Potential new storage rot problems in UK Cox apples

Angela Berrie, B. E. Ellerker, J. D. Robinson

Abstract: Recent surveys of rotting in Cox apples in the UK have identified new fungal rots due to *Botryosphaeria obtusa*, Basidiomycete fungi and *Phomopsis mali* causing losses in the orchard and in store. Only studies on *B. obtusa* are reported here. *B. obtusa* causes a brown rot of fruit in the orchard and in store a purple rot, usually at the stalk end, and with a distinct medicinal smell. The fungus can invade fruit directly or via wounds. All apple varieties tested were susceptible to *B. obtusa*, but Cox was most susceptible. The rot also occurs on pears but at a much lower incidence. Studies on *B. obtusa* invasion of wood showed that the fungus did not form cankers on trees or invade wounds, but rapidly colonised dead 1-3 year-old branches on the tree. Similarly prunings on the ground were also rapidly colonised by the fungus. Dead apple twigs in orchards are therefore the main source of inoculum. *Botryosphaeria* infected apple twigs were present in all orchards examined. *B. obtusa* was rarely found on alder or *Chamaecyparis* twigs and windbreaks do therefore not appear to be a source of the fungus for apple trees. Monitoring fungal activity on infected twigs showed that conidia were produced all year round. Studies on *B. obtusa* rot in store on Cox, Gala and Fiesta showed that rot development was very slow and secondary spread to healthy fruit unlikely to be significant. Losses in store will therefore depend on the level of fruit infection in the orchard. Changes in orchard management practices relating to pulverisation of prunings in the orchard rather than removal and burning have probably contributed to the increase in incidence of *Botryosphaeria*.

Is it possible to predict the aerial concentrations of *Venturia inaequalis* ascospores in apple orchards?

Laurent Brun, Frédérique Didelot, Freddy Combe, Gilles Orain, Cécile Payen, Arnaud Lemerquand, Luciana Parisi

Abstract: Daily aerial concentrations of ascospores of *Venturia inaequalis*, the infectious agent responsible for apple scab, were observed over four years in apple orchards in the Drôme and Maine-et-Loire departments in France. These concentrations were recorded throughout the entire primary ejection period with Burkard 7-day volumetric spore traps, placed directly on the ground at the inter-row level of the orchard. During days with particularly high ejections, i.e., greater than 5% of the total quantity of ascospores trapped for the year, concentrations of more than 400 ascospores/m$^3$ of sampled air could be observed in the two regions. Using meteorological data recorded by the weather stations located near the orchards studied, it was possible to model daily ascospore ejections with two types of decision support software used on a regular basis in France for agricultural warning systems. However, these models did not correctly estimate a significant number of large ejections for some of the years. It would therefore be unrealistic to recommend the use of these modelled values of daily ascospore ejections for pest control strategies requiring precise details about these quantities, without taking excessive risks. On the other hand, it seems...
possible to use these two models to determine the period (from 1 to 2 months, depending on the
year) during which the aerial concentrations of ascospores are the highest.

Searching inoculum sources of brown spot of pear
Jürgen Köhl, Lia Groenenboom-de Haas, Helen Goossen-van de Geijn,
Richard van Hoof, Pieter Kastelein, Cees Waalwijk

Abstract: Stemphylium vesicarium causes brown spot disease on pear and leaf blights in
asparagus and onion. Multiple fungicide applications for disease control are common in infested
pear orchards. The fungus is also able to colonise plant debris saprophytically. The objectives of
our study were (1) to determine the pathogenicity on pear of S. vesicarium isolates from different
origins, (2) to develop a molecular tool for discrimination between isolates pathogenic or non-
pathogenic on pear and (3) to quantify pear-pathogenic populations of S. vesicarium. S. vesicarium was isolated from infected pear fruits and necrotic leaves of pear, orchard lawn
grasses, onion and asparagus. The pathogenicity of 116 S. vesicarium isolates was assessed on
detached pear fruits and on leaves. Disease incidence was similar for isolates from fruits or leaves
of pear or from necrotic orchards lawn grasses. Isolates from asparagus or onion caused no
symptoms on pear. AFLP patterns of isolates showed clustering of isolates originating from pear
orchards (either from diseased fruits or from orchard lawns), whereas onion and asparagus
isolates clusters into separate groups. AFLP bands unique for pear-pathogenic S. vesicarium
isolates were sequenced and a quantitative detection was developed based on one of these unique
AFLP bands. The specific quantification of pear-pathogenic populations of S. vesicarium by
TaqMan-PCR is currently used in studies on population dynamics in orchards. Results will be
used for the development of efficient sanitation measures which will reduce the risks of brown
spot epidemics.

Efficiency of association of scab control methods on resistance durability of apple:
the case study of cultivar Ariane
Valerie Caffier, Frédérique Didelot, Gilles Orain, Arnaud Lemarquand,
Luciana Parisi

Abstract: The major resistance gene Vf has been deployed in several commercial cultivars. This
resulted in the emergence of virulent isolates of Venturia inaequalis in Europe. In France, isolates
virulent to Vf developed since 1995, mainly in North-West region. To increase the durability of
resistance of Vf cultivars in regions where virulent isolates are not yet present (or present at a low
frequency), it was recommended that leaf litter be destroyed in winter and to apply fungicides at
times of the highest scab risks. These recommendations, however, had not been evaluated
experimentally previously. In 2004, we initiated a project to test these recommendations on
cultivar ‘Ariane’, which has been deployed in France since 2002. Our objective was to evaluate
the efficiency of association of scab control methods to delay the breakdown of Vf. In an
experimental orchard planted with ‘Ariane’, we compared scab development in 3 untreated and 3
treated plots. In untreated plots, scab increased quickly to 98% of scabbed trees and 35% of
scabbed fruits in 2008, showing the high susceptibility of ‘Ariane’ in case of breakdown of its
resistance. In treated plots, destruction of leaf litter was performed each year, and 5 to 9
fungicides were sprayed each spring to cover medium and high risks of scab development
following Mill’s curves. For comparison, about twice the fungicide sprayings were applied in the
same region on susceptible cultivars. In 2008 on the treated plots, 4% of the trees presented a
very low severity of disease, and 0.2% of scabbed fruits were observed. This study shows the
efficiency to associate sanitation and reduced number of fungicide sprayings to complement Vf
resistance and delay its breakdown.
Control of Oriental Fruit Moth, *Cydia molesta* Busck, by Isomate OFM-Rosso Dispensers in Peach Orchards of Bulgaria – Preliminary Results

**Hristina Kutinkova, Jörg Samietz, Vasiliy Dzhuvinov, Vittorio Veronelli, Andrea Iodice**

**Abstract:** Peach is the major fruit in South-East Bulgaria. Its main pest is the oriental fruit moth (OFM), *Cydia molesta* Busck. For a long time pest management in stone fruit production in Bulgaria relied on organophosphate and pyrethroid insecticides. Although originally quite effective, recently their effectiveness decreased, apparently due to the resistance developed in many pests. Hence, alternative means of control are urgently needed. The most common environmentally friendly methods are those related to sex pheromones. Until recently, their use has been limited mainly to monitoring, aiming at precise timing and reduction of chemical treatments. Mating disruption (MD) presents a more promising solution, however. The trials on mating disruption in the present study were carried out with Isomate OFM rosso dispensers (Shin-Etsu, Japan) in an isolated 10-ha peach orchard in 2007 and 2008. Pheromone trap catches were completely inhibited in the MD block whereas they were numerous in the reference, i.e. conventionally treated orchard. The Isomate OFM rosso dispensers, installed before the first flight of OFM at the rate of 500 units per ha, efficiently reduced fruit damage down to 0.1-0.2% at harvest. In the reference orchard, with 5-6 insecticide treatments against OFM, damage still reached 5-6%. The results indicate that mating disruption for control of oriental fruit moth may be effective in Bulgaria. Its use will be helpful in meeting the requirements of EU for residues free fruit production.

**An Integrated Approach for Reducing Fungicide Sprays Against Scab in Organic Apple Orchards**

**Imre J. Holb, Barbara Balla, Ferenc Abonyi**

**Abstract:** The aim of this study was to evaluate scab control efficacy in integrated approaches of i) three sanitation treatments (fallen leaf removal combined with winter pruning and non-sanitized control), ii) three onsets of first fungicide sprays (dormant bud, early tight cluster and pink bud stage), and iii) three final dates for finishing fungicide programs (mid-July, mid-August and mid-September) in an organic apple orchard on a moderately scab susceptible cultivar, Jonathan. A delay in the onset of first spray until pink bud stage resulted in higher scab incidences on both leaves (16-21%) and fruits (13-15%) compared with the non-delayed spray treatments (5-8% and 6-9%, respectively). Final leaf and fruit scab incidences increased significantly when sprays were omitted after mid-July compared to spray treatments finished at mid-August or mid-September. A combination of leaf removal with pruning resulted in lower scab incidence (5-12%) compared with the non-sanitized plots (7-15%) when spray treatments were finished at mid-August or mid-September. Results on cv. Jonathan suggested that scab sprays could only be omitted before early tight cluster and after mid-August if leaf removal and pruning was applied.

**Late winter climatic conditions influence ascospore production and release in Venturia inaequalis**

**Vincent Philion, Arne Stensvand, Håvard Eikemo, David M. Gadoury**

**Abstract:** Most fungicide applications targeting apple scab aim to control primary infections caused by ascospores and spraying is thereby linked to ascospore availability. We investigated the effect of pre bud break climatic conditions on seasonal patterns of ascospore release. Apple leaves bearing pseudothecia of *Venturia inaequalis* were overwintered at orchard sites in 8 countries for up to 3 years. Leaf samples were collected 2 to 5 weeks before bud break and again at bud break, air dried, and sent via airmail to Norway. The samples were stored at -18°C upon arrival until tested. Disks cut from each replicate leaf sample were incubated moist at 20°C to allow ascospore maturation but prevent discharge. Matured ascospores were induced to discharge twice a week and enumerated until the supply was exhausted. The proportion of ascospores ejected was fitted against degree-day accumulation using logistic regression. The regression intercept (onset maturation), slope (maturation rate), as well as the absolute number of spores counted differed significantly (P< 0.001, P = 0.05, P< 0.001 respectively) among sites and sampling dates. There
was a significant interaction between site and sampling date, indicating that climatic conditions prior to bud break differentially impacted the subsequent ascospore availability. Observed differences could perhaps be used to further refine previously described models of ascospore maturity.

The initiative: Monitoring of Venturia inaequalis virulences

Andrea Patocchi

Use of the A-scab model for rational control of apple scab

Vittorio Rossi, Simona Giosuè, Riccardo Bugiani, Tito Caffi, Gian Franco Pradolesi, Massimiliano Melandri, Tullio Bevilacqua

Abstract: A-scab is a dynamic model for Venturia inaequalis primary infections. It simulates ascospore maturation, ejection, deposition, and infection during the season based on hourly data of air temperature, rainfall, relative humidity, and wetness duration. A-scab produces a risk index for each infection period and predicts the time of disease onset. Since the validation works showed that the model produces accurate and robust predictions, a 3-year (2006 to 2008) experiment was carried out in order to determine the possibility of using A-scab for scheduling fungicide sprays. Trials were performed in northern Italy (at Ravenna and Bologna) by comparing: i) untreated control, ii) farming practice, iii) A-scab recommendations. The disease incidence on both leaves and fruits in the plots sprayed according to A-scab predictions did not change significantly relative to the farm practice. The use of A-scab led to a general reduction in the number of fungicide applications.

Efficacy of fungicides mixtures to avoid apple scab fungus resistance in integrated apple orchards

Regina Rancane, Maija Eihe

Abstract: IOBC guidelines for integrated fruit production prescribe use of forecasting systems in direct plant protection. In Latvia, LPPRC, model RIMpro for apple scab Venturia inaequalis control was tested from 2003. Following to FRAC guidelines to reduce the risk of fungus resistance developing, from 2007 efficacy of fungicides mixtures (Chorus, a.i. cyprodinil + Dithane NT, a.i. mancozeb; Effector, a.i. dithianon + Candit, a.i kresoxim-methyl) and alternately curative or strobilurine – protective fungicides use was tested. In all cases the first protective application before scab ascospores discharge was carried out with Cu product Champion 50. In case of emergency Effector was used during the secondary scab infection period. Fungicides registered in Latvia for apple scab control were effective with a mixture of protective/curative or strobilurine products being alternately used, the exception being the strobilurine Candit (Qo inhibitor) which was used separately, until fungal resistance appeared in the 3rd season of Candit use. The efficacy of Candit/Effector mixture was on a level with other treatments and that of the curative product Chorus wasn’t lost after 6 seasons of use when applied no more than 3 times per season. Nevertheless, further strategy of resistance preclusion has to be considered and what request minimal at-risk products to use separately. In all cases fungicides applications, even Chorus/Dithane mixture, were more effective if used before infection and as weather forecasting was not always the number of necessary applications had to increase. Under Latvia conditions frequently there are three severe scab infection periods during the total primary infection period, subsequently 3 or 4 fungicides applications being necessary in addition to the first Champion treatment.

Monitoring of Venturia inaequalis strains sensitive to strobilurin fungicides and occurrence of apple scab on resistant cultivars in the Czech Republic

Radek Vávra, Jana Kloutvorová, Stanislav Boček, Antonín Svoboda

Abstract: Occurrence of apple scab (Venturia inaequalis) on resistant cultivars was investigated in the Czech Republic however symptoms have never been observed up to the year 2006. Apple
scab is currently recorded in six isolated plantings of resistant cultivars in the territory of the Czech Republic. Apple scab was founded only on Vf resistant cultivars (Rubinola, Topaz, Rajka, Otava, Melodie etc.) in all cases indicating that those isolates can be classified as the race 6 or 7. Monosporic isolates of *V. inaequalis* were prepared for next testing using plant indicators and distinction using PCR methods.

At the same time, sensitivity of *V. inaequalis* to strobilurine fungicides was tested in the orchards, where the chemical treatment against apple scab was ineffective. Leaf samples were collected from 22 commercial orchards, one sample was taken from apple tree solitary growing in natural conditions and one sample was taken in experimental orchard. A germination of spores in aqueous fungicide solutions was assessed. A decrease of strobilurine sensitivity of *V. inaequalis* was observed in several localities.

**Apple Proliferation phytoplasma in South Tyrol – an Integrated Approach**

*Marcus Prantl, Robert Wiedmer, Josef Österreicher, Michael Unterthurner ........357-360*

**Abstract:** In 2000 and 2001 a severe occurrence of apple proliferation phytoplasma was noticed for the first time in apple orchards in South Tyrol (Italy). At the same time, in 2000 an increased occurrence of *Cacopsylla melanoneura* and in 2004 for the first time also a second vector, *Cacopsylla picta*, were detected in the orchards. The, in some cases, rather heavy economic losses caused by these attacks induced all appropriate institutions to look for solutions together with the producers. The phytoplasma had to be controlled in compliance with the principles of integrated fruit production. The complete elimination of all infected trees including the roots in combination with chemical control of the two vectors proved successful and resulted in a considerable reduction in infections in the past two years.

**Poster Session 1: Pesticides & Resistance**

**Development and validation of a rapid method testing of CpGV susceptibility in codling moth populations**

*Johannes Jehle, Stefanie Schulze...........................................................362*

**Abstract:** In the last five years the phenomenon of emerging resistances of codling moth (*Cydia pomonella*) against *Cydia pomonella* granulovirus (CpGV) has been observed in about 30 orchards in different European countries. So far, bioassays with the F1 generation of the diapausing CM larvae have been used for testing CpGV susceptibility. This is labour-intensive and time consuming; results are only available about 9 months after collection of larvae. Therefore, we were seeking for an alternative method by performing a direct test on the younger instars during the season. We developed and validated a more rapid test by optimizing the virus concentration in the bioassay, duration of bioassay and improvement of diet in order to be able to directly test the susceptibility on second to fourth instar larvae extracted from apples. By testing more than 3700 larvae extracted from 12000 infested apples from 20 orchards in Germany, Switzerland, The Netherlands, Austria and Italy we could prove that direct testing is feasible and provide results within 3 weeks after sampling. This new method allows us to make precise predictions about the status quo in resistance of an examined population, even if the orchard was treated with CpGV products, pheromones or chemical insecticides, which, as a matter of course, complicates the identification and determination of a potential resistance.

**Effect of a growth enhancer Carbon Kick Booster® on mites and natural mite enemies in apple**

*Tuomo Tuovinen...........................................................363-366*

**Abstract:** The importance of mite pests is increasing in Finnish apple production due to lack of efficient pesticides and the effect of climate change. Integrated pest management has been successful to enhance natural control of mites by indigenous OP-resistant phytoseiid mites but rejection of OP-insecticides will cause increasing problems. Plant derived substances have been successful to restrain pest populations in greenhouses. Tests with a growth enhancer ‘Carbon Kick Booster®’, containing rape seed oil, emulsifiers and triacontanol were conducted in the laboratory
and field conditions to evaluate its effect on apple rust mite (Aculeus schlechtendali) and fruit tree red spider mite (Panonychus ulmi). In the laboratory 1-2% solution killed a majority of the pest mites in 1-4 days. In field tests the results were inconsistent but comparable to sulphur treatments. Mites of the families Tarsonemidae and Tydeidae were not affected and in field tests phytoseiid mites survived the enhancer sprayings better than the sulphur sprayings. Predatory cecidomyiid larvae were present in the trees and limited both red spider mite and apple rust mite population increases in all treatments.

Biological Efficacy of Botanical Insecticides in the Control of Green Apple Aphid (Aphis pomi De Geer)

Slobodan Milenkovic, Snežana Tanasković

Abstract: The effects of the botanical insecticides pyrethrin (Pyros®), rotenone (Rotenone®) and pyrethrin + rotenone (ShowTop) were monitored in two apple orchards planted with cvs. Granny Smith and Kožara. The trial was set up according to the EPPO PP1/21(2) Protocol. The insecticides were applied in each of four rows. Four leaves from each tree were designated as samples for monitoring the population pressure of Aphis pomi De Geer. The insecticides were applied in June by spray drift and atomiser. The temperature was 23°C and relative air humidity 63%. The pest population pressure was checked immediately before the treatment and on the 1st, 2nd, 3rd and 7th day after treatment (DAT). The highest efficacious insecticide was Pyros® (83.2%) on 1 DAT followed by ShowTop (82.8%), whereas Rotenone® was the least effective (67.1%) at controlling A. pomi. Rotenone® was most effective on 2 DAT (72.1%), with subsequent inspections showing a decrease in efficacy (67.3% and 44.7%). For Pyros®, further inspection on 2 and 3 DAT registered a decline in efficacy to 72-73%, whereas on 7 DAT it reduced to 55.7%. The inspection on 2 DAT reported the highest efficacy of ShowTop (84%) and a further decline to 76.4% and 69.5% on 3 DAT and 7 DAT, respectively.

Evolution of apple surface metabolites throughout the season and codling moth (Cydia pomonella L.) egg-laying behaviour.

Nadia Lombarkia

Abstract: Cydia pomonella behaviour is related to plant surface metabolites. Among them soluble carbohydrates (glucose, fructose and sucrose) and sugar alcohols (sorbitol, quebrachitol and myo-inositol) influence plant site acceptance and stimulate egg-laying. It is generally observed in orchards that throughout the season the females shift their egg-laying site whenever a majority of eggs remaining on the leaf surface. On the variety Granny Smith they first lay eggs in majority on the twigs and upper side of corymb leaves and then progressively they lay more eggs on the lower side of corymb leaves and fruits. Our aim is to study the relationship between the chemicals throughout the season and the behaviour shifts. For both varieties Golden Delicious and Granny Smith, we considered different plant organs: twigs, leaves, leaf sides, fruit at several growth stages. Within the six metabolite pattern the concentrations and ratios (ng/cm²) of metabolites vary with the plant organ, leaf side and the season period. Although quantities are different between the varieties, differences remain according to the sites and are rather similar: the upper side of corymb leaves is the richest site throughout the periods. On the twigs, fructose, sorbitol and mannitol increase throughout the periods but quebrachitol decreases dramatically. Apple surface enriches in sorbitol and grow poorer in fructose. On the base of our knowledge on the influence of metabolite blend on egg-laying behaviour we verified a good correlation between them in orchards throughout the season. This study could open new ways of apple tree protection based on the recognition of the host by the insect.
Poster Session 1: Population Modelling

Evaluation of integrated management scenarios of the peach tree - *Myzus persicae* system using a crop-pest model

Isabelle Grechi, Françoise Lescourret, Benoît Sauphanor, Nadine Hilgert, Michel Génard, Rachid Senoussi, Marie-Hélène Sauge, Arnaud Chapelet, Jean-Philippe Lacroze

Abstract: Integrated Fruit Production (IFP) calls for an adaptation of production processes to improve crop quality and environmental safety. This approach gives priority to alternative methods of pest control. Our study investigates the potential of management scenarios that integrate chemical, biological (inudative release of *Harmonia axyridis* ladybirds) and cultural (nitrogen fertilization and winter pruning) pest control methods for the peach tree-aphid system. We used a modeling approach to address this question. We defined 108 management scenarios, which were based on theoretical pest control strategies combined with control variables relative to pest control and cultural practices. Then, we performed model simulations of these scenarios and studied the relationships between control variables and model outputs referring to agronomical, economical, sanitary (pest), and sustainability performance. Results showed that ‘agronomical performance’ was largely controlled by ‘agronomical practices’, while ‘pest performance’ was largely controlled by ‘pest control practices’.

Modelling codling moth damage as a function of adult monitoring and crop protection

Benoît Ricci, Olivier Martin, Pierre Franck, Jean-François Toubon, Rachid Senoussi, Claire Lavigne

Abstract: The codling moth (*Cydia pomonella*) is responsible for most insecticide treatments in pear and apple orchards. In a context of reduction in pesticide use, we aim at better understanding factors that affect codling moth damage intensity. We modelled the link between the proportion of damaged fruits and both constant covariables (type of orchard: pear or apple, organic or not, with or without mating disruption) and time-varying covariables (weekly counts of adults and number of insecticide treatments). Observations were collected in 40 orchards in south-eastern France. We found that damage intensity increased with the number of adults trapped. An analysis of the random orchard effect indicated a certain temporal stability in the risk probability of orchards and a lower risk probability in orchards surrounded by numerous pomefruit orchards and windbreak hedgerows.

Poster Session 1: Semiochemicals

A Comparative Study on Auto-Confusion by Exosex2 Gvm-Lb and Mating Disruption by Isonet-L against European Grapevine Moth, *Lobesia botrana* Den.-Schiff. (Lep.: Tortricidae) in Turkey


Abstract: Turkey has more than 300 native grape varieties. Round Seedless (Sultana) is the most important variety. The Aegean Region is the first by possessing 28% of the vineyard surface in Turkey. The production area of Sultana seedless is mostly placed in Manisa Province. Bozcaada Island is in the Marmara Region, in the northwest part of Turkey. The island is very important because of its unique varieties cultivated such as Çavuş and Karasakız. It has 1000ha of viticulture. The two regions have different agro-ecosystems and ecological conditions. Up to now, synthetic pesticide application has been given priority against European grapevine moth (EGVM), (*Lobesia botrana* Den.-Schiff.) (Lepidoptera: Tortricidae), the key pest of grapes in Turkey. However, negative effects of chemical control on the environment and human health have led up to the necessity of biotechnical methods against the pest. Among them, the mating disruption technique has been tested against EGVM in Turkey. Isonet-L dispensers were proved to be as effective as
The objective of this study was to determine in different conditions of Bozcaada Island and Manisa whether the Exosex² GVM-LB auto-confusion system for EGVM, reduces mating and subsequent larval damage to the fruit by comparing with Isonet L, the registered material. By this study, auto-confusion was tested in Turkey for the first time. The auto-confusion (AC) technique by Exosex² dispensers (10 mg pheromone/dispenser) was applied in 17.3ha and 24.2ha in Manisa (Aegean Region) whereas it was applied in 12ha in Bozcaada Island (Marmara Region) in 2007 and 2008, respectively. Only in Manisa, classical mating disruption (MD) technique by Isonet L dispensers (172mg pheromone/dispenser) was used as a comparative technique in 15 and 6ha in 2007 and 2008, respectively. Chemical-treated vineyards were also included in the research as comparison (C) vineyard. At the beginning of first flight period, 180 Exosex² dispensers /ha and 600 Isonet L/ha were installed. Exosex² installation was repeated at sixty day-intervals. The need and time of chemical applications was decided by means of Forecasting System against L. botrana in C vineyards. In critical periods when the eggs and larvae of first, second, third and fourth generations were expected, and just before harvest; 100 bunches per hectare were controlled in the centre and borders of each AC and MD sampling vineyard, and 100 bunches in each C vineyard separately. Infestation rates were determined. Exosex² dispensers from both locations were analysed by GC. In 2007, the pheromone samples were taken from the first application tablets of both Regions on 31 May 2007. In 2008, the pheromone samples were taken from the second application tablets of Bozcaada on 13 August and third application tablets of Manisa on 09 October. The average infestation rate of all AC vineyards in Manisa was calculated as 6.3 % just before harvest in 2007. In the course of the experiment, 9.6ha-AC vineyards were treated against L. botrana once, whereas 6ha-AC vineyards were treated two times because of the infestation rate was higher than the threshold of 5%. Fortunately, a 1.7ha part of AC vineyards did not require any chemical treatment against the pest and auto-confusion has suppressed EGVM in alone. Moreover, the infestation rates were still higher than 5% in 30.6% of the entire AC surface (5.3ha-9 vineyards) at harvest time. In Manisa, 18.67% part of the entire MD surface had to be sprayed once at least, whereas 13.3% had to be applied twice in 2007. Average infestation rate of all MD vineyards was calculated as 8% at this time. However, insecticide application has been avoided since the grapes are being harvested. In the last assessment in 2008, average infestation rate of all AC vineyards was calculated as 4.55% at harvest. In the course of the experiment, all AC vineyards in Manisa were totally treated against EGVM twice because of the infestation rates in 3rd generation were higher than the threshold of 5%. In 12% of the entire AC surface, the infestation rates were still higher than 5% at harvest time. They were only 3 vineyards having a surface of 3ha, totally. In Manisa, 16.67% part of the entire MD surface had to be sprayed once in 2008. Average infestation rate of all MD vineyards was calculated as 4.75% at this time. Only smaller MD vineyard had an infestation rate higher than the threshold at harvest. It can be concluded that small surface of MD caused higher infestation rate. However, insecticide application has been avoided since the grapes are being harvested. In comparison vineyard, broad-spectrum insecticides were applied against L. botrana five times. Infestation rates of the comparison vineyard were always lower than AC plots during the whole season owing to the sprayings of broad-spectrum insecticides. It is also usual to apply chemicals against EGVM in the centre of Manisa Province four or five times per season. No insecticide treatment has been used against any other pest in AC and MD vineyards. The best effectiveness from Auto-confusion has been obtained in Bozcaada against EGVM. No complementary treatment has been applied to suppress the pest. Auto-confusion by Exosex² dispensers was very effective. In comparison vineyard of Bozcaada broad-spectrum insecticides were applied against the pest three times. As occurred in the world, it is possible to have some years and some localities in Turkey, where biotechnical methods are not suitable or successful to control a pest in alone and require complementary insecticide treatment. Mating disruption technique is also registered in Turkey on condition that it should be supported by a biological insecticide treatment preferably to decrease the population density when the infestation rate exceeds 5-6% in the vineyard. By all means, when compared to chemically controlled vineyards, it can be assumed that Exosex² dispensers reduced the number of insecticide applications from 4-5 to 1-2 even in the Aegean Region where population density is higher, flight period is longer and temperatures are higher than Bozcaada.
Island. Temperature is one of the most efficient factors, which affect the efficacy and stability of pheromone in outer conditions. Average daily temperatures were lower in 2008 when compared with 2007 recorded in Manisa. Results of weekly Isonet-L weights also reflected this phenomenon by consuming their pheromone 3 weeks earlier in 2007 when compared to 2008. According to the results of GC analysis, it was determined that 97.3% of total pheromone amount from Exosex dispensers has been consumed in Bozcaada, whereas only 84% has been released in Manisa in 2007. Despite the higher temperatures in Manisa than Bozcaada in summertime, it can be assumed that the stronger winds might be more effective factor for the emission of pheromone from the dispensers because of lower leaf density in springtime. On the other hand, only 60% of total pheromone amount from Exosex dispensers has been consumed in Bozcaada, whereas 76% has been released in Manisa in summertime in 2008. Therefore, auto-confusion technique can be applied in the vineyards for the control of *Lobesia botrana* by installing 180 Exosex™ dispensers/ha three times per season with 60 days interval. However, it must be combined in the Aegean Region of Turkey with a biological insecticide preferably, if the average infestation rate of the pest exceeds 5-6% once or twice per season.

Identification of the female sex pheromone of the pear midge, *Contarinia pyrivora*  
Lakmal Amarawardana, David Hall, Jerry Cross, Michelle Fountain, Gunnhild Jåstad

**Abstract:** The pear midge, *Contarinia pyrivora* (Riley), is a pest of pear fruitlets and the damage causes severe crop losses. Although it can be controlled by application of insecticide, the timing of application is crucial as C. pyrivora is present for only a short period in the year. Identification of the female-produced sex pheromone was undertaken so that it can be used in monitoring and control of the pest. Late larvae of C. pyrivora were removed from damaged fruitlets and reared in plastic tubes individually. After sexing, volatiles were collected from both males and females by air entrainment. Collections were analysed by gas chromatography (GC) coupled to electroantennographic (EAG) recording from a male antenna, and by GC coupled to mass spectrometry (MS). Male midges showed EAG responses to two components in collections of volatiles from female. The major and the minor components were identified as 2,7-diacetoxy-undecane and 7-acetoxy-2-undecanone respectively. Stereoisomers of the synthetic pheromones were separated by HPLC on a chiral phase and the racemates, individual stereoisomers and binary mixtures were evaluated in field trapping tests. Male C. pyrivora were attracted to stereoisomer A of 2,7-diacetoxyundecane and to the first eluting stereoisomer from HPLC fractionation of 7-acetoxy-2-undecanone and these are proposed to be components of the female sex pheromone. However, results were confused by the presence of at least one other midge species in the traps and the experiments will be repeated.

Raspberry beetle *Byturus tomentosus*: flight monitoring with semiochemical traps  
Catherine Baroffio, Charly Mittaz

**Abstract:** The raspberry beetle, *Byturus tomentosus* is a major pest of Swiss raspberries. In 2008, in the frame of an international cooperation with UK, Norway and France the flight activity of the raspberry beetle has been monitored for the first time in the Swiss Alps with the semiochemical trap (floral attractant) and non-sticky funnel trap developed in Scotland by SCRI. Early results show an irregular attractiveness of the trap. The traps were installed before flowering at the beginning of June and were immediately attractive for 2 weeks. Then the catch of raspberry beetles decreased till end of July. A second important flight activity pattern was observed at the end of July and at the beginning of August. Fruit analysis showed that there was a gradient in the percentage of damaged fruits. Around the traps the damage was about 1% but the average of the whole plot was 5% in one plot and 9% in the second one with semiochemical traps. Neighbouring woods with wild *Rubus* sp. and other wild hosts near the plot could explain high raspberry beetle populations. This monitoring will continue for three years.
Control of the Plum Fruit Moth, *Cydia funebrana* (Treitsch.) (Lepidoptera, Tortricidae), by false-trail following

Paola Rioli, Roberto Bruni, Luigi Cappella, Franco Rama; Isidoro Nunzio ............401-404

**Abstract:** *Grapholita funebrana* (plum fruit moth) is a serious pest in many plum orchards in Italy. Control of the plum fruit moth using the false-trail following technique or ‘sexual disorientation’ is here evaluated in two commercial plum orchards for baby-food production, based on a zero pesticide residue management system. The effectiveness of the false-trail following technique was demonstrated through experimental trials over two seasons in two orchards located in the Ascoli Piceno Province of the Marche Region (central-eastern Italy). Specific, biodegradable, pheromone dispensers, known as Ecodian CFTM, were used for each application, with about 2,000/ha. During 2005, three dispenser applications were carried out, with two in 2006. The evaluation of this technique was through monitoring adult males by specific synthetic sex pheromone traps and visual inspections for fruit damage. *Anarsia lineatella* (peach twig borer), a secondary pest in plum orchards, was also monitored. The efficacy of Ecodian CFTM dispensers was compared with that achieved in commercial plum orchards sprayed with chemical insecticides or managed with mating disruption techniques. Over the two seasons, the control of the plum fruit moth in the experimental orchards was as good as or better than that in the check plots.

Eight years of practical experience with mating disruption to control grape berry moth,

*Lobesia botrana*, in Porto Wine Region

Cristina Carlos, Fernando Alves, Laura Torres ..............................................405-409

**Abstract:** Since 2000 the mating disruption technique has been applied to control *Lobesia botrana* (Den. & Schiff.) in the Porto Wine Region. ISONET-L dispensers have been used in plots whose surface ranged from 3.0 to 25.0 ha. The average percentage of male disorientation for the 8-year experimental period ranged from 80.5 to 100%, being 100% in 55.5% of the 72 sampling periods studied. However, the rate of reduction obtained in larval infestation by the pest, even in favourable conditions (large areas and continuous application), was variable. Some constraints to the technique have been identified, such as the high biotic potential of the species, the high summer temperatures and the local orography (high steepness). In this paper, the results are critically discussed and weak spots are analyzed, as a basis for identifying the real possibilities of the technique in the Porto Wine Region.

Cells responding to pheromone components and plant volatiles could affect semiochemical based control strategies of insect pests in agriculture ecosystems

Antonio De Cristofaro, Gianfranco Anfora, Giacinto Salvatore Germinara, Claudio Ioriatti, Valerio Mazzoni, Giuseppe Rotundo ...........................................410

**Abstract:** Electrophysiological and behavioural responses by several insect pests have been recently recorded in order to identify plant volatile compounds, and particularly kairomones, involved in the host-finding process and oviposition site selection. Such compounds have been addressed as candidates to be used in semiochemical based control strategies since they are potentially able either to enhance the sex pheromone activity or to monitor female emergence or to interfere on their behaviour. During similar studies, olfactory cells sensitive both to pheromone components and plant volatiles in *Cydia pomonella* antennae were described. In the present paper we analysed single cell recordings (SCR, surface contact technique) from olfactory neurons of different tortricid moths (*C. pomonella*, *C. splendana*, *C. fagiglandana*, *Pammene fasciana*, *Lobesia botrana*) stimulated by the two categories of compounds. Cellular types varying from the specific (relatively to the tested compounds) to the highly generalist ones were identified. The finding of these cells partly supports the observations reported by various authors about the ability of plant compounds to modulate the biological activity of a pheromone component. It seems not inappropriate to hypothesize that these “peripheral interferences” in odour perception could culminate in changeable behavioural responses that should also be of practical importance when pheromone based control strategies are applied in different agricultural environments, where they frequently show a variable efficiency.
Use of Sprayable Pheromone Formulations in Europe

Enzo Casagrande

Abstract: Sprayable formulations of pheromones for the mating disruption control of different moth species offers an innovative alternative to the use of the current dispenser based technologies. While still assuring the same efficacy as the dispenser systems, the sprayables offer greater flexibility and ease of use. Applied using standard spray equipment, the sprayables can be combined with other treatments. The paper will review the technology, efficacy and use strategies of the Checkmate sprayable technology in Europe.

Using Insect Behavior to Facilitate Precision Agriculture: Odor-Baited Trap Trees For Management of the Plum Curculio, Conotrachelus nenuphar (Herbst)
(Coleoptera: Curculionidae)
Tracy C. Leskey, Starker E. Wright, Jaime C. Piñero, Ronald J. Prokopy

Abstract: Management programs for tree fruit have been developed based on an intensively managed perennial monoculture with standardized management practices. This design has had unforeseen consequences for pest management in that horticultural uniformity leads to a homogenous resource distribution requiring protection on a whole-orchard basis. The ecological foundation of insect behavior offers a clear opportunity to replace indiscriminate whole-orchard insecticide treatments with targeted management zones, bringing together the sustainability of IPM and behavioral control with the efficiency of precision agriculture. Behaviorally active stimuli are presented to attract and retain pests within a particular location in the orchard to allow for implementation of precise control strategies, thereby reducing insecticide inputs and increasing sustainability of the cropping system. The plum curculio, Conotrachelus nenuphar (Herbst), is one of the most destructive direct tree fruit pests in eastern North America. A novel approach termed the ‘odor-baited trap tree strategy’ (based on the tenets precision agriculture and insect behavior) has been developed to replace standard whole-orchard insecticide treatments. Select apple trees in the perimeter row are baited with a synergistic two-component lure comprised of the synthetic host plant-derived volatile benzaldehyde and the synthetic male-produced aggregation pheromone grandisoic acid in order to aggregate adult activity in specific perimeter row trees. Then by applying insecticides to these select baited trap trees rather than the entire perimeter row or whole orchard after petal fall, substantial reductions in the amount of insecticide applied can be achieved without compromising plum curculio control. Over the course of four years, comparisons of the trap-tree and perimeter-row treatment strategies have revealed that these strategies prevented penetration by immigrating populations of plum curculio and resulted in economically acceptable levels of injury. The trap tree management strategy resulted in a reduction of ~70% total trees being treated with insecticide compared with perimeter row sprays and 93% compared with standard full block sprays. We currently are working to improve this strategy based on deploying even more powerful attractants within tree canopies to increase aggregation activity and reduce the number of required trap trees.

Integrating pear ester into direct management programs for codling moth
Alan Knight, Janet Haworth, Bill Lingren, Vince Hebert

Abstract: Several management approaches utilizing pear ester combined with codlemone have been developed in the first 10 years after the discovery of this ripe pear fruit volatile’s kairomonal activity for larvae and both sexes of codling moth. These include a lure that consistently outperforms other high load pheromone lures within pheromone-treated orchards, and the use of a microencapsulated formulation that can improve both mating disruption and the effectiveness of insecticide sprays. Field studies demonstrating the effectiveness of combining pear ester with codlemone are presented.
Cage test to assess the mating disruptant activity for different pheromone blends and formulations on Peach Twig Borer (*Anarsia lineatella* Zeller) in the orchards

**Fabio Molinari, Manuela Cigolini, Andrea Iodice, Vittorio Veronelli**

**Abstract:** Mesh cages were used as a method for assessing the disruption of Peach Twig Borer (*Anarsia lineatella* Zeller) and Oriental Fruit Moth (*Grapholita molesta* (Busck)) mating in peach orchards where different blends of synthetic pheromones and different dispenser formulations have been applied. The trials carried out in the seasons 2006-2008 showed that this method is easy to apply for evaluating the effectiveness of MD in the field and gives a reliable feedback allowing fine-tuning of formulations.

Comparison of different pheromone lures to monitor the flight of *Cydia pomonella*

**Denis Pasquier, Patrik Kehrli**

**Abstract:** The control of the codling moth, *Cydia pomonella*, relies on an accurate understanding of its biology and phenology. Pheromone trapping is an effective and timesaving technique to follow the phenology of adults and to estimate the appearance of the different larval instars. In this study we tested three different pheromone lures for monitoring the flight of *C. pomonella*. The Tripheron capsule attracted most males followed by a capsule developed at the University of Neuchâtel and the unattractive PheroNet capsule. In the future, we recommend the use of the Tripheron capsule for monitoring the flight of *C. pomonella*, especially in regions with low population density.

Effectiveness of mating disruption and granulovirus against codling moths in Central Bulgaria

**Penka Peeva, Nyonka Velcheva, Olia Karadjova, Vittorio Veronelli, Denis Pasquier, Radoslav Andreev, Katia Radeva**

**Abstract:** Due to economical changes, problems of resistance and the parceling of agricultural area, mating disruption (MD) was studied on its own or in combination with granulosis virus (CpGV) against the codling moth (CM), *Cydia pomonella* L., in the region of Plovdiv (Bulgaria). The effectiveness of MD and CpGV was tested in small orchards with high pest density. Until the 5th of July 2005, the percentage of CM-damaged fruits was at an acceptable level of 5.1% in the 0.5ha apple orchard treated with Isomate C LR® dispensers. The number of trapped CM males was 11 times lower than in a conventionally treated orchard, which served as a reference. Except for *Rhynchites* spp. and *Stephanitis pyri*, fruit damage by other pests was around the economical threshold. In 2007, Isomate C plus® dispensers together with the CpGV as Madex® were applied in a 19 years old orchard of 1.3ha. Once again, fruit damage by CM was bellow the economical threshold until the beginning of July. Thereafter, five treatments with chlorpyrifos-ethyl and chlorpyrifos-methyl were made to avoid higher infestation levels. At pre-harvest, only 1.9% of apples had CM larvae, compared to 17.0% in the reference orchard that was treated 11 times with conventional insecticides. The combination of MD and CpGV showed the best results in an 8-year old apple orchard. In this orchard, only 1.5% of apples were infested with CM larvae at pre-harvest and we detected 1.5 diapausing CM larvae per tree. In the accompanying reference orchard, the density of hibernating CM larvae was 23-times higher. Overall, the development of alternative IPM strategies incorporating mating disruption and granulosis viruses seems to be promising.

Mating disruption across the peach/apple interface

**Peter Shearer, Kris Tollerup, Ann Rucker Rutgers**

**Abstract:** Our hypothesis is that deploying mating disruption against the oriental fruit moth, *Grapholita molesta* (Busck), across adjacent peach and apple blocks provides better control than if applied to only one of the two crops. CheckMate OFM dispensers were applied in mating disrupted peach blocks and CheckMate CM/OFM Duel dispensers were used in mating disrupted apple blocks. Where used, mating disruption was in addition to insecticide programs. Results confirm that it is easier to disrupt oriental fruit moth in peach than codling moth in apple.
Control of codling moth (*Cydia pomonella*) under the aspects of active mating disruption, different application systems and varieties

Barbara Schildberger, Lothar Wurm, Eva Vogl, Manfred Kickenweiz

Abstract: Alongside standard systems of mating disruption, the activity of Exosex CM and Ecodian® under different application systems and on several varieties were tested in 2007 and 2008 at the research station of the Federal College and Institute for Viticulture and Pomology, Klosterneuburg. Standard mating disruption techniques usually rely on the introduction of amounts of pheromone similar to those emitted by natural populations of pest species into the atmosphere. Exosex CM significantly reduces deployment time and labour costs in the orchards, additionally the flexibility of integrating this technique with IPM programmes was tested. Ecodian® dispensers were distributed at a rate of 2000 dispensers/ha. The tube dispensers of pheromone (Exosex CM) were placed in a three hectare orchard, which was split into three trial fields: one left untreated, one where the first generation was treated and one in which all generations of codling moth (*Cydia pomonella*) were treated. Additionally, in 2008 different application systems were used. Ecodian® was tested on one hectare and compared with untreated areas. The assessments to quantify efficacy were made visually on windfall fruits, fruits on the tree and on all fruits at harvest and statistically evaluated. In 2007, among the fruits sprayed within the IPM system there was an infestation rate by the first generation on the variety Idared of 0.8%. The second generation treated with Exosex showed an infestation of 13%. In the biological trial, however, the infestation by the first generation was about 4% and the infestation by the second generation about 31%. The 2008 results were comparable to those of 2007.

Exploring the potential for using peripheral treatments with pheromone dispensers for controlling the grape berry moth (*Lepidoptera: Tortricidae*) by mating disruption

Mitch Trimble, D. B. Marshall

Abstract: The potential for using peripheral treatments with hand-applied pheromone dispensers for controlling *Paralobesia viteana* (Clemens) by mating disruption was examined in commercial vineyards in the Niagara peninsula, Ontario, Canada during 2007. Four 1ha (100 x 100m) experimental plots, each separated by 100m, were established within each of three vineyards. Twenty-five synthetic sex pheromone-baited traps were deployed in each plot on a 20 x 20m grid to indirectly measure the effect of pheromone treatments on the mate locating ability of male moths. The application of 500 dispensers/ha reduced the mean total number of moths trapped by 96% compared to the untreated control, indicating a high level of mating disruption. Trap catch was reduced by 87% when 80 or 160 dispensers were applied at intervals of 5 or 2.5m, respectively, along the periphery of the 1ha plots. The results provide impetus for additional research to determine if peripheral treatments with pheromone dispensers can be used to control *P. viteana*.

Control of codling moth, *Cydia pomonella* (L.) (*Lepidoptera: Tortricidae*), with EcoTape pheromone dispensers

Federica Trona, Mario Baldessari, Gianfranco Anfora, Valerio Mazzoni, Enzo Casagrande, Claudio Ioriatti, Gino Angeli

Abstract: A mating disruption approach using high densities of pheromone point sources has been developed for codling moth, *Cydia pomonella* (L.) (*Lepidoptera: Tortricidae*), control. The EcoTape® device comprises a continuous adhesive tape integrated with 3cm length dispensers at a separation of 0.6m, loaded with 2.5mg codlemone. Thus, in comparison with standard mating disruption, the content of dispensers is strongly reduced, whereas the density of point sources is increased (2,000 or 4,000 points/ha), with the purpose of increasing the competition between natural and synthetic sources. The release rate of new and field aged dispensers, measured directly by solid-phase micro-extraction (SPME), decreased over time but at the end of the season was still more potent than a calling codling moth female. Dispensers elicited close-range approaches in a wind tunnel irrespective of their field age. Traps lured with aged EcoTape dispensers were also able to catch a number of males in the field throughout the season.
comparable to that of traps loaded with reference dispensers. The results of field trials (2004-2007) showed that codling moth control can be obtained applying EcoTape dispensers. Our experiments demonstrated that EcoTape dispensers are a useful tool for efficient CM control throughout the season under the climatic conditions of the Trento Province (North Italy) and may satisfy some of the prerequisites for producing false-trail following effects.

**Poster Session 2: Arthropod Pests**

**Two Spotted Mite, *Tetranychus urticae* Koch, Emerged as a New Pest in Persimmon Orchards and Approaches to Their Control**
Bu-Keun Chung, Mitsuhiro Kawashima, Chuleui Jung

**Abstract:** Oriental persimmon, *Diospyros kaki* Thunb., endemic to East Asia is one of the major fruit crops in Korea. We conducted a faunal survey of mites on persimmon trees in Korea from June to September 2006, focusing on herbivorous and predacious mites. Mites of Tetranychidae and Tenuipalpidae were dominantly collected as herbivores, while those of Phytoseiidae and Stigmaeidae were predominant as predators. All identified tenuipalpid mites were *Tenuipalpus zhizhilashviliae* Reck. Most of the collected tetranychid mites were found to belong to the genus *Tetranychus*. To clarify the species identity, additional collections of tetranychid mites during summer 2007 on sweet persimmon were made. The mites were identified as *Tetranychus urticae* Koch. Four phytoseiid species, *Neoseiulus womersleyi* (Schicha), *Amblyseius eharai* Amitai and Swirski, *Phytoseius (Dubininellus) rubii* Xin, Liang and Ke and *Typhlodromus (Anthoseius) vulgaris* Ehara were collected. Among them, *A. eharai* was the most dominant species. Seventeen populations of two spotted mites (TSM) were observed 3 times per month from May to October to decipher their fluctuations at the site of individual farmer’s orchard from Sacheon, Sancheong, and Jinju in Gyeongsangnam-do and Gwangyang, Gurye, and Suncheon in Jeollanam-do. Among them, only 2 sites were properly managed, 5 sites were required to control but the farmers had little information on the mite and its damage, though 10 orchards were not at risk of infestation. Numbers of TSM on 100 leaves reached more than 400 at orchards from Sacheon, Okgok, and Muncheok, showing remarkably discolored leaves.

**Observations on the relation between the induction and termination of diapause in codling moth in Dutch and Belgian populations**
Marc Trapman, Matty Polfliet, Herman Helsen

**Abstract:** Effective codling moth (CM) management requires accurate information on the phenological stage and development of the local CM population to be controlled. Several advisors and scientists in Europe explain local differences in pheromone trap catches from the hypotheses of “recalled diapause day length”. According to this hypothesis, individuals in the population remember the day length at which their diapause was induced, and terminate their diapause the following spring at the same day length. This would mean that events that have a quantitative impact on parts of the population shape the phenological development next year. This has the practical consequence that codling moth phenology is determined at a local scale and regional warning systems cannot provide the information necessary for local control. The aim of our work was to test if this hypothesis holds for CM populations in the Netherlands and Belgium. CM collected from orchards in the Netherlands and Belgium in 2007 consisted for 98% of univoltine individuals. For these individuals we found no relation between the date we collected them as fully grown larva during summer 2007, and their date of pupation in 2008. These results mean that the hypothesis of “recalled diapause day length” does not hold for the almost completely univoltine CM populations in the Netherlands and Belgium. Therefore, the phenology of our local populations cannot be influenced by events in the previous year. Temperature relations and a normal distribution can be used to describe the spring pupation of a codling moth population.
Practical results of a Stacked Control Strategy for Codling Moth (Cydia pomonella L.) management
Marc Trapman, Herman Helsen, Matty Polfliet

Abstract: Codling moth (CM) is an important pest in both organic and integrated apple production in the Netherlands and Belgium. Control of the pest became more difficult during the past ten years. A series of biological and chemical plant protection products (PPP’s) is available for the regulation of CM, but field trials throughout Europe have shown that season long application of the same PPP provides only 50 to 70% control. Random alternation of products is not likely to improve efficacy. However, the available PPP’s have different modes of action, and act at different life stages in the CM biology. When applied with respect to their individual mode of action, and scheduled according to the local biology of the CM population, the efficacy of PPP’s could be stacked, yielding a technically, economically and ecologically improved control. This approach was tested in commercial apple orchards in an extension project in 2007 and 2008. The penology of the CM populations was calculated with the RIMpro-Cydia model using weather data from on-farm weather stations. Combinations of pheromone confusion to reduce the total number of eggs deposited, fenoxycarb at 30% rate as an ovicide at the predicted peaks in egg deposition, and granulosis virus at a 50% rate in periods of predicted peaks in egg hatching where used on the farms following the Stacked Control Strategy. Randomly chosen orchards in the same geographic region that did not take part in the extension project served as control group. In both years CM control in the Stacked Control Strategy orchards was more effective, and had a lower insecticide input and a lower environmental impact compared to the control group.

Poster Session 2: Biocontrol Agents

Biological aspects and predatory capacity of Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae) fed Planococcus citri (Risso, 1813) (Hemiptera: Pseudococcidae)
César Carvalho, Gerane C. D. Bezerra, Brígida Souza, Lenira V. C. Santa-Cecília

Abstract: In the citrus mealybug complex, Planococcus citri is one of the most important pests and its control is affected by insecticides. The green lacewing Chrysoperla externa is an insect often found in citrus orchards and is a natural predator of this pest. This work deals with studies on the predatory capacity and some biological aspects of larvae fed the three instars and adult female of P. citri. The experiments were conducted at 25±1°C, 70±10% of RH and 12-hour photophase with four treatments, represented by the development stages, and 30 replicates in a complete randomized design. It was found that the total predatory capacity of lacewing larvae was 231.2; 77.9; 32.6 and 21.2 for the three instars and adult females, respectively. The longevity of second and third instars of green lacewing larvae was lengthened when fed on adult mealybug females. The pupal stage was longer when it originated from larvae fed second and third instar larvae and adult females. The immature stage lasted from 19.8 to 22.9 days, and survivorship for this period was from 78.0 to 91.0%. A reduction in the number of consumed mealybugs was found in each instar, regardless the lacewing instar, however both nymphs and adult mealybug females were adequate prey for the larval development of C. externa.

The Effect of Floral Strips on the Abundance of Hymenopteran Parasitoids in Apple and Olive Organic Orchards
Hazem Dib, Gilles Libourel, François Warlop

Abstract: Habitat manipulation techniques improve the availability of resources required by natural enemies to increase their effectiveness. This study focused on the effects of sown floral strips on hymenopteran parasitoid abundance. The experiments were conducted during spring 2007 in one organic low-input apple orchard and five organic olive orchards located in southern France. The density and the diversity of parasitic wasps collected from sown floral strips were higher than those from naturally occurring flora or mowed plants. The family of parasitic wasps
of Braconidae was strongly dominant, followed by Mymaridae, Eulophidae and Pteromalidae. Among the 26 studied flowering species in the apple orchard, the greatest diversity and density of parasitic wasps were collected from *Potentilla reptans*, *Achillea millefolium*, *Trifolium repens* and *Torilis arvensis*. In terms of the early flowering plants, the most important results were observed in *Euphorbia helioscopia*, *Senecio vulgaris* and *Veronica persica*. To give an idea of the functional role of these plants, we studied the parasitic wasps of the diapausing larvae (cocoon) of codling moth *Cydia pomonella*. We recorded three emerged species: *Ascogaster quadridentata*, *Pristomerus vulnerator* and the hyperparasite *Perilampus fulvicornis*. However, none of these species have been observed on the 26 studied plants. Hence, this result may be suggesting that the studied plants do not have a functional role concerning these parasitoids. These studies may be advantageous for biological control programs in order to select flowering plant species attracting parasitic wasps specific to fruit pests.

**Side effect of selected insecticides on Aphidius colemani, Amblyseius cucumeris and Neoseiulus cucumeris as model species of natural enemies**

Jitka Stará, Josef Havlík, Kamill Holý, František Kocourek

**Abstract:** Side-effects of selected insecticides on model species of natural enemies, *Aphidius colemani*, *Aphidoletes aphidimyza* and *Neoseiulus cucumeris* were tested in laboratory conditions. Methoxyfenozide (Integro), indoxacarb (Steward 30 WG), pyridaben (Sanmite 20 WP), acetamiprid (Mospilan 20 SP), azadirachtin A (NeemAzal T/S) and spinosad (Spintor 480 SC) were tested against adults of *A. colemani* and larvae of *A. aphidimyza*. Propargite (Omite 570 EW) and Cyperkill 25 EC (cypermethrin) were also tested against adults of *N. cucumeris*. Mortality of tested species after 24 or 48 hours of exposure to residues of insecticides was evaluated. For insecticides with a low toxic effect, the effect on fecundity of *A. colemani* was tested. Methoxyfenozide had low toxic effect on all three insect species, causing mortality after 24 hours from 4.6% to 29.8%. Similarly, indoxacarb caused mortality after 24 hours from 11.1% to 25%. However, higher mortality of *A. colemani* was found after 48 hours of exposure to residues of methoxyfenozide and indoxacarb. Acetamiprid was highly toxic to *A. colemani* (100% mortality), medium toxic to *A. aphidimyza* (48.1% mortality) and no effect was found to *N. cucumeris* (2.3% mortality). Similar results were obtained with NeemAzal T/S. However, low toxicity to *A. colemani* was found when pure azadirachtin A was tested instead of formulated product NeemAzal T/S. In general, *N. cucumeris* exhibited the lowest sensitivity to all the insecticides. In contrast to this, *A. colemani* was highly sensitive to most of the insecticides.

**Poster Session 2: Biodiversity**

**Is the distribution of beneficial arthropods influenced by mixed hedgerows?**

Jean-François Debras, Rachid Senoussi, René Rieux, Elise Buisson, Thierry Dutoit

**Abstract:** Farming intensification in recent decades has led to an alarming level of degradation and loss of wildlife and its hedgerow habitat. The relationship between biodiversity and ecosystem functioning has emerged as a central issue in ecological sciences, but the situation regarding hedgerow function as a potential source of biological control agents against agricultural pests remains poorly understood. We evaluated possible effects of the arthropod community in a neighbouring hedge on the distribution of the pest psylla *Cacopsylla pyri* L. (Hemiptera: Psyllidae) in a pear orchard *Pyrus communis* L. over three consecutive years (1999-2001). We measured the diversity of the arthropod community in the hedge and in the orchard at increasing distances from the hedge using Shannon index of diversity, and the Hellinger distance and Mahalanobis index to highlight dissimilarities between population distributions. Our results showed a convergence between predator populations in the orchard and the hedgerow during Psylla proliferation. There was a decreasing diversity gradient as distance from the hedge increased. Beneficial arthropod exchanges occurring between the mixed hedgerow and the pear orchard during the pest proliferation period suggest that field border management can be used in an integrated pest management strategy aimed at reducing insecticide use.
Avian biodiversity: impacts of phytosanitary practices and landscape in South-Eastern French apple orchards
Jean-Charles Bouvier, Julia Agerberg, Benoît Ricci, Claire Lavigne ..........................465-468

Abstract: In French apple orchards, the predominant conventional management strategy has resulted in insecticide resistance in major pests like codling moth and an increased frequency of environmentally harmful insecticide applications. Organic agriculture as well as IPM represent alternatives to this situation.

Impacts on the avifauna of three different management strategies (organic, conventional and integrated) were studied during three years in 15 commercial apple orchards. These orchards were situated around Avignon and had similar contexts in terms of local and landscape features.

Our results show that the avifauna differ significantly among the three management strategies with abundances of 46, 30.3 and 7.6 individuals/ha for the organic, integrated and conventional orchards respectively; species richness of 18.1, 14 and 7.6 breeding species/ha respectively and Shannon diversity indexes of 3.8, 3.3 and 2.6 respectively. The functional structure of bird communities is also affected, with a lesser proportion of insectivores in conventional orchards than in other orchards. Phytosanitary and environmental factors taken together explain 52% of the variability of the composition of bird communities. Phytosanitary treatments and local environment of the orchards had a similar explanatory power of 11% while environment at the landscape scale explained approximately 19% of the variability.

We have demonstrated an important impact of phytosanitary practices on all parameters used to describe bird communities. These results highlight the influence of fruit production on avian biodiversity and its consequences in terms of protection of species of agronomical or patrimonial interest.

Changes of entomofauna in orchards under different pest management regimes
Vladan Falta, Jitka Stará, František Kocourek .................................................................469

Abstract: Integrated fruit production is facing problems with intensive pesticide use accompanied by the reduction of nature enemies in agroecosystems. This results in outbreaks of pests with high reproductive potential (aphids, psyllids, leaf midges, etc.). The side effect of plant protection products on the diversity of beneficials, as well as, the effect of pest control on selected pests (mining Lepidoptera, codling moth) were evaluated in different pest control regimes (conventional, integrated, biological). Insects were sampled before and after each application using the limb jarring method. During the first season (2006) fewer Heteroptera species (ca 10x) and Forficula auricularia nymphs (3x) were found in conventional and IPM variant in comparison with biological regime. In the 2nd experimental year (2007) this effect was very similar with a higher total number of Hymenoptera species (x 1.5) sampled in biological regime. In contrast, ladybirds, lacewings and Cantharidae species showed relatively stable abundance. Direct influence of particular treatments on entomofauna was not so evident when the number of individuals before and after applications was collected. In spite of this, the preliminary results suggest that a shift in insect populations develops, although this process is relatively slow and more apparent changes may be expected during the next experimental seasons. As far as the direct efficiency of control of mining Lepidoptera species is concerned the most effective appears to be IPM with the use of selective insecticides. Codling moth was successfully controlled in conventional and IPM variants, and in the biological regime with applications of CpGV.

Arthropods and mycorrhizal fungi associated to the rhizosphere of grapevine in Sicily
Alessandra Martorana, L. Torta, G. Lo Verde, E. Ragusa, S. Burruano, S. Ragusa Di Chiara.............................................................................................................470

Abstract: To evaluate the variation of AM fungi and arthropod populations and their possible interactions in mycorrhizosphere of grapevine in Sicily, a research in different tillage systems was carried out: the first data on the endomycorrhizal fungi and arthropods are reported. One vineyard in Palermo in state of neglect and two vineyards in Alcamo (TP), one organically managed and the other traditionally managed, were investigated during 2007. The index of root mycorrhization (IM) and the whole population of both AM fungi and arthropods were evaluated. The IM was
similar in soils traditionally and organically managed: high in winter and in spring and lower in summer; the vineyard in state of neglect, during all seasons, showed IM variable values. In all Sicilian vineyards the highest number of spores was detected in winter, whereas in spring AM populations decreased. With respect to the arthropods low Shannon’s index (H') was observed in all soils, while the BSQ values were found higher in vineyards traditionally and organically managed.

Mixed deciduous hedgerows as sources of anthocorids and other predators of pear psyllid in the UK

Csaba Nagy, Jerry Cross, Martin Luton, Caroline Ashdown

Abstract: Anthocorid predatory bugs are the key natural enemies of pear sucker but they often migrate into orchards too late and/or in too small numbers to affect adequate natural control of pear sucker populations. A 4 year study began at East Malling Research in 2008 to develop conservation biocontrol methods to maximise anthocorid populations and other natural enemies of pear sucker in the spring. Part of this study is to identify woody species and species mixes for hedgerows/ windbreaks that act as sources of pear psyllid natural enemies, especially early in the season. Three established hedgerows with a range of plant species compositions and structures adjacent to pear orchards in Kent, UK were identified and characterised. The aim was to identify species mixes that maximise anthocorid populations in the spring and foster their migration into pear orchards when pear sucker populations start to increase. The arthropods were beat sampled from the woody species and sweep net sampled from stinging nettles at 3-4 week intervals from April to September.

A large data base comprising more than 30,000 individuals, sampled and identified from 24 plant species, was constructed but not yet analysed. However, some trends in the data are obvious. 1) The largest numbers of anthocorids were found on hawthorn, goat willow and stinging nettle in the early season, while on downy birch, grey willow, stinging nettle, hazel, black alder, goat willow, field maple, blackthorn, rose and sycamore late in the growing season. 2) In the early growing season the highest numbers of anthocorids were found on the same plants that had the highest numbers of psyllids. 3) Later on, anthocorids were present mostly on plant species that had high numbers of aphids. 4) A large number of other predatory arthropods (mostly Miridae, Araneae, Dermaptera, Neuroptera, Cantharidae, Coccinellidae) also potential predators of pear psyllids were found on the hedge plants. 5) Cacopsylla pyri (L.) was discovered to be the most dominant psyllid species in the pear orchards, not Cacopsylla pyricola (Foerster), as previously reported for the UK.

Species diversity, dominance and frequency of leaf-eating Lepidoptera in plum biocenose in Bulgaria

Nyonka Velcheva

Abstract: The mating disruption technique is one of the most selective methods of controlling Cydia funebrana Tr. and is under development in Bulgaria. In this connection, a pre-study was carried out to follow the dynamics and density of the leaf-eating and fruit-surface damaging lepidopteran larvae in an abandoned plum orchard of mixed varieties in Sofia region. Species belonging to eleven families were found during the eight years of observations. Permanent inhabitants in the plum biocenose were larvae of Gelechiidae, Tortricidae and Geometridae with index of constancy c=100. The next by frequency of occurrence were species of Coleophoridae and Noctuidae (c=87.50), followed by Yponomeutidae (c=75), Lycaenidae (c=50), Lymantriidae and Pieridae (c=25). The rarest were individuals of families Ypsolophidae, Chimabachidae and Lasiocampidae with c=12.50. In 1998 and 2002 the dominant species of all collected lepidopteran larvae was Recurvaria nanella (Denis & Schiffermüller, 1775) and Anarsia lineatella (Zeller, 1839) in 1999. Operophtera brumata (Linnaeus, 1758) dominated in complex of external lepidopteran larvae in 2000 and 2005, Neusphaleroptera nubilana (Hübner, 1799) in 2003, Hedia nubiferana (Haworth, 1811) in 2006 and Argyresthia spp. in 2007. Specimens belonging to 35 genera and 47 species were identified altogether. In spite of very rich biodiversity, the density of leaf-eating and fruit-surface damaging lepidopteran larvae was above
economical threshold only during three of the eight years of investigation, so we consider it possible to develop plant protection programs for biological production of plum fruits in West Bulgaria.

Poster Session 2: IFP

Flash grazing of hogs in apple orchards for pest management
David Epstein, M. Grieshop

Abstract: A project to develop and evaluate an orchard system for Upper Midwest (USA) fruit growers that integrates rotational swine grazing for control of insect and disease pests, while enhancing profit potential through sales of organic pork was investigated in 2007-2008. The impact of hog grazing on aborted apples for control of one of the most serious pests of organic apples, Conotrachelus nenuphar, was evaluated most extensively. The number of June Drop apples for two cultivars, Idared and McIntosh, was quantified as a mean of ca. 123 apples per tree for both years. Forty-seven percent of field-collected, aborted apples in 2008 had at least one C. nenuphar oviposition scar, and 15.7% of drops contained viable larvae. Twenty-seven two-month old Berkshire hogs (Ca. 20-30kg), grazed prior to predicted emergence of C. nenuphar larvae, consumed over 98% of dropped apples in 0.4ha plots in 2007. In 2008, 24 two-month old Berkshire hogs consumed over 99% of dropped apples. Hogs were rotated among 3 grazed plots, spending 2-3 days in each grazed plot per week for three weeks. A controlled feeding experiment demonstrated that ingestion of C. nenuphar larvae in apples by pigs was 100 percent lethal to the larvae. Spring egg-laying injury from C. nenuphar in 2007, prior to start of grazing, was 11% in grazed plots, 8% in non-grazed. Summer C. nenuphar feeding injury, following the start of grazing in 2007, was 4.9 fold higher in non-grazed control plots (p=2.081E-13). Spring C. nenuphar oviposition injury in 2008 was 8.7% in non-grazed plots and 4.1% in grazed plots (p=7.763E-05). Summer C. nenuphar feeding injury was 3.4 fold higher in non-grazed plots in 2008 (p=1.326E-05). Rooting of young hogs (under 45kg) in the tree row soil, as they foraged through the orchard, averaged 4-6 inches in depth. Rooting by hogs larger than 45kg resulted in some exposure of tree roots and some destruction of sod in the drive rows. Overall, the health status of all animals was acceptable, and did not require the use of any pharmaceuticals. Apple pulp and discarded whole apples were provided continuously, about 450 kg per day since weaning, providing over 50% of their daily food intake. Anecdotal observation in 2007 suggested superior weed control and improved nutrient availability resulted from hog grazing/rooting. Data collected during the 2008 season on weed growth, nutrition, and control of codling moth (Cydia pomonella) and apple scab (Venturia inaequalis) will be reported on in this paper.

Hazelnut quality and sensory evaluation in organic and conventional growing systems
Valerio Cristofori, B. Pancino, C. Bignami, E. Rugini, S. Gasbarra

Abstract: Consumer acceptance of organic products requires the association of the production system with directly perceivable quality attributes. Up to now, organically grown hazelnuts have been scarcely characterised for specific quality traits. Nuts of two Italian hazelnut cultivars, ‘Tonda Gentile Romana’ and ‘Tonda di Giffoni’, grown in conventional and organic systems, were evaluated for technological traits, kernel chemical composition and sensory profile. Organic nuts showed a slightly lower oil and starch content, a lower incidence of total saturated fatty acids and a higher content of oleic acid in comparison to conventional ones. Crude protein content in the kernel was higher in organic nuts in ‘Tonda di Giffoni’. In both cultivars, the organic regime has positively influenced the content of polyphenols in the kernel. Sensory evaluation revealed differences associated with the growing system for the attributes of colour and oiliness of roasted kernels. The organic samples were the most appreciated for both cultivars.
Abstract: The usage of pesticides and biocontrol agents in soft fruit production has always been an important subject for the IOBC/WPRS Working Group "Integrated Protection of Fruit Crops" Study Group "Soft Fruits". The usage of pesticides and biological control methods varies considerably between countries and it is very difficult to get a good overview on the range of products that are applied or in development in soft fruits. In order to share and facilitate the flow of information, the Study Group "Soft Fruit" initiated a survey on the availability and usage of active ingredients and biocontrol agents in the different European countries in 2007. First, the most important pests and diseases in strawberry and raspberry production were identified. Then members of the different countries listed available products on the domestic market and indicated their usage in the field. So far 15 countries have contributed to the survey. The received data are accessible on the website http://www.any3.ch/IOBC/Softpest/index.html

The sterile insect technique as a component of area-wide integrated pest management

Andrew Jessup, Marc Vreysen

Abstract: The benefit of integrated pest management (IPM) when applied on an area-wide (AW) basis is that all habitats are treated. Such programmes are successful if the pest is suppressed to below economic or environmental thresholds and its re-establishment is prevented. Apart from horticultural production areas AW-IPM programmes often impact urbanised and native vegetation areas and waterways. The requirement for the protection of humans, fauna and flora and their communities and eco-systems demands the use of biologically sensitive technologies in AW-IPM programmes. The sterile insect technique (SIT) is a form of biological control which uses releases of sterile mass-reared insects to suppress wild populations of the same species. Desired outcomes from SIT include a reduction in the use of toxic pesticides, improved production, quality and marketability of produce where only the target pest species is affected. To date a wide range of insect pests has been targeted, successfully, by SIT in diverse regions of the world but SIT is most effective when used as a component of AW-IPM programmes. SIT is recognised as a component of internationally accepted systems approaches to pest management. For example the FAO/International Plant Protection Convention’s International Standards for Phytosanitary Measures (ISPM) numbers 3, 9, 18 and 26 have provision for the transport or deployment of sterile insects for SIT purposes. In this paper we will discuss the requirements for a thorough understanding of the biology and behaviour of the target pest and its interaction with the geography, climate and host flora of an area under pest management and the means by which SIT can be an essential component to AW-IPM.

Organic Raspberry Production in Serbia

Slobodan Milenkovic, Snežana Tanasković, Dušica Sretenović

Abstract: In Serbia, the first raspberry plantings maintained according to the organic production procedure were established in 1999. So far, the production has reached some 3,000 t/yr. This programme is promising, provided strict observance of regulations EC 2092/91, EC 834/2007 and EC 889/2008 is performed. Organic production plantings are established in well-drained, loose soils containing high quantity organic matter. The incorporation of 20t/ha of manure into the soil is a regular cultivation practice. Considering the control of diseases and pests, the following control measures are applied: setting up plantings on suitable terrains, application of appropriate cultivation practices, healthy planting material, and application of sulphur and copper fungicides. The control and monitoring of pests was aided by the use of visual inspections (Rebell traps and Moerick vessels) and pheromone traps (monitoring of Resseliella theobaldi). The incidence of
gray mold caused by *Botrytis cinerea* is a major problem in seasons with high rainfall rates. Unfortunately, efficient biological fungicides on raspberry have not yet been registered.

**Is organic hazelnut cultivation profitable?**  
*Barbara Pancino, Valerio Cristofori*  

**Abstract:** In order to analyze the economic results of hazelnut cultivation in an organic regime, the two methods of production commonly used in the Monti Cimini hazelnut district (central Italy) were used. These systems of production, due to the different levels of input that they require, can be considered to be “extensive” and “intensive”. Costs and productive values were evaluated for the two techniques and, afterwards, a comparison with conventional management was carried out, referring to a standard method of production which allows average yields of 2.7t/ha to be achieved. The examination of the costs of production for these systems highlighted a substantial homogeneity in variable costs, although remarkable variations were observed in the different categories (raw materials, mechanization, work). On the contrary, the produce which can be sold varies greatly according to the different orchard management forms. A comparison of gross margins showed that the results achieved by conventional management are intermediate between those of the two organic techniques. This result justifies the contrasting opinions of hazelnut producers on the relative convenience of the two management forms. The only certainty is that, because of public aid, organic hazelnut production is able to guarantee better economic results.

**Further observation on hazelnut yielding and fruit quality under organic and conventional management**  
*Alessandro Roversi, Gian Luca Malvicini*  

**Abstract:** In some previous contributions, our Institute has pointed out some difficulties in the organic management of filbert orchards. A further two years of investigation showed that the main negative aspect of organic management is the high rate of nuts affected by bugs. Therefore another important problem is the reduction in productivity.

To validate the conclusions of previous works, the comparison between organic and conventional management was carried on in three typical hazelnut orchards named “Alta Langa”, “Langa” and “Monregalese”. In these areas conventional and organic orchard management were chosen to record productivity and nut quality traits. In the years 2007-08, both total and average (t/ha) production were recorded for each hazelnut orchard, and 3kg samples of nuts were taken from whole nut yielding. Each sample was studied through the standard marketing surveys. In particular fruit and kernel weight, *Curculio* holes, fruit empty and insect kernel damage percentage, has been considered. The results were statistically analyzed through conventional-organic comparisons, and tested with the "t" test.

**Codling moth proof hail nets**  
*Benoit Sauphanor, G. Severac, L. Romet, E. Esberard, J. F. Toubon, S. Maugin*  

**Abstract:** Single row hail nets (3x7.4mm) modified to wrap up whole tree canopies, named Alt’Carpo, were evaluated as a way of control of orchard lepidopteran pests. A two years study was conducted in a 10 rows experimental apple orchard in Southern France, together with large field trials in commercial orchards. The experimental orchard was insecticide free in year 1 and pesticide free in year 2. Eight rows were protected with the nets, two rows were unprotected. The nets allowed an 80% reduction of fruit injury when compared to the unprotected rows, which suffered over 70% codling moth injury. However this efficacy was lower than in commercial orchards, especially those covered with 2.2x5.4mm nets in which fruit injury did not exceed 0.1%. The outer females, issuing from unprotected rows, were proved able to lay eggs on leaves or apples touching the 3x7.4mm nets. Virgin females or synthetic lures baited traps poorly captured wild or marked and released males under the nets, while the traps placed in unprotected rows captured over 30% of the released males. Moreover, significant rates of males released under the nets were captured outside while only 1 out of 300 males released in the control rows was observed to pass through the net, proving the need for flying over the canopy for sex encounter. Despite the known alteration of communities in protected crops, no significant effect
of the net was observed on rosy aphid and scab injuries on leaves or fruits. The agronomic, economic and environmental consequences of replacing chemical insecticides by synthetic barriers are discussed.

Building up, management and evaluation of orchard systems: a three-year experience in apple production
Sylvaine Simon, Benoît Sauphanor, Sophie Buléon, Johanny Guinaudeau, Laurent Brun

Abstract: Three apple orchard systems were planted in 2005 to assess agronomic and environmental effects of different pest management regimes: organic farming (OG), conventional supervised (SV) and low-input (LI) systems. Three apple cultivars presenting different susceptibility to scab were planted in each system: Ariane (Vf-resistant), Melrose (low-susceptibility) and Smoothee 2832T® (susceptible), creating nine «system x cultivar» situations. Decision rules were defined within the framework of each system, and their possible interactions were integrated. Starting from planting, the survey included pest and disease assessments, and agronomic and environmental parameters. The OG system was the slowest to produce commercial yield, whereas the SV one showed the highest performances. Although globally low, pest and disease fruit damage at harvest was the highest in the OG system. The treatment frequency index (TFI) was the highest in the SV system, and in Smoothee plots within each system. Two-fold more treatments were applied in any SV plot and in Smoothee OG compared to Melrose LI. The LI system presented the lowest TFI and the lowest environmental impact of pesticides calculated by the I-phyARBO fuzzy expert system. Apart from Smoothee, I-phyARBO in the OG system scored between LI and SV. From the first four years of the experiment, the importance of the cultivar in the management of the orchard diseases (and to some extent pests) is outlined whatever the system, with a high variation in the number of treatments. This experimental design proved to be a functional tool permitting the conception of decision rule patterns, and also to assess the agronomic, environmental and economical performances of the systems.

Effect of different type row mulches on the success of biological control of strawberry tarsenomid mite
Tuomo Tuovinen, Isa Lindqvist, Pirjo Kivijärvi

Abstract: Organic experimental strawberry fields were established to study the effect of mulching materials on growth, yield, fruit quality and mites. Black plastic, flax fibre mat, fresh green mass, barley straw, buckwheat husks, pine woodchips and birch woodchips were used for mulching. Strawberry tarsenomid mite was recorded in the autumn of the planting year and biological control of mites was started in the spring by introduction of Neoseiulus cucumeris which kept the strawberry tarsenomid mite under control. Small numbers of Anthoseius rhenanus and Euseius finlandicus were also introduced, but these species were rarely found afterwards in folded leaf samples. In the third year, one release of N. cucumeris took place at the beginning of June. In late August strawberry tarsenomid mite population growth was unacceptable in black plastic and barley straw mulches whereas in green mass and buckwheat husk mulches the mite was controlled by predatory mites during the whole season. Faster vegetative growth in green mass and buckwheat husk mulches in organic farming is proposed to enhance biological control of strawberry tarsenomid mite.

Poster Session 2: Pathology
Inventory of European canker in southern Sweden and Nectria galligena as a soil pathogen
Boysen Bengt
The growers mainly import new trees from nurseries in Belgium or Holland. Soon after the trees have been planted the trees are heavily affected by canker disease. To assess the extent of the outbreaks a survey has been started which will include orchards from all parts of the Scania province. In Swedish fruit orchards it is a common management practice to leave pruned branches containing canker on the orchard floor and cut them into small pieces with a heavy duty lawn mower. The wood chips eventually get incorporated into the soil and the fungus might infect the trees via the roots. We are currently conducting experiments investigating the canker fungus’ ability to survive in soil and infect apple tree roots.

**The OrganicA Project: Organic Disease Management in Orchards with ‘Newer’ Cultivars**


**Abstract:** Although there is significant interest in organic apple production in the New England region of the USA, there are few certified organic orchards, in part, because of disease challenges associated with ‘McIntosh’, the predominant cultivar grown in the region. However, recent shifts in consumer preference for ‘newer’ cultivars have led to the planting of different apple cultivars which have different disease susceptibility. A long-term research project was initiated in 2006 to examine the opportunities and challenges of organic apple production within the two production systems growers are using to change to new cultivars: planting a new orchard with young trees purchased from a nursery and/or “top-grafting” an established, older orchard to new cultivars. The cultivars being studied in replicated plots in each orchard system are: ‘Zestar!’, ‘Ginger Gold’, ‘Honeycrisp’, ‘Macoun’, and ‘Liberty’, a scab-resistant cultivar. Both orchard systems are being managed with approved, organic practices and materials. Standard foliar disease assessments for apple scab, caused by *Venturia inaequalis*, and other diseases are being conducted to determine differences in disease incidence and severity among the cultivars. Based on initial foliar disease assessments during the establishment years of the orchards, ‘Honeycrisp’ appears more resistant to apple scab than the other scab-susceptible cultivars ‘Zestar!’, ‘Ginger Gold’, and ‘Macoun’, but appears more susceptible to cedar apple rust, caused by Gymnosporangium juniperi-virginianae, than ‘Liberty’ and ‘Zestar!’ . ‘Macoun’ and ‘Zestar!’ exhibited a higher incidence of necrotic leaf spots than the other cultivars. This research is on-going and will document disease challenges and the economic costs, returns, and risks associated with these five cultivars being grown under organic production practices within the two orchard systems.

**Investigation on survival and viability of cankers of Nectria galligena following removal from apple trees and pulverisation on the orchard floor**

*Angela Berrie, B. E. Ellerker, K. Lower, G. Saunders* .......................................................... 521-524

**Abstract:** The risk of pulverised excised canker prunings to apple trees was evaluated in two orchard trials. Cankers (*Nectria galligena*) on one year shoots were collected from apple trees cv. Gala in two orchards and distributed among sprout net bags. Cankers on two, three or older wood were similarly collected and pulverised with a tractor-trail standard orchard pulveriser before placing in sprout net bags. Both sets of bags were pegged out in two orchard sites, either in the tree row or the grass alley way between trees in February 2005. The bags were sampled at monthly intervals and the state and viability of the cankers assessed. The pruned out cankers whether pulverised or unpulverised continued to produce perithecia for at least 16 months after removal from the trees. Conidia were only found in the first two samples. Perithecia were produced more abundantly on pruned out cankered one year shoots. Pulverised prunings decayed more rapidly in the grass alley way than in the tree row. This study shows that pulverised canker prunings could be a source of inoculum of *N. galligena* and hence a risk to apple trees for more than a year after pulverising.
Integrating scab control methods with partial effects in apple orchards: the association of cultivar resistance, sanitation and reduced fungicide schedules
Frédérique Didelot, Valérie Caffier, Maël Baudin, Gilles Orain, Arnaud Lemarquand, Luciana Parisi

Abstract: To preserve the environment, consumer health and reduce the economic impacts of apple scab, it is crucial to improve disease control while reducing the number of treatments and the impact of fungicide spraying. To reach this goal, the planting of cultivars with partial resistance to the disease, associated with an integrated control strategy, may be an attractive alternative. However, to decrease the risks for growers, cultivars with a high partial resistance level are required, and several methods of control must be associated. The application of such a strategy must be simple and reliable. The thresholds for chemical spraying must be defined and validated, taking into account the cultivar resistance level and the sanitation practices applied. Since 2006, we have studied within an experimental orchard the association of the cultivar 'Reine des Reinettes' (which presents good partial resistance) with:

i) A sanitation practice: reduction of leaf litter.

ii) A chemical schedule: fungicide spraying only if a medium or high Mill’s risk is recorded or expected.

The results obtained in 2006 and 2007 showed that, with only 5 to 6 sprayings per season (on average, twice as many sprays were applied in conventional orchards in the Loire Valley), scab control was efficient with less than 2% of scabbed fruits.

Application of thermo- and chemotherapy in vitro for elimination of some viruses infecting fruit trees and small fruits
Miroslawa Cieslinska

Abstract: In vitro culture is known currently as a technique used to eliminate viruses from plants. In this study thermotherapy and chemotherapy in vitro were applied to eliminate ACLSV and PNRSV from myrobalan, PNRSV from 'Empress' plum, PDV from 'Early Rivers' sweet cherry, ACLSV from apple 'Jonagold' and pear 'Pierre Corneille', and RVCV from 'Norna' raspberry. Shoots were placed in a growth chamber where the temperature was raised gradually to 36°C and kept at this level for 4 weeks for thermotherapy. Chemotherapy was conducted using 10-100mg/l Virazole® (ribavirin) applied into the proliferation medium. Combining both methods was also used. ELISA assays for ACLSV, PNRSV and PDV were conducted one year after therapy. The rooted raspberry plants were planted in a greenhouse and observed for possible RVCV symptoms. Thermotherapy in vitro was highly effective for PNRSV and ACLSV elimination but it was not efficient for obtaining PDV-free sweet cherry and RVCV-free raspberry. Efficiency of chemotherapy varied depending on concentration of Virazole®, virus and species of infected plant. Virazole® at concentration 25-100mg l⁻¹ was effective in eliminating ACLSV from myrobalan and PNRSV from plum but was not successful in eliminating PNRSV from myrobalan and PDV from sweet cherry shoots. Combining thermotherapy and chemotherapy contributed to elimination of all studied viruses from most treated shoots.

In vivo antagonism of Acremonium byssoides, endophyte in Vitis vinifera, towards Plasmopara viticola
Gaetano Conigliaro, Valeria Ferraro, Alessandra Martorana, Santella Burrano

Abstract: The endophytism of Acremonium byssoides in Vitis vinifera was recently ascertained in Sicily. In particular, the hyphomycete was observed in leaves of three vine cultivars (Regina Bianca, Catarratto and Insolia). Moreover, in the leaves of cultivar Insolia inoculated with P. viticola, the A. byssoides showed an antagonistic activity (hyperparassitism and antibiosis) towards asexual and sexual structures of the oomycete.

In spring 2002 and 2007 “Insolia” vines, infected by the endophyte, suffered repeated attacks by P. viticola that lasted until the formation of gamic structures of pathogen. The aim of our researches was to ascertain in vivo the effect of A. byssoides on viability of oospores, the only means of P. viticola overwintering. The “mosaic spotted” leaves were collected in October from vines colonized (cv. Insolia) or not (cv. Catarratto) by A. byssoides and exposed to natural
climatic conditions. The oospores viability was assayed by germination tests.

The differentiated oospores in endophyte-free leaves showed the highest mean germination value, whereas the other ones were degenerated and did not germinate at all. This study shows that the interaction between *A. byssonoides*, *V. vinifera* and *P. viticola* could assume a determinant role to contain the mildew infections in our environment.

**Preliminary investigation on the endophytic communities in *Olea europaea* L. in Sicily**

Valeria Ferraro, Gaetano Conigliaro, Livio Torta, Santella Burruano, Giancarlo Moschetti .539-543

**Abstract:** An investigation was carried out in order to study the composition of the endophytic community of olive (*Olea europaea* L.) in Sicily (Italy). One olive-yard in San Cipirello (Palermo) and another one in Racalmuto (Agrigento) were sampled, similar for plant age, cultivars and agricultural management. Isolation assays were carried out on samples collected from each locality in spring, summer and autumn during both 2007 and 2008.

Numbers of fungal and bacterial isolates differed between the sampled sites. Prevailing fungal genera in almost all samplings were *Alternaria*, *Cladosporium*, *Diplodia*, *Phoma*, *Septoria*, *Stemphylium* and its teleomorph *Pleospora*. Isolation frequencies were dependent on the sampling site. Our preliminary results show a constant composition of endophytic assemblage of *O. europaea* in Sicily, even if the degree of infection varies depending on both geographical and environmental factors. Further studies will be carried out in order to complete fungal and bacterial identification and to analyse the interactions between endophytes, host and environment.

**Population variability of strawberry powdery mildew (*Podosphaera aphanis*) in different geographical regions**

Nick Harvey, Angela Berrie, Xiangming Xu .545-553

**Abstract:** Strawberry powdery mildew, caused by *Podosphaera aphanis*, is one of the most important diseases worldwide. Mildew lesions were sampled from a number of cultivars at several sites in the UK; a limited number of lesions was also sampled from China, the USA, Italy and Israel. SSR markers were developed and used to genotype sampled isolates for determining population variability; the ITS region of 20 samples selected from different countries was sequenced. Both SSR and ITS data indicated that there were significant differences between samples from the USA and the other countries. In the UK, there was significant population differentiation between mildew samples from different cultivars at the same sites, or between mildew samples from the same cultivar at different sites.

**Evaluation of fruit genetic resources for disease resistance**

David Szalatnay, Kaspar Hunziker, Brion Duffy, Jürg E. Frey, Markus Kellerhals .555-558

**Abstract:** A field survey throughout Switzerland established an inventory of fruit genetic resources. The decentralised collections network was subsequently completed and the characterization of the accessions is ongoing. Considering international standards, guidelines for the phenotypic description of the fruit genetic resources were developed and practically applied. Apple accessions from the Swiss pool of genetic resources were tested for fire blight (*Erwinia amylovora*) resistance in the greenhouse. Results of the fire blight screening confirm significant differences between accessions. Additionally, the accessions were analysed with SCAR markers surrounding a QTL for fire blight tolerance. Moreover, young trees of 600 accessions were planted to evaluate their scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) resistance in a field trial. The project aims at defining accessions useful for cultivation as standard trees for cider and juice production and that are an important landscaping and ecological factor. Promising accessions are being used for breeding.

**Activity of Physpe (laminarin) in control of strawberry diseases**

Beata Meszka, Anna Bielenin .559-563

**Abstract:** Strawberry plants are susceptible to many pathogens, such as *Botrytis cinerea*, *Mycosphaerella fragariae* and *Sphaerotheca macularis*. Phytochemicals are intensively used to
limit pathogen infections on strawberry plantations in Poland. Resistance problems, residues in fruits and protection of the environment require alternative strategies. In the present study the efficacy of Physpe (laminarin) in control of main strawberry diseases in field conditions was tested. Experiments were conducted in 2006 and 2008. Laminarin reduced *B. cinerea* infection by approximately 50 to 80%, depending on the experimental site. Its effectiveness in reduction of leaf spot symptoms was about 50% and almost 80% in reduction of powdery mildew. The use of Physpe in program with fungicides sprays could be acceptable for commercial use and gives possibilities to reduce the number of chemical treatments against main strawberry diseases.

Prediction of *Xanthomonas harboricola pv. pruni* infection on peaches

*Riccardo Bugiani, Vittorio Rossi, Simona Giosuè, Ceredi Gianni*..........................565-569

**Abstract:** *X. arboricola pv. pruni* (*Xap*) is present on *Prunus* spp. in some European countries, and it is listed as an A2 quarantine pest by EPPO; its importance in Northern Italy has increased in the last decade. An empiric model predicting *Xap* infection has been developed in late ’90s. Occurrence of the first seasonal infection was monitored in peach orchards of Romagna, in 1992 to 2008, and compared to model predictions: an infection was predicted when there were at least 3 successive rainy days, with temperature between 14 and 19°C; symptom’s onset was expected after one to four weeks of incubation. *Xap* symptoms appeared in 10 out of 17 years; first seasonal symptoms become visible between 19 May and 12 July. These infections were always correctly predicted by the model, with an average incubation period of three weeks. Five infection periods were predicted by the model that did not result in actual infection. In five years the disease did not appear at all. In four of these years the model did not predict infection all season long, while in one year it wrongly predicted two possible infection periods. Sensitivity, specificity and accuracy of the model showed that one would have somewhat more confidence in predictions of non-infections than in predictions of infections. In a practical use of the model, this would lead to some unjustified alarms.

Eutypa dieback as an important disease in red currant (*Ribes rubrum*) and gooseberry (*Ribes uva-crispa*) in the Netherlands

*Marcel Wenneker, Peter Vink, Ilse Heurneman, Marcel van Raak, Anne Sophie van Bruggen*.................................................................570

**Abstract:** Over decades, growers in the Netherlands have problems with a disease that causes dying branches and stem cankers in red currant. For many years it was assumed that this disease was related to fungi such as *Nectria cinnabarina, Phomopsis* spp. and the insect *Synanthedon tipuliformis*. However, recently it was found by Applied Plant Research and the Plant Protection Service that the causal organism is the fungus *Eutypa lata*. The disease is considered of major economic importance, especially as red currant growing is rapidly expanding in the Netherlands. *E. lata* was identified with three detection methods (visual, plating and DNA). Symptoms of *Eutypa* do not usually appear until currant plants are at least three to four years old. These cankers are always associated with old pruning wounds. Eventually, the entire branch is killed. High disease incidences and annual losses of 10% -30% of the productive branches are reported. In some cases entire fields have to be replanted. *Eutypa* is well known as one of the most destructive diseases of grapes. The importance of this disease in currant growing was not known. Research is focusing on the evaluation of control measures; e.g. chemical and biological control treatment of pruning wounds, and disease management such as sanitation practices. Also, the epidemiology of *Eutypa* is studied. Recently, high densities of ascospores of *Eutypa* were found in a spore trap placed in a red currant field in the Netherlands. In the subsequent field survey, fruiting structures (stromata) and ascospores were found on dead infected red currant wood.
Monitoring of virus and phytoplasma diseases by laboratory diagnostic methods (PCR, RT-PCR, DAS-ELISA) in apple and pear after sanitation process

Lubos Talacko

Abstract: Sanitation of apple cultivar (’Rubinstep’) and pear cultivars (’Astra’, ’Bohemica’, ’David’, ’Elektra’, ’Erika’) was carried out by in vitro thermotherapy and chemotherapy. In the course of sanitation, the plant material was periodically tested to verify the suitability of selected methods. The presence of pathogens in selected initial trees was detected by PCR, RT-PCR and DAS-ELISA before the beginning of sanitation in 2005. Twenty clones of apple cultivar ‘Rubinstep’, 20 clones of pear cv. ‘Elektra’, 19 clones of pear cv. ‘Erika’, 20 clones of pear cv. ‘Astra’, 20 clones of pear cv. ‘Bohemica’, and 12 clones of pear cv. ‘David’ were tested after chemotherapy in years 2007-2008. Fifteen clones of pear cv. ‘Elektra’, 6 clones of cv. ‘Lada’ and 10 clones of cv. ‘Rubinstep’ were tested after thermotherapy in 2008. The occurrence of viruses Apple chlorotic leaf spot virus (ACLSV), Apple stem grooving virus (ASGV), Apple stem pitting virus (ASPV), Apple mosaic virus (ApMV) and phytoplasmas Candidatus ‘Phytoplasma pyri’ (CPP) and Candidatus ‘Phytoplasma mali’ (CPM) were monitored. The clones, which remained infected with viruses or phytoplasmas after therapy, were later discarded. Those in vitro clones that proved to be pathogen-free after repeated testing were further multiplied and in vitro rooted. The results presented here are preliminary.

Poster Session 2: Pesticides and Resistance

Chlorantraniliprole (DPX-E2Y45, Rynaxypyr®) (Coragen®20SC and Altacor®35WG) - a new diamide insecticide for control of codling moth (Cydia pomonella) and other top fruit Lepidoptera. Product features with regards to IFP criteria

Andrea Bassi, Axel Dinter, Kristin Brugger, Niels-Martin Frost, John Wiles, Jean Luc Rison

Abstract: Chlorantraniliprole (DPX-E2Y45, Rynaxypyr®) is a new compound from DuPont belonging to a new class of selective insecticides (anthranilic diamides) featuring a novel mode of action (group 28 in the IRAC classification). By activating the arthropod ryanodine receptors it stimulates the release and depletion of intracellular calcium stores from the sarcoplasmic reticulum of muscle cells causing impaired regulation, paralysis and ultimately death of sensitive species. Extensively tested in the field since 2002, it is registered in the USA, Australia, Canada, China and it is close to market introduction in all the main top fruit producing countries. The product general features have been presented in previous, referenced papers. It has very low toxicity for mammals (both acute and chronic), high biological activity on the sensitive species with strong ovi-larvicidal efficacy and good residual properties, excellent performance on codling moth and other chewing pests, stability of performance across the different climatic and farming conditions, no cross-resistance detected to any existing insecticide and minimal impact on pollinator and beneficial arthropod species. Published studies indicate that chlorantraniliprole may have significant mating disruptive effects on C. pomonella adults when both males and females are exposed to the residues equivalent to the recommended field rate. This paper focuses on the product features that best fit IFP (Integrated Fruit Protection) criteria and may enhance IFP options while ensuring higher efficacy standards. After reviewing some toxicity data, examples from field/semi-field and laboratory tests are provided regarding comparative performance assessment, minimal impact on beneficial arthropods and bees and a possible reduction in the number of applications versus current standards.

Can delayed flight activity serve as an indicator for insecticide resistance?

Patrik Kehrli, Denis Pasquier, Pierre-Adrien Roux

Abstract: Together with the codling moth, Cydia pomonella, the summer fruit tortrix moth, Adoxophyes orana, is a major pest insect in apple orchards of western Switzerland. Whereas codling moth developed simple, cross and multiple resistances to various classes of insecticides over the last decade, A. orana seemed to be still susceptible to these pesticides. However, since
2004, fruit growers indicate more and more failures of conventional control schemes against summer fruit tortrix moths. Using laboratory bioassays we established that *A. orana* shows resistance to insect growth regulators and to insect growth inhibitors. This resistance becomes manifest in the slower development of *A. orana* larvae. Field observations showed that the flight of resistant moth populations is delayed. Delayed flight activity might therefore serve as a reliable indicator of insecticide resistance in summer fruit tortrix moths. In conclusion, the key to successfully managing insecticide resistance is to reduce selection pressure. This can be achieved by incorporating cultural, biological and pheromonal control practices, by minimising the use of insecticides and by the alternate use of insecticides with different modes of action.

**No evidence in codling moth for cross-resistance between chemical insecticides and *Cydia pomonella* granulovirus**

*Annegret Schmitt, Johannes Jehle, Isabella Bisutti, Benoît Sauphanor, Jürg Huber*

**Abstract:** Codling moth larvae from 23 orchards located in five European countries were tested for their susceptibility/resistance to the *Cydia pomonella* granulovirus (CpGV-M) in standardized laboratory bioassays. Farmers observed in several of these populations reduced susceptibility to CpGV-M treatment. For each *C. pomonella* strain, the percentage of larvae surviving CpGV-M concentrations of 104 to 106 OB/ml were calculated 14 days after start of the trial and used for prediction of percentage of resistant individuals in the collected population. The mortality was corrected using Abbott’s formula, with the average mortality determined in the controls of all 14-day trials performed (mortality due to other reasons than virus). In general, the results from the bioassays were in accordance with the observations in the field. Most orchards from which the farmer reported failure of the CpGV-M treatment contained resistant codling moth populations. The percentage of resistant individuals in a population ranged roughly from 30 to 90%. However, in some apparently susceptible populations there were also hints for the presence of a very small fraction of resistant individuals. Several of these European populations were tested for susceptibility to eight insecticides including different classes of insect growth regulators and neurotoxic compounds. High mortality was recorded to most insecticides, independent of resistance to CpGV. A reduced susceptibility to azinphos, diflubenzuron, and tebufenozide was recorded in several populations. Overall, there was no indication for the occurrence of cross-resistance between CpGV-M and insecticides in the tested populations. First laboratory tests showed that populations of *C. pomonella* resistant to CpGV-M were susceptible to new CpGV strains. This study was funded by the EU, CRAFT project 32857; Further information can be found under www.sustainpgv.eu.

**Cydia pomonella** (Lep: Tortricidae) resistance and cross-resistance to various classes of insecticides in Central Europe

*František Kocourek*

**Abstract:** Insecticide bioassays were used to investigate resistance of *Cydia pomonella* (L.) to insecticides with various types of active ingredients. The efficacy baselines of selected insect growth regulators (fenoxycarb), insect growth inhibitors (diflubenzuron, teflubenzuron), organophosphorous insecticides (phosalone) and neonicotinoids (thiacloprid) against the eggs, first- and fifth-instars larvae of sensitive laboratory strains of codling moth were determined. The lethal concentration ratio quantified the relation between the efficacy of selected insecticides against fifth-instar larvae found by topical application and against first-instar larvae found by diet-treated bioassay. According to concentration-mortality baseline, 50% lethality concentration values and 90% lethality concentration values were determined for all the tested insecticides. The bioassay was used to monitor the resistance of codling moths collected in 2003-2005 in two apple orchards with different intensities of chemical control. Resistance ratios to the tested insecticides were determined for both field populations of codling moth. For the population of codling moth from an apple orchard in Velké Bílovice, cross-resistance to fenoxycarb, teflubenzuron and phosalone was detected after the topical application of insecticides to fifth-instar larvae. The population of codling moth from Prague-Ruzyn was slightly resistant to phosalone and
teflubenzuron. No resistance to diflubenzuron was detected in either tested population. This work was funded by the Czech Science Foundation, the Czech Republic, grant 522/04/P181. Partial funding was also obtained from the Ministry of Agriculture, the Czech Republic, project 0002700603.

Trials for the development of alternative control strategies against the codling moth  

(Cydia pomonella) in pome fruits in Austria in 2007  

Christa Lethmayer, H. Hausdorf, J. Altenburger

Abstract: The development of future alternative control strategies against the codling moth, Cydia pomonella (Tortricidae, Lepidoptera), is an important subject for the pome fruit production both nationally and internationally. The reasons are not only the increasing resistance of C. pomonella against plant protection products including virus products, but also the expiration of the authorization of important plant protection products especially for integrated production. In Austria great problems are expected from 2008 onwards due to the loss of the most commonly used organophosphate insecticide against the codling moth at present. Therefore, in 2007 control trials against the codling moth also suitable for integrated production were carried out by the Institute of Plant Health (AGES) in coordination with the chambers of agriculture of Lower Austria and Styria.

Trials were conducted according to the EPPO-guideline PP 1/7(3) comprising 8 variants including one untreated control. Four plant protection products with Fenoxycarb, Methoxyfenozid, Chlorpyrifos and Indoxacarb as active ingredients were used in different numbers of applications and combinations.

The untreated control plots showed very high infestation levels (66% infestation). Although the other treatments resulted in different efficacy levels in the reduction of the pest, the economic damage threshold (1% infestation) was exceeded in every treatment.

Because the infestation levels of the codling moth and resistance problems increased during the last years it can be concluded that more effective control strategies have to be developed to ensure the quality and quantity of pome production for the future.

Efficacy of chlotianidyna (neonicotinoid group) in the control of the strawberry root weevil (Otiorhynchus ovatus) on strawberry  

Barbara Labanowska

Abstract: The strawberry root weevil (Otiorhynchus ovatus) feeds on roots and, therefore, it is a very dangerous pest on older strawberry plantations. The efficacy of two clothianidine formulations (Apacz 50 WG (clothianidine 50%) and TI 435 1 GR (CAGR 8; Santana 1 GR) (clothianidine)) were tested against the strawberry root weevil on strawberry plantations. Both insecticides belong to neonicotinoid group. Granular formulation (TI 435 1GR) incorporated into soil at the rate of 10 and 15kg/ha in the spring, before strawberry blossom, reduced significantly the number of weevil larvae. In two trials TI 435 1 GR applied at the higher rate (15kg/ha) decreased the number of larvae by 72%. The efficacy of this insecticide used at the lower rate (10kg/ha) against weevil larvae was 61.3 and 78.7%. Results obtained with TI 435 1 GR were similar to those obtained with standard insecticide – Diazinon 10 GR (80kg/ha). Apacz 50 WG applied as a spray treatment at the rate of 0.15 and 0.20kg/ha before strawberry blossom reduced weevil larvae by 74.5-99.6%. Apacz 50 WG applied at the rate of 0.15 and 0.20kg/ha just after strawberry harvest reduced the pest abundance by 72.1-96.3%. Reduction of the pest at this time is very important because after harvest adults of the strawberry root weevil feed on leaves and females lay eggs. The results obtained with Apacz 50 WG were similar or better than those obtained with standard the insecticides; Diazinon 10 GR or Dursban 480 EC (chlorpyrifos).
Abstract: Insecticide resistance can be a serious threat to the application of Integrated Pest Management. The Green Peach-Potato Aphid, *Myzus persicae* (Sulzer) is a serious pest in peach orchard. Insecticide treatments have selected many populations that have different degrees of insecticide resistance due to different resistance mechanisms. These resistance mechanisms can interfere with many classical insecticide classes, but, fortunately, till now, there is no clear evidence for resistance to neonicotinoids. The severity of this problem is also increased by the reduction of the available active ingredients that can lead to an abuse of a single group of insecticides. Many populations of *M. persicae*, both in Italy and in Europe, over-express a carboxylesterase (E4/FE4) that reduces in various degrees the efficacy of several insecticides by hydrolysis and/or by sequestering. Recently, many authors have demonstrated that piperonylbutoxide (PBO) can efficiently interfere with esterase activity overcoming insecticide resistance. Several microencapsulated products (in polyurea or cyclodextrin) with PBO and various active ingredients have been tested in laboratory bioassays against a susceptible and against an esterase resistant population of *M. persicae*. A comparison was done with the commercial formulated products alone or mixed with PBO.

The results achieved with the different formulation are discussed in term of increased mortality, application rate as well as offsprings reduction.

According to the results, the use of these types of microencapsulation together with PBO could be an interesting tool to be included in resistance management strategies against the green peach-potato aphid.

**Susceptibility to abamectin of pear psylla, *Cacopsylla pyri* (L.) (Hemiptera: Psyllidae) in pear orchards of north-east Spain**

* Xavier Miarnau, Miquel Artigues, Maria José Sarasúa

Abstract: *Cacopsylla pyri* (L.) (Hemiptera: Psyllidae) is a key pest of pear orchards in the fruit growing area of north-east Spain. Chemical control is the most common method used against pear psylla, but the number of insecticides registered to control it has been reduced in the last years. The high selection pressure with abamectin, applied repeatedly over the whole area, can result in the appearance of resistance, as has happened with other products. With the aim of monitoring future changes in the susceptibility of *C. pyri* to abamectin, we used topical application bioassays in adults, and residual application in nymphs to obtain current data on the susceptibility in the area. We collected 15 populations from different orchards in Lleida, Huesca and Girona, where heavy use of insecticides (including abamectin) is the common practice. The bioassays were carried out from October 2004 to September 2006. To check the evolution of abamectin treatments in the last years we analyzed the records of the treatments from the different orchards. We obtained the current data, LC50 and LC90 of all the populations (adults and all instars nymphs). No evidence of a high level of resistance has been found. However there are a few populations that presented a lower susceptibility, as well in adults as in nymphs. The populations with the lowest level of susceptibility in nymphs were the same that presented the lowest level of susceptibility in adults and they came from the fields with the highest number of insecticide applications.

**Plant infusions to limit the development of pests or diseases: results on *Aphis pomi***

* Sophie-Joy Ondet

Abstract: We started research on physiomedicalism in 2003, in order to limit the development of pests or diseases in an environment-friendly manner. The potential of indigenous medicinal plants is largely explored and used for human and veterinary medicines, but lately work has started to look at their potential for providing pesticides for use on cultivated plants. Our preliminary tests target has been *Aphis pomi* in apple orchards. To ensure the feasibility of growers using them in the future our preparations are home-made, from dry medicinal plants. From the literature, six
plants were selected and then tested to see if they would limit the development of *Aphis poni*: *Artemisia absinthium* L., *Artemisia vulgaris* L., *Saponaria officinalis* L., *Mentha x piperata* L., *Salvia officinalis* L., *Tanacetum annuum* L. The best results of 2006 and 2007 trials were obtained with the infusions of *Mentha x piperata* and *Artemisia vulgaris*. Results are discussed.

**Comparison of susceptibility and nycthemerals rhythms between reared insects of Mediterranean fruit fly (*Ceratitis capitata*) and wild population of Algeria treated with a fenthion insecticide**

*Salah Oukil, René Causse* ................................................................. 595

**Abstract:** Fenthion toxicity was studied with topical application and lethal dose LD 50 and DL 80 were assessed on various *C. capitata* Wiedemann populations. Toxicity was lower in wild individuals than in reared insects, among which individuals irradiated at 90 Gy gamma ray were significantly more susceptible. A nycthemeral variation in the susceptibility to this insecticide was characterized, with some peculiarities related to the origin of the insects and the LD considered.

**Preliminary resistance screening of abamectin on pear psylla (Hemiptera: Psyllidae) in Northern Italy**

*S. Civolani, Edison Pasqualini, R. Peretto, C. Chieco, M. Chicca, M. Leis* ................. 596

**Abstract:** In northern Italy (Emilia-Romagna Region), integrated pest management (IPM) has been adopted for several years to control pear psylla, *Cacopsylla pyri* L. (Hemiptera: Psyllidae), a relevant pest of pear (*Pyrus* spp.) orchards. After the outlawing of amitraz in 2005, the most common active ingredient now used for control is abamectin, a mixture of avermectin B1a and avermectin B1b. After the development of *C. pyri* resistance to different active ingredients in several European growing areas, an evaluation using a range of laboratory tests (topical application on adults, spray application on eggs, leaf dip test on young and old larvae) were carried out during 2007 and 2008 to assess *C. pyri* susceptibility to abamectin, using populations of this pest which had been obtained, from several orchards where a range of control strategies were being applied. The results are discussed.

**Strategies and timing of protection practices against Cydia pomonella (L.) in apple orchards**

*Daniel Plénet, Camille Picard, Jean-François Toubon, Olivier Martin, Rachid Senoussi, Benoît Sauphanor* ................................................................. 597-601

**Abstract:** The understanding of actual farmer practices is essential to identify the constraints for the adoption of new integrated pest management strategies. From data collected in 2006 in 71 randomised pear and apple orchards in a small production area in south France, our objective was to comprehend the management practices against codling moth (*Cydia pomonella* L.). We first investigated the timing and frequencies of insecticide applications in relation with national and regional recommendations. The orchards were classified according to three management strategies: conventional with major use of chemical insecticides, MD associating mating disruption with chemical pesticides and organic orchards. For each plot and day, the probability of applying an insecticide was described by a logistic model taking into account the main variables that influence farmers’ decisions to make the application. The protection strategies significantly affected the number of insecticides applied against *C. pomonella*, the application frequencies during the risk periods of each generation of the pest and the choice of active ingredients. Farmers followed the application guidelines more closely within MD protection strategy.

**Insecticide Resistance of Cydia pomonella (L.) (Lepidoptera: Tortricidae) Eggs and First Larval Instars in Spanish Field Populations**

*Marcela Rodríguez, Dolors Bosch, Tânia Marques, Jesús Avilla* ............................... 602

**Abstract:** To know the efficacy of insecticides on codling moth (*Cydia pomonella* (L.) (Lepidoptera: Tortricidae)) Spanish field populations of this insect were collected from orchards
with heavy damage and the mortality caused by the LC90 of a susceptible strain (S_Lleida) was recorded. Five ovicides and 7 larvicides were tested on eggs and first instar larvae (L1), respectively, from field populations. Commercial and technical products were used for L1 and eggs, respectively. Eggs were topically treated (0.1 µl/egg) and L1 were exposed to semiartificial diet treated on its surface (2µl/cm²). Every insecticide showed an efficacy significantly lower than its efficacy for S_Lleida for at least one population. The majority of the field populations were significantly less sensitive to the insecticides than S_Lleida was (96% and 70% for ovicides and larvicides, respectively). Fenoxycarb and thiacloprid were the most effective ovicides, and lambda cyhalothrin, alpha cypermethrin and chlorpyrