0.75 kg/ha (efficacy 100%, 14 days after treatment, and 70% at 3 weeks after treatment), Calypso 480 SC (thiachloprid) at the rate 0.15 l/ha (efficacy 91.3%, 15 days after treatment and 63.8% at 3 weeks after treatment) and Actara 25 WG (thiamethoxam) at the rate 0.1 kg/ha (98.5% and 90.2%, 15 and 21 days after treatment, respectively. (Actara 25 WG was withdrawn from the blackcurrant protection programme in Poland). It is important, that on plants treated with Movento 100 SC numerous (no statistical analysis applied) Coccinellidae (larvae and beetles) and larvae of Syrphidae were observed.

Session 7. *Drosophila suzukii*

The Swiss approach to combat *Drosophila suzukii*

Patrik Kehrl, Serge Fischer, Christian Linder, Jörg Samietz,

Catherine Baroffio 303-304

Abstract only

Short range communication in *Drosophila suzukii*

Valerio Mazzoni, Gianfranco Anfora, Meta Virant-Doberlet 305-307

Abstract: We describe a short range mating behaviour of *Drosophila suzukii* with particular emphasis on the sound communication. A double approach for signal recording was adopted: a prepolarized microphone for air-borne signals and a laser vibrometer for substrate-borne signals. Males and females were inserted into a recording arena and audio/video was recorded throughout the mating process. The analyses of collected data revealed the common use of several acoustic signals by males from the first approach to the final copula. Some of these signals are clearly substrate-borne and are produced by abdominal vibrations. During the courtship males combine wing exposure with sound emission so that visual and acoustic cues work together to increase female acceptance. No female signals were ever detected.

Olfactory responses of *Drosophila suzukii* to host plant volatiles

Santosh Revadi, Francesca Eccher, Valerio Mazzoni, Shuhub Al Ani,

Silvia Carlin, Urska Vrhovsek, Gianfranco Anfora 309-313

Abstract: *Drosophila suzukii* is a highly polyphagous invasive pest endemic to South East Asia, which has recently invaded western countries. Its serrated ovipositor allows this fly to lay eggs on and damage unwounded ripening fruits, and for this reason it is considered a main threat to fruit production. *D. suzukii* presence in Europe is spreading rapidly and has now been reported in nine countries. The development of environmentally-safe control methods is urgent for a safeguard of the concerned fruit industry. The aim of this study was therefore to characterize and identify the volatiles of the *D. suzukii* host plants which influence its olfactory behaviour in order to set-up management strategies based on semiochemicals. The olfactory responses of the adult flies for the odour released by intact host fruits in behavioural assays have been evaluated. It was shown that *D. suzukii* females are attracted to the volatiles emitted from the tested fruits. Volatile compounds emitted by the attractive host fruits have been extracted and identified (GC-MS), and their biological activity on *D. suzukii* females screened by means of electrophysiological analysis (GC-EAD).

Drosophila suzukii in the USA; monitoring and management in berries and cherries

Peter W. Shearer, Elizabeth H. Beers, Preston Brown, Hannah J. Burrack,

Rufus Isaacs, Jana Lee, Betsey Miller, Lauren Novotny, Steve Van Timmeren,

Robert Van Steenwyk, Vaughn Walton, Caroline Wise 315-316

No abstract

The potential economic impact of *Drosophila suzukii*
on small fruits production in Trentino (Italy)

Giorgio De Ros, Gianfranco Anfora, Alberto Grassi, Claudio Ioriatti 317-321

Abstract: Small fruits production is an important agricultural activity in Trentino, a mountain region in the North East of Italy. Between 2000 and 2010 cultivated areas almost doubled, while output increased from about 15 to more than 30 MEUR per year. Overall, this made soft fruits a viable alternative for local growers to the more traditional, and commercially-mature, apple production. This development was recently challenged by the emergence of *Drosophila suzukii*, first detected in the area in 2009.

In order to provide a first estimate of the pest's economic impact, the five host crops mostly affected by the pest infestation (strawberry, raspberry, blueberry, blackberry and cherry) were singled out. Business data coming from the grading of infected samples at the level of marketing co-op were used. It was assumed that quantity reductions caused by infestation in Trentino do not affect market prices but, given that the damages vary during harvesting season, production losses were valued on a weekly basis with the corresponding weekly output.

DROSKII: a transnational attempt for insight on the damage potential of
Drosophila suzukii and on the development of risk management
and control measures

Sauro Simoni, Peter Baufeld, Phil Northing, Howard Bell, Elisabetta Gargani,
Andrew Cuthbertson, Christa Lethmayer, Alois Egartner, Sylvia Bluemel,
Patrik Kehrl, Gianfranco Anfora, Alberto Grassi, Catherine Baroffio,
Alberto Masci, Christian Linder, Claudio Ioriatti 323-326

Abstract: "Droskii" is a 2-year project running in the frame of Eupresco II – an European Research Area Network (ERA-NET) project for the development and implementation of research policies in the field of statutory and emerging plant pests, diseases and invasive species – devoted to deepen the knowledge and to face the pressing needs posed by the recently introduced spotted wing drosophila (SWD), *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae).

D. suzukii has a wide host range and can attack many fruit crops, mainly small fruits, fruit trees and grapevine. It poses a major challenge to the development of alternative Integrated Pest Management strategies. Given the importance of soft fruits, stone fruits and grapes in the daily food intake, the risk of pesticide residues from the over-reliance on chemical products, the main control measures currently adopted against *D. suzukii*, is increasing. Furthermore, the economic costs of SWD do not only include direct yield losses but also associated labour and material costs for monitoring and management as well as revenue losses due to the closure of fruit export markets from SWD-infested regions by trading partners.

The "Droskii" project is sub-divided in four main work packages: 1) the monitoring and forecasting activities of *D. suzukii* in Europe, e.g. by means of the development of efficient traps; 2) evaluation of the susceptibility of different fruit varieties and host plants; 3) survey and assessment on the infestation of grapes varieties in Europe; 4) actions for the containment and control of *D. suzukii* by environmentally-friendly measures. An additional activity of this project will be the transnational dissemination of the project acquirements and the reduction of pesticide use in fruit production, a vital mission both for occupational health and for consumer safety.

Session 8. Integrated plant protection of diseases in fruits

Movement and dispersal of plum pox virus in Turkey

Birol Akbaş, Işıl Özdemir, Kemal Değirmenci, M. Selçuk Başaran 329-336

Abstract: Extensive surveys to detect movement and dispersal of plum pox virus (PPV) in the Central Anatolia region were carried out between 2007 and 2010 in commercial stone fruit orchards and nurseries, in non-commercial stone fruit trees at other locations and in rural and urban residential properties located in 25 provinces of the region. Surveys were conducted both in orchards and in any kind of sites, consist of stone fruit trees. During the surveys, in addition to

Prunus samples, weeds and aphid samples were collected in the survey areas. A total of 2,817 samples were collected from almond, apricot, mahaleb, nectarine, plum, peach, sweet cherry and sour cherry. Collected samples were tested by serological and biological tests. Confirmation tests were applied by molecular tests. Twenty nine samples from 3 provinces (Aksaray, Kayseri and Konya) other than Ankara province were found to be infected with PPV. This virus has occurred in Turkey since 1968 and in Ankara province since 1973. Role of weed, its aphid vectors and other factors were tried to determine in its movement and dispersal to other locations and orchards. Its movement to far location was considered to realize by propagating materials, the role of aphid vectors and some fault agricultural practices from orchards to orchards in same location and from tree to tree in same orchard were determined. During this study, it was detected that weeds in even infected orchards had no role the movement of PPV in the region.

Molecular detection of apple chlorotic leaf spot virus in different hosts in Central Anatolia

Kemal Değirmenci, Birol Akbaş 337-343

Abstract: Partial molecular properties of apple chlorotic leaf spot virus (ACLSV) isolates were studied on previously known ACLSV infected pear and quince trees. Isolates were taken from infected fruit trees in Ankara. RT-PCR test was used for molecular detection. cDNA Sequence analysis was performed on the coat protein (CP) coding regions for isolates from pear and quince, in order to determine the sequence similarity among ACLSV isolates. Sequences of the investigated isolates were also compared with those of genome fragments of ACLSV isolates published in the GenBank database. The similarity in the percentage figures of the sequence variability of sequences of pear isolates and GenBank ACLSV sequences was between 79 and 92%, respectively. DAS ELISA and biological indexing to bean were used for verification. Results were obtained with total nucleic acid preparations from a set of ACLSV isolates taken leaf samples of pear and quince trees. ACLSV was not detected in symptomless leaves of these trees. RT-PCR amplification of ACLSV isolates gave expected products at 677 bp with the ACLSV primer set. Virus-free trees were differed from virus infected trees by the conventional RT-PCR assay. The nucleotide sequence of a pear isolate was deposited in the GenBank database under accession numbers HM490312. First ACLSV isolates was sequenced and deposited in GenBank and alternative detection method to biological indexing and ELISA was presented in use.

Reduced sensitivity of *Venturia inaequalis* to strobilurins and anilinopyrimidines in Italy

Riccardo Fiaccadori, Marina Collina, Agostino Brunelli 345-350

Abstract: A survey to verify the sensitivity of *Venturia inaequalis* to strobilurins and anilinopyrimidines was carried out in Northern Italy over many years (2003-2010) in more than 100 orchards where difficulties in scab control with these fungicides were reported. A sample of 30-40 scabby leaves was collected in each orchard treated with anilinopyrimidines and/or strobilurins. Bulk populations of *V. inaequalis* (one isolate for each sample) were evaluated by biological tests *in vitro* and *in vivo* for their sensitivity towards strobilurins and/or anilinopyrimidines. Concerning strobilurins, EC₅₀ values in spore germination on water agar were calculated. Afterwards, through comparison with EC₅₀s of previously characterized “reference populations”, the sensitivity of each population was assessed as ‘normal-moderately reduced’ or ‘reduced’. Sixty-six out of ninety-nine tested populations showed a reduced sensitivity, probably corresponding to field control issues. As regards anilinopyrimidines, % relative efficacy with a preventive or curative application on apple seedlings was assessed and the evaluation of population sensitivity was based on curative activity. Similarly to strobilurins, through comparison with “reference populations”, the isolates were ranked as ‘normally (or moderately less) sensitive’ and with ‘reduced sensitivity’, this latter case likely corresponding to field control issues. For more than half of thirty samples collected in Emilia Romagna, a reduced curative activity was observed, while samples from Lombardy (10) were almost all normally sensitive. The reduced sensitivity to the two fungicide groups shown by sampled populations can be related

to field control issues pointed out in some Italian areas. In particular, for strobilurins this shows the occurrence of many cases of practical resistance. For anilinopyrimidines the resistance situation is less clear, but the reduced curative activity observed on some populations seems to indicate an ongoing sensitivity shift, with a moderate practical activity reduction. In any case, this new situation has led to reconsider the use of strobilurins and anilinopyrimidines, which since the late 1990s have become the key products against apple scab in Italy.

Influence of rain protective tree covering on sweet cherry fruit cracking and decay

Regina Rancane, Liga Vilka 351-356

Abstract: Cherry fruit cracking induced by the rain and high humidity is one of the main reasons for the high incidence of fruit rot. Damaged fruits are not marketable due to poor fruit quality. Investigations were carried out two years (2011-2012) in collaboration with the Latvia State Institute of Fruit-Growing. Combinations of covering and fungicide applications were tested on two sweet cherry cultivars: 'Iputj' and 'Krupnoplodnaja'. The most common fruit rot in the experiment was brown rot (*Monilinia* spp.) and gray mold (*Botrytis cinerea*). The incidence of decay was higher in the uncovered area what was associated with a heavier cracking. Observations showed that the number of fungicide applications under the covering could be reduced till one time per season what is important aspect for the integrated production.

Control of brown rot blossom blight (*Monilinia laxa*) on apricot in organic agriculture

Václav Psota, Martin Bagar, Petr Ackermann, Matěj Veselovský 357-360

Abstract: The effect of copper, sulphur, sodium bicarbonate, lime sulphur and plant resistance improver based on algae extract (Alginure) on brown rot blossom blight on apricots was studied during spring 2011 and 2012. The small plot trials were conducted in two commercial apricot orchards (varieties: Pincot, Goldrich and Leskora) located in South Moravia (Czech Republic). Treatments were applied during the flowering period three times in 2011 and four times in 2012. Evaluation was done according to the EPPO 1/38(2) method. In 2011 all treated variants were significantly different from the untreated control. The most effective was copper 66% following by sodium bicarbonate 63%, Alginure 63%, sulphur 56% and lime sulphur 38%. In 2012 the brown rot blossom blight infestation was very low. Therefore only variants of lime sulphur and combination of Alginure with copper were significantly different from untreated control. Efficacy of combination of Alginure with copper was 100% and combination of Alginure with lime sulphur reached 67.6%.

Screening breeding apple progenies with *Vf* apple scab (*Venturia inaequalis* (Cke.) Wint.) disease resistance gene specific molecular markers

Suat Kaymak, Emel Kaçal, Yusuf Öztürk 361-365

Abstract: Apple scab (*Venturia inaequalis* (Cke.) Wint.) is the most important fungal disease of apples. Since commercially grown apple cultivars are sensitive to this disease, fungicides are extensively used for controlling apple scab disease. Using resistant varieties is the most efficient way of controlling the disease and reduction of pesticide applications. In this study, Williams' Pride (Co-op 23) and Priscilla (Co-op 4) varieties known to have resistant *Vf* gene were crossed with Golden Delicious to get resistant new varieties in Isparta Fruit Research Station. Apple progenies were tested for presence of *Vf* gene with three different SCAR markers linked to the *Vf* gene. For this purpose, samples were tested for the presence of *Vf* gene by SCAR PCR using primers specific to ALO-7, ACS-7 and ACS-9 SCAR markers. Also crossed progenies were evaluated in natural inoculation field conditions. According to results natural inoculation and markers were compared and sameness was determined. In Golden Delicious x Williams' Pride combination resistivity was transferred 46%, and Golden Delicious x Priscilla combination resistivity was transferred 44%.

European pear rust control possibilities based on life cycle of the pathogen

Baiba Lāce and Inga Moročko-Bičevska 367-370

Abstract: Pear is one of the most common fruit crop in Latvia and pear orchards occupy approximately 200 hectares. Although European pear rust caused by *Gymnosporangium sabinae* (Dicks.) G. Winter is not considered as a key problem in commercial pear orchards, during the last decade severe damages have occurred. Mainly severe damages were observed in home gardens or organic orchards. In recent years, the disease occurred also in some commercial orchards where applications of fungicides according to standard schemes appeared not to be sufficient for European pear rust control. The aim of this study was to evaluate current fungicide treatment schemes and their optimization for European pear rust control based on the pathogen life cycle and weather conditions. Data analysis showed statistically significant differences in disease severity among the years and it correlated with the time of first fungicide application and release of basidiospores.

Sensitivity of *Erysiphe necator* to quinoxifen in Italian vineyards

Marina Collina, Ceren Turan, Ivan Portillo, Leonardo Bacci, Gregory Kemmitt, Agostino Brunelli 371-375

Abstract: Grape powdery mildew, caused by *Erysiphe necator*, is of major economic importance on cultivated grapevines worldwide. Quinoxifen is a preventive fungicide that specifically controls powdery mildew pathogens by interfering with germination or pre-infection development. The aim of this study was to evaluate quinoxifen sensitivity of *E. necator* collected from Italian vineyards characterized by different type of usage of this fungicide. The study was carried out on populations of *E. necator* sampled in 23 vineyards localised in different viticultural regions of Italy during the 2009 and 2010 growing seasons. Sensitivity tests were performed by application of different concentrations of quinoxifen on “Trebbiano” grape seedlings followed by experimental inoculation of conidia suspension. A preliminary comparison among data obtained from plant assays, leaf disc sporulation tests in a settling tower and conidial germination tests was also carried out. In some of vineyards where samples were collected field trials were also conducted. The distribution of EC₅₀ values was found to range from 0.0008 to 6.28 mg/l. These wide variability may be related to the peculiar mode of action of quinoxifen as also observed in previous baseline studies. Overestimation of leaf disc test was also preliminary pointed out and the results of field trials showed a good control of the disease. The EC₅₀ values detected in 2009-2010 in Italy did not show any changes in sensitivity of *E. necator* to quinoxifen both in bioassays and in field trials. Evaluation of sensitivity has been in progress through qualitative plant assays together the quantitative conidial germination tests on monoconidial isolates.

Detection and characterization of phytoplasmas infecting fruit plants in Poland

Mirosława Cieślińska, Halina Morgaś, Dorota Kruczyńska, Barbara Kowalik 377-382

Abstract: Plants of strawberry, raspberry, blackberry and hybrids of the *Rubus* species, sweet cherry, sour cherry, plum, peach, apricot, nectarine, apple and hazelnut growing in the orchards, on commercial, experimental, and amateur plantations located in various regions of the country were the research objects. Phytoplasma identification and classification was based on the PCR/RFLP analysis of 16S rRNA gene. It was shown that the tested fruit plant species were infected by phytoplasmas classified into four 16Sr groups. Most positively tested stone fruit trees (cherry plum, peach, apricot, nectarine) were infected with ‘*Candidatus* Phytoplasma prunorum’ belonging to the subgroup B of the apple proliferation phytoplasma group (16SrX-B). In individual nectarine and sweet cherry trees apple proliferation phytoplasma (‘*Ca. P. mali*’, 16SrX-A) and pear decline phytoplasma (‘*Ca. P. pyri*’, 16SrX-C) were identified, respectively. Two phytoplasmas were associated with witches-broom disease of apple trees: ‘*Ca. P. mali*’ and ‘*Ca. P. asteris*’ classified in subgroup B of the aster yellows (AY) phytoplasma group (16SrI-B). In the course of the research ‘*Ca. P. asteris*’ was also identified in hazel, and blackberry plants. Most positively tested *Rubus* species plants were infected by rubus stunt phytoplasma (‘*Ca. P. rubi*’) classified in elm yellows group (16SrV), but phytoplasma belonging to X-disease

group (16SrIII), less-known in the horticultural crops in Europe, was detected in *Rubus* hybrid loganobaccus plant.

Session 9. Management of postharvest diseases in Integrated Production

Incidence of *Colletotrichum acutatum* on apple fruits and possible sources of inoculum

Jorunn Børve, Arne Stensvand 385-388

Abstract: In order to quantify the importance of bitter rot caused by *Colletotrichum acutatum*, possible inoculum sources and stored fruits of cv. Aroma were followed over three years in eight commercial apple orchards located in southern Norway. Prior to bud burst, buds were collected and incubated for 3 weeks at 20 °C and in water saturated air. Leaves were collected in summer (July) and in autumn (September, before harvest), surface sterilized and frozen for five hours at -18 °C before incubation for six days at 25 °C. Apple fruits were harvested and stored for 3-4 months at 4 °C in normal air conditions followed by two weeks at 20 °C. Bud scales with conidial growth of *C. acutatum* were found only from one orchard, in the year following the most severe attack on the fruits. Conidial masses of *C. acutatum* were found on leaves, but only when assessed in September, not in July, in five of eight orchards. The highest incidence on leaves was in the orchard with infested buds. Bitter rot incidence after storage was from 0 to 27%, and apples with bitter rot was found in all orchards, but not every year.

Use of (pulsed) UV-C light to control spore germination and mycelial growth of storage diseases causing fungi, and effect on control of storage rot in apples and pears

Marcel Wenneker, Nina Joosten, Ludo Luckerhoff 389-393

Abstract: A heavy reliance on synthetic fungicides has been necessary to control postharvest decay of fruits. Recently, there is an ongoing concern about pesticide residues on fruits. Consumers increasingly prefer fruits without pesticides, and this is used by supermarkets as a selling strategy (residue free fruit). The use of ultraviolet-C (UV-C, 190-280 nm wavelengths) offers interesting possibilities for controlling storage decay. UV-C acts directly by damaging the microorganisms on the exposed surfaces, and indirectly by stimulating defense mechanisms in the treated product. In our study the effect of UV-C on spore germination (inactivation) and mycelial growth was examined. All conidia of the tested fungal species were completely or partially killed with UV-C. However, conidia with dark pigments, such as *Alternaria alternata* and *Venturia inaequalis*, were shown to be more resistant as compared with weakly pigmented conidia, such as *Penicillium expansum* and *Botrytis cinerea*. UV-C irradiation was not able to inhibit in vitro mycelial growth. However, a reduction in growth and sporulation was noticed for most tested fungal species. Intense light pulses (ILP) is a technique to decontaminate surfaces by killing micro-organisms using short time pulses of an intense broad light spectrum, including UV-C light. In a series of trials, the effects of ILP in controlling fruit rot caused by *P. expansum* and *B. cinerea* on apples ('Elstar') and pears ('Conference') was tested. It appeared that controlling fruit rot of these (inoculated) apples and pears was very difficult. Most likely due to UV-C shielding effects, which prevent the light beams from reaching the target.

Efficiency of cold treatment to cherry fruits infested by Mediterranean fruit fly (*Ceratitis capitata* Wied.) and cherry fruit fly (*Rhagoletis cerasi* L.) during storage

Turkan Koclu, Özlem Altindisli, Tevfik Turanlı, Fatma Özsemerci 395-398

Abstract: In this study, the effect of cold treatment to Mediterranean fruit fly and cherry fruit fly on the cherry fruits in the storage conditions has been examined. In the climate chamber, mass-reared Mediterranean fruit fly has been used to artificially infest to the cherry fruits; while for the cherry fruit fly, naturally infested cherry fruits have been used. The tests have been made at

0.5 ± 0.5 °C and 85 ± 5% relative humidity conditions in the cold storage room, which has TS EN ISO 9002 Quality System Certificate. Egg and third instar-larvae which are the most resistant instars of the Mediterranean fruit fly have been used in the tests. Larva tests have been made on 80,000 individuals in total, and egg tests have been made on 60,000 individuals. In the same storage conditions cherry fruit fly tests have been made on 11,000 fruits in total and on 880 larvae. As a control character; cherry fruits have been infested with 5,450 larvae and 5,450 eggs, and the progress has been observed at 25 ± 1 °C. During the tests, fruit flesh temperature has been measured and postharvest quality has been evaluated. As a result of these tests, it was concluded that cold treatment of 20 and 12 days at 0.5 ± 0.5 °C and 85 ± 5% relative humidity killed 100% of cherry fruit fly and Mediterranean fruit fly in the cherry fruits, respectively.

Session 10. Sustainable plant protection strategies to minimize residues in fruit

Management of European cherry fruit fly (*Rhagoletis cerasi*)

with exclusion netting: first results

Gisela Brand, Heinrich Höhn, Stefan Kuske, Jörg Samietz 401-404

Abstract: The effect of exclusion netting against European cherry fruit fly (*Rhagoletis cerasi*) was studied in a cherry orchard in two subsequent years. Particularly, the treatments included different netting periods and net types on the cultivars Star and Regina. Single trees were covered with nets that were tied around the stem. At harvest time, cherries were collected, stored in the climate chamber and after 20 days the infestation rate was estimated by counting the emerged pupae. The results suggest that netting has the potential to be as efficient against *R. cerasi* as chemical treatment. However, covering the trees until harvest is particularly important for successful cherry fly management. This seems to be even more important than covering the timespan before colour change. The use of 1.3 mm BiocontrolNet is recommended for cherry fly control, since a finer meshed net does not result in additional reduction of infestation.

Zero insecticide residues: the aim of Trentino apple production system

Mario Baldessari, Claudio Rizzi, Roberto Larcher,

Silvio Canestrini, Claudio Ioriatti 405-409

Abstract: The reduction of the residue of pesticides on fruits both in terms of the number of active ingredients and quantity of individual pesticides, is now not only a request from the consumer or the retailer, but a specific objective of the growers. The Integrated Apple Production System operating in Trentino (Italy) has been engaged on this front for years. According to the chemical analyses performed on the 575 samples collected in 2011 there are in average 3.24 p.a. per sample. Moreover, in 98% of the samples with detectable residues, the level did not exceed 30% of the official MRL. This result is achieved thanks to the implementation of the guidelines for integrated production by the 8000 fruit growers, to an extension service which justifies the need of the treatment and gives advice on which pesticide fit better for the time-pest combination, to the systematic check up of the sprayers, to the correct sizing of mix volumes to spray according to the size of the canopy, to the selection of active ingredients based on their residual activity in field tests, and to the systematic monitoring of the level of residues found on representative samples of the product at harvest. With these assumptions, the next goal is to eliminate all traces of insecticides and acaricides now present only in 30% of the samples. This aim could be achieved by extending the use of pheromone mating disruption to control fruit feeding Lepidoptera, as well as by promoting the use of short persistent residue products during the final part of the season. Results of some of the experimental field trials are presented and commented.

'Earwig Management Tool': Transferring knowledge of population dynamics and side effects on earwigs (*Forficula auricularia* L.) into practical sustainable plant protection strategies in pip fruit growing
Tim Bellien, Rob Moerkens, Herwig Leirs, Gertie Peusens, Dany Bylemans 411-418

Abstract: The improvement of integrated pest management (IPM) strategies plays an important role in minimizing chemical sprayings and residues on fruit. A key element of IPM is the suppression of potential pest outbreaks by beneficial arthropods. The European earwig, *Forficula auricularia* L., is an important natural enemy of a wide range of insect pests in pip fruit orchards. However, their univoltine life cycle makes earwigs vulnerable to orchard management interventions and a single disastrous event has long-lasting repercussions. In order to avoid harmful effects on earwigs and thereby maximizing their densities, it is necessary that growers have a good awareness of the earwig population development and potential side effects of orchard management interventions at every moment in the season. Therefore, we recently developed a software tool called 'Earwig Management Tool'. This program can be used by growers to accurately predict the earwig phenology in their orchards. In addition, a pesticide database with known side effects of a wide range of products on the different life stages of earwigs is integrated in the software tool. Hence, based on the output/advice generated by this user-friendly software fruit growers can adapt their orchard management taking into account the presence of (sensitive) life stages of earwigs. Here, we present the general outline of the tool and data behind it. Furthermore, we executed a new series of side effects trials last season, in order to update the program with side effects data of recently registered products in pip fruit growing.

Integrated production of grapes for juice in southern Brazil
Samar Velho da Silveira, Loiva Maria R. de Mello, Gildo Almeida da Silva, Alexandre Hoffmann, Lucas da Ressurreição Garrido 419-423

Abstract: New concepts of agricultural production should be introduced in Brazilian agriculture to become competitive. The integrated system is an agricultural technology that should be also applied to grape production. The purpose of this work was to evaluate two systems of agriculture production. Two plots (Plot IP), *Vitis labrusca* grapes and Hybrid, were chosen in fields conducted within the integrated production system (IPS) for juice production. All practices adopted in the plots were documented in a field book to ensure the traceability. The results were compared with Conventional System (CS) production of the same cultivars situated in two neighboring areas. The IPS plots provided a decrease in the amount of fungicides by 36.46% (fungicide g/ha). In Conventional System, 3,000 ml herbicide/ha were used. In IPS, herbicide was not applied due to the maintenance of the ground cover. Grapes produced in this system resulted in a yield 32.08% higher than in CS. There was no insecticide application in any of the two systems. The IPS provided a reduction in pesticide application without affecting yields and the biological assays revealed no presence of metabolism inhibitors. With the IPS, it is possible to product high-quality grapes that are safe for both consumers and farmers.

The Fruit.Net programme (pome and stone fruit) in Catalonia (NE Spain)
Pere Vilardell, Mariano Vilajeliu, Lucía-Adriana Escudero-Colomar, Josep-Lluís Batllori, Ramon Torà, Isidre Llorente, Jordi Cambay, Josep Usall 425-429

Abstract: The Fruit.Net Project has been carried out since 2009 on apple orchards in Girona and since 2011 on peach orchards in Lleida, both in Catalonia, Spain. The main objectives are to reduce chemical spraying by maximising the use of alternative methods, and to minimize residue content on fruits at harvest.

Strategies of pest and disease control were based on predictive models for apple scab and brown rot on peach, mating disruption for codling moth and oriental fruit moth, and mass trapping for Mediterranean fruit fly. These strategies required far fewer fungicide and insecticide sprayings and, at preharvest, fewer residues of active ingredients of pesticides were found in the Fruit.Net fruits compared with samples from orchards under standard management.

Minimising pesticide residues in strawberry through integrated pest, disease and environmental crop management

Robert Saville, Angela Berrie, Jean Fitzgerald, Chantelle Jay, Harriet Roberts, Erika Wedgwood, Xiangming Xu, Jerry Cross 431-438

Abstract: In a five year Hort-Link funded project an Integrated pest and disease management programme (IPDM) was developed for strawberry production over three years. In the final two years the programme was evaluated on commercial fruit farms for economic performance, effects on yield, fruit quality, pests, diseases and beneficial insects and the incidence of pesticide residues in the fruit compared to a conventional grower production programme (GS). In the IPDM programme, management of Botrytis fruit rot was based on the use of Botem, a forecasting model, to determine disease risk periods and bumble bees were used to vector bio-control agents (BCAs) to flowers. The use of conventional fungicides was restricted to pre-flowering and post-harvest use only. Management of powdery mildew was similarly based on a disease forecasting system to determine the risk periods and sulphur or potassium bicarbonate was used during flowering for disease control. The disease management strategies in the IPDM programme were, in general, successful, limiting Botrytis fruit rot and powdery mildew to acceptable levels, while showing a significant reduction in the number of pesticide residues in the fruit. Overall fruit yield and quality in the IPDM programme was equivalent to, or better than, that achieved in GS. We conclude that the IPDM programme developed can perform well, particularly in early season strawberry production when pest and disease risks are usually low. However, where pest and disease pressure was high the programme was less successful. So adoption of the IPDM programme by growers will require precise crop management. Further work is required to refine the models.

Determination of important parameters for weed control

in intensive apple orchards: weed species and its density

Ersin Atay, N. Pınar Güzel, Seçkin Gargın, Ahmet Eşitken, Hamza Şenyurt, A. Nilgün Atay, Mesut Altındal, Özgür Çalhan 439-442

Abstract: Weed control especially in the tree strips cost high values in intensive apple orchards. Determination of important parameters such as weed biomass, the quantity and quality of yields for weed control is important for orchard profitability. In this study weed species, their densities and weed biomass in intensive Golden Delicious⁷/M 9 orchard were determined. 18 weed species belonging to 11 families were determined and they were generally perennial. Total dried biomass was calculated 910.9 g/m². While field bindweed had the highest weed density value, curly dock had the highest dried weed biomass value (228.6 g/m²).

Session 11. Climate change and implication for plant protection

Climate change and implication for plant protection: a general view

Ahmet Uludag 445-447

Abstract: Climate change is an element of a larger change, which is called global change that is constituted with increased nitrogen deposition, altered disturbance regimes, increased habitat fragmentation, invasion by alien species so on. It can be described as long term changes in global climate as a result of anthropogenic events since the beginning of industrialization era and has been documented with observed and projected data/effects. Climate change, which affects environment either natural or disturbed, includes global rise in greenhouse gases and temperatures, alteration in precipitation, and increases in incidence and irregularity of extreme weather events such as storms, flooding etc. Although this text will focus on the effect of climate change on plant protection in managed areas, mainly fruits, it is difficult to limit discussions with climate change itself because elements of global change have generally combined effects and interactions. Crop, pest (arthropods, disease agents, weeds and other harmful organisms are referred in this article) and management tools are main elements of the crop protection. Effect of climate change can be neutral, positive or negative on any biological processes, from gene level

to ecosystem level depending on organism, region, and magnitude of change so on. However, we are still far away to make generalizations and set theories. In the text, the answer of where plant protection research might focus on will be summarized using reports and scientific papers which have used current data, projections and predictions.

Impact of climate change on phenology and sustainable management

of the codling moth (*Cydia pomonella*)

Jörg Samietz, Sibylle Stoeckli, Martin Hirschi, Christoph Spirig,

Heinrich Höhn, Pierluigi Calanca, Mathias Rotach449-457

Abstract: Current and projected global warming will have direct impacts on agricultural cropping systems (e.g. productivity), as well as indirect effects through changes in the phenology and life-history adaptation in many species. Hitherto these changes were not easy to simulate for actual phenologies because of the rough temporal (season) and spatial (regional) resolution of climate model projections. We evaluated the impact of climate change on phenology and prospective diapause induction in a global insect pest – the codling moth, *Cydia pomonella*. Seasonal and regional climate change signals were downscaled to the hourly temporal scale of a pest phenology model and the spatial scale of pest habitats using a stochastic weather generator operating at daily scale in combination with a re-sampling approach for simulation of hourly weather data. Under future conditions of increased temperatures (2045-2074), the present risk of below 20% for a pronounced second generation (peak larval emergence) in Switzerland will increase to 70-100%. The risk of an additional third generation will increase from presently 0-2% to 100%. We identified a significant two-week shift to earlier dates in phenological stages, such as overwintering adult flight. The magnitude of first generation pupae and all later stages will significantly increase. Additionally first generation pupae and later stages will be prolonged. Also a significant decrease in the length of overlap of first and second generation larval emergence was identified. Such shifts in phenology will ultimately induce changes in life-history traits regulating the life cycle. An according life-history adaptation in photoperiodic diapause induction to shorter day-length is expected and would thereby even more increase the risk of an additional generation. With respect to codling moth management, the shifts in phenology and voltinism projected here will require adaptations of plant protection strategies to maintain their sustainability.

Using Eco-Climatic diagrams to create a model for forecasting

Sahin Ince, Vincenzo Verrasto, Francesco Porcelli 459-461

Abstract: Wladimir Koppen published the first climate classification in 1868. Then, Walter Heinrich (1978) was created climate-diagrams and they became a model for forecasting. Today the idea of mapping and collecting climatic graphs of all the meteorological stations are accessible in a specific area and to compare different climatic regions in the world, in which vegetation is similar to one another. Values of climate-diagram maps are; mean annual temperature and precipitation, mean monthly temperature and precipitation, mean daily minimum temperatures of individual months and the absolute monthly minimum, for stations in the tropics often also the mean daily maximum of the warmest month, the absolute maximum and the mean daily variation of temperature (Tonietto & Carbonneau, 2004). For this purpose, GIS (Geographical Information System) will be used in finding the similarities between regions. This will show, the effects of climate on soil and plant relations (such as fertility, growth mechanism... etc.). In addition, the model will be used for taking strategic decisions for long term planning such as: selection of crops and livestock, forest species introduction and moreover scheduling agricultural operations such as; planting and pest control.

Session 12. Application technology

Orchard spray application in Europe – state of the art and research challenges

Jerry Cross, Paolo Balsari, Grzegorz Doruchowski, Jean-Paul Douzals, Andreas Herbst, Paolo Marucco, David Nuyttens, Peter Walklate 465-475

Abstract: Axial fan airblast sprayers are still the most commonly used for orchard spray applications in Europe because they are of comparatively low cost, robust, durable and flexible for use in a wide range of orchard types though they are gradually being replaced by more efficient and better targeted designs. Axial fan sprayers, normally produce a large radial spray plume that is poorly targeted and which results in high spray losses to the ground and as spray drift, and growers rarely make adequate adjustments to optimise sprayer performance in particular orchards.

A wide range of other machine types are also in use including cross-flow designs and those with ducting which aim to better target the spray plume to the tree, with varying degrees of success. Several designs of tunnel sprayer to reduce spray losses are available but tunnel sprayers are only used by a few growers. Multi-row sprayers are being increasingly adopted to increase work rates. Sprayers with canopy sensors that adjust sprayer output in real time, mainly by switching nozzles off in response to gaps in the canopy, have been shown to reduce spray use, though these as yet are not widely used in practice. However, spray drift and environmental contamination rates are still high compared with arable crop spraying and a range of methods of drift mitigation of varying degrees of effectiveness and practicality have been developed, some of which are now legally required, notably mandatory buffer zones on pesticide labels and the use of low drift air induction nozzles which produce very coarse spray qualities. There are important changes in the way dose rates are being expressed on pesticide labels and efforts are underway to develop methods of adjusting dose rates to suit the very wide range of orchard canopies to achieve deposits that are more uniform between different canopy sizes at different growth stages. Regular sprayer testing is now mandatory in many countries, to ensure that sprayers are adequately maintained and calibrated.

In this paper, the state of the art of orchard spraying practice in Europe including machinery, air adjustment, atomisation/nozzles, canopy sensing, drift mitigation, dose expression and adjustment and sprayer testing are broadly overviewed and the main technical and research challenges presented.

Innovations in orchard spraying: sensor guided precision sprayers

Marcel Wenneker, Ard Nieuwenhuizen, Jan van de Zande 477-481

Abstract: The reduction of the emission of plant protection products (PPP) to the environment is an important issue when applying agrochemicals in fruit growing in the Netherlands. In the last years several strategies and innovations have been developed in order to come to a practical spray application solution that results in a reduction in spray drift, reduction in total amount of plant protection products used, together with an efficacy at the same or an increased level as of conventional orchard spraying. The innovations consisted of combining sensor signals, decision algorithms, and actuators in the integrated automated spray technology. The advances of canopy density based spraying in pear was foreseen at the points of: no spraying where gaps were detected in the crop foliage; reduced spraying when minimal crop foliage was present, optimal spraying where large amounts of crop foliage was present.

Performance evaluation of two different air injection nozzles in vineyard application

Oncul K. Caner, Huseyin Guler, Erkan Urkan, Murat Apaydin 483-492

Abstract: Air-assisted sprayers are widely used in spray operations in vineyards which are cultivated in large areas in the Ege Region and vineyard production has a significant share in the Turkish economy. Generally hollow cone nozzles are used at high working pressures (> 25 bar) and high application rates. Since working with the high pressures causes more drift prone droplets, it increases pesticide losses. Especially during the full vegetation period because of high

working pressures and application rates most of the sprayed pesticides run off from the canopy to the ground. The pesticide drifted from the target side is a threat for human and environment health and also may cause fail on plant protection. The objectives of this study were to make adjustments on application and to determine spray performances of some air injection nozzles in the vineyards to achieve some goals like to reduce drift amount, to increase deposit amount of sprayed pesticide on the target, to reduce pesticide consumption and its cost by reducing drift. The experiments were conducted by using three different nozzles (Conventional nozzle, Lechler ID, and Teejet AITX) at three phenological periods (blossom, ripening and full vegetation). For blossom period 700 l/ha and for ripening and full vegetation period 1160 l/ha were applied as conventional application rates and 50% of each conventional application rate (350 l/ha and 580 l/ha, respectively) were also employed. Therefore, four different application rates were applied during the experiments. In the experiments, sodium fluorescein was used as tracer dye, water sensitive papers were used to determine coverage rates and to measure droplet sizes, and filter papers were used to determine deposition and distribution uniformity. Experiments were conducted according to the ASABE S561.1 APR04 standard. Lechler ID nozzle provided better results than Teejet AITX nozzle when distribution uniformity, coverage rates, deposits and drift amount were concerned. Although conventional domestic nozzle provided good results in some conditions, generally Lechler ID nozzles were found more successful. Air injection flat fan nozzles which generate coarse and very coarse class size droplets at low and medium pressures may provide efficient application in the vineyards. These results will be supported with biological efficacy studies.

Evaluation of spray drift in apple orchards of Trentino:

comparison of different solutions to reduce environmental contamination

Daniel Bondesan, Claudio Rizzi, Gino Angeli, Claudio Ioriatti 493-499

Abstract: The main characteristics of the agricultural scenery of Trentino, Italy, are: intensive orchards closely connected with inhabited areas, recent renewal of most old plantings with modern ones consisting of dwarfing rootstock trees with a height of up to four meters. Based on these features an experimental investigation is on-going into drift management in apple orchards in the province. Comparative tests were carried out in different wind conditions in an apple orchard using 1) a standard axial sprayer equipped with ATR swirl nozzles; 2) an on-target tower sprayer with anti-drift air injector nozzles; 3) a handheld lance. Results have been compared to establish the average degree of mitigation achievable by each type of equipment and how this is affected by wind conditions. The most appropriate equipment to adopt in the Trentino mountain growing context seems to be the on-target sprayer with anti-drift air injector nozzles. Considering the instability of wind conditions during treatments, to ensure the maximum level of drift reduction, further experiments are needed to find other technical approaches which may be combined with the spray equipment already tested.

Biological efficacy evaluation of low-drift nozzles compared to classic

hollow cone nozzles for chemical control of key pests *Cacopsylla pyri*

(pear sucker) and *Eriosoma lanigerum* (woolly apple aphid) in apple and pear

Eva Bangels, Nico Hendrickx, Tim Belien 501-510

Abstract: Over the last decade, the reduction of the emission of plant protection products to the environment has become an important issue in pip fruit growing. One elegant solution to limit spray drift to a minimum is the use of low-drift nozzles. Air-induction nozzles generate large drops filled with air bubbles which explode into fine droplets in contact with the plant. However, information regarding the efficacy of these drift reducing nozzles compared to classic hollow cone nozzles in spray applications for the control of insects pests in pip fruit orchards is scarce. The objective of this study was to examine the biological efficacy of different spraying techniques, in particular different nozzle types, in controlling key pests *Eriosoma lanigerum* (Haus.) and *Cacopsylla pyri* (L.) in apple and pear orchards, respectively. Field trials were set up in apple and pear orchards in a fully randomized block design, with the untreated control included and in a homogenous pest presence. Insect pests were sprayed with registered plant

protection compounds applied with different spraying techniques in the different trial object. This way four spraying variables were tested: two different sprayer types (axial fan and cross-flow sprayer) and two different nozzle types (air-induction and classic hollow cone nozzles). Assessments of the presence of the insect pests were executed according to international standards, following the appropriate EPPO guidelines. Regardless of some biological variation peculiar to field trial studies no significant differences in biological control efficacy of *E. lanigerum* and *C. pyri* were obtained for the different nozzle types used in this study. For both, systemic as well as contact insecticides, the low-drift nozzles performed equally to the classic hollow cone nozzles. The low-drift nozzles even tend to have a better control of *C. pyri* in the top part of the trees, especially when a contact insecticide was treated with the axial fan spraying equipment. Our results show that air-induction hollow cone nozzles are as effective as classic hollow cone nozzles for spraying crop protection compounds against *E. lanigerum* and *C. pyri* in apple and pear orchards, respectively. Hence, the use of this more environmentally friendly spraying technique can go hand-in-hand with excellent control of these key pests.

Session 13. Pesticide risk indicators to assess the sustainable use of pesticides in IFP

Building sustainability in European agriculture

through the common agricultural policy and sustainable use of pesticides

Ettore Capri, Alexandru Marchis, Amalia Kafka 513-517

Abstract: One of the major concerns of the policy makers and society in the process of reforming the Common Agricultural Policy (CAP) is to create the right framework for the development of a sustainable agricultural production. The reformed CAP uses the “greening” constituents of direct payments to enforce essential agricultural practices for environmental and climate. The CAP integrates also other agro-environmental measures through payments in the rural development program to the farmers for the supply of their environmental services. The objectives of the CAP promote good agricultural practices and more specifically, they target to improve farmers’ life in the rural areas, increase biodiversity, protect natural habitats, and support better water management. One of the policy instruments is the Directive for the Sustainable Use of Pesticides (SUD - Dir. 128/2009). The main aim of this regulation as policy instrument is to reduce the risks associated with the use of pesticides by bridging the gap between the agricultural practices applied on a daily basis by the farmers and the theoretical practices assumed by risk assessors when they evaluate if a pesticide is safe for use. SUD includes a requirement to establish a system of indicators which would reflect such progress. OPERA Research Centre has initiated an EU-wide consultation, drawing on experts from the fields of agriculture, industry, trade, academia, environment and consumer protection, to produce a document that supports the transposition process of the Directive and the drafting of National Action Plans (NAPs), following the requirements of the EU. NAP is the tool that transforms EU policy, into an organized set of national actions. The result of this consultation process is a publication that focuses on the proposal of a package of national indicators of risk, practical measures and the potential benefit they have in meeting the objectives of the SUD. Risk Indicators are expected to help national regulatory bodies to assess trends in pesticide risk reduction and to judge the effectiveness of their plans. There is no universal ideal indicator which can be used for pesticide and environmental policy monitoring and evaluation. Therefore, there is a need to select indicators that capture information and trends not directly related to the volume of pesticide used, but that show a significant impact in reducing the risk from pesticide use.

VIGNETO: a GIS-based model to evaluate environmental impact of the Italian viticulture

Matteo Balderacchi, Andrea Di Guardo, Lucrezia Lamastra, Ettore Capri 519-521

Abstract: A novel global easy-to-use software named VIGNETO (Vineyard environmental impact indicator) has been developed to assess the environmental impact of the viticulture. The

software VIGNETO can be used as a farm certification tool and as a decision support system for farmers and other administrators. It aims to evaluate the impact of the viticulture on water, air, soil, living organisms, biodiversity and society according to the OIV guidelines and to the sustainability pillars. For reaching this ambitious goal, VIGNETO is a web-based GIS fuzzy expert system based on 6 modules: pest management, manuring, soil fertilization, soil management-compaction, soil management-erosion, and landscape; that outputs 6 indexes that feeds a fuzzy machine. The fuzzy machine allows defining a judgment attributing values according the agronomic practices. VIGNETO reports two judgments because the indicator is calculated at the field level and after is upscaled at the farm level. The web-GIS system improves the user experience and in particular the data input management and the data visualization.

Dual indicator set for crop protection sustainability surveys DISCUSS:

preconditions for implementation on fruit farms

Hilde Wustenberghs, Ilse Delcour, Tessa De Baets, Charles de Schaetzen, Karoline D'Haene, Ludwig Lauwers, Fleur Marchand, Walter Steurbaut, Pieter Spanoghe 523-529

Abstract: A participatory - expert-driven – approach was used to create DISCUSS, a dual indicator set that pairs a pesticide risk assessment system with a farm inquiry. DISCUSS was designed for implementation in farmers' discussion groups, coached by an advisor. Before taking it from the design table into practice though, some additional conditions need to be fulfilled. This paper discusses some of the preconditions for the implementation of DISCUSS with e.g. groups of fruit growers.

Application of DEXiPM[®] as a tool to co-design pome fruit systems towards sustainability

Aude Alaphilippe, Frédérique Angevin, Jan Buurma, Tito Caffi, Yvan Capowiez, Gabriele Fortino, Bart Heijne, Herman Helsen, Imre Holb, Martina Mayus, Vittorio Rossi, Sylvaine Simon, Jörn Strassemeier 531-535

Abstract: The design of fruit production systems considering the latest innovations is a real challenge. Before being tested in an experimental station or in real farm conditions, the global sustainability of these newly designed orchards needs to be evaluated.

Based on the DEXiPM[®] model, the DEXiPM-pomefruit tool has been designed to make an *ex ante* assessment of the sustainability of innovative orchard systems. This model is based on a decision tree breaking the decisional problems of sustainability assessment into simpler units, referring to the economic, social and environmental dimensions of sustainability.

Based on two case studies, we present here the steps and thought process of our group to improve fruit production systems towards innovative and integrated production systems. DEXiPM-pomefruit tool has been tested on apple and pear production systems in the frame of a working group of European researchers. It proved to be sufficiently reliable to select the most promising innovations in a given context. DEXiPM-pomefruit was also used as a dashboard to determine strengths and weaknesses of the tested production systems and therefore to identify improvements.

How to optimize fruit production systems using Life Cycle Assessment

Aude Alaphilippe, Sylvaine Simon, Laurent Brun, Frank Hayer, Gérard Gaillard 537-538

No abstract

HAIR risk indicators used for evaluating sustainable plant protection in fruit orchards

Roel Kruijne 539-543

Abstract: Trends in environmental risk resulting from the use of plant protection products in fruit orchards in the Netherlands during the period 1998-2008 were calculated with the

HAIR2010 software instrument. The results are discussed and compared with the outcomes of the evaluation of the Dutch crop protection plan.

Worker exposure to plant protection products in the framework of the BROWSE project

Kim Doan Ngoc, Erik van den Berg, Richard Glass, Lynn Frewer, Kyriaki Machera, Ettore Capri, Marc Kennedy, Andy Hart, Pieter Spanoghe 545-549

Abstract: The BROWSE project (Bystanders, Residents, Operators and Workers Exposure models for plant protection products) aims to develop new and improved exposure models for operators, workers, bystanders and residents. Work package 2 (WP2) of the project deals with worker exposure. New conceptual and mechanistic models have been developed, taking into account dermal and inhalation exposure. Priority exposure scenarios to be considered within the BROWSE project have been identified. Cooperation with the cross-cutting themes on volatilization, transfer coefficients and statistical modeling ensures a consistent approach throughout the project. Implementation of the model and development of a user-friendly software tool are currently under development. The model will also be used to develop risk indicators and training materials (in support of the Sustainable Use Directive) and will therefore contribute to the sustainable use of plant protection products.

The database PESAP to design pomefruit protection strategies

Martina Mayus, Aude Alaphilippe, Jan Buurma, Tito Caffi, Yvan Capowiez, Gabriele Fortino, Bart Heijne, Herman Helsen, Imre Holb, Vittorio Rossi, Sylvaine Simon, Christian Scheer, Martin Trautmann, Jörn Strassemeier 551-555

Abstract: The sustainability of pomefruit protection strategies requires the design of innovative IPM tools and development of tools to build up and analyze new pest control strategies. Within the EU-project PURE (www.pure-ipm.eu) a database (PEASAP -Pests of Europe and control Strategies for Apple and Pear) has been developed to collate data for identification of optimization possibilities. Data was collated in 5 major European pomefruit regions. PESAP proved to be useful for simple queries and to design alternative control strategies. Moreover, it was adequate for data transfer into the environmental risk indicator SYNOPS.

Establishment of national maximum residue limits of pesticides used in grapes

Alev Burçak, A. Uğur Duru, Meryem Kaya, Ergün Cönger, Öner Tatlı, Özgür Gölge, Suna Dokumacı 557-558

Extended abstract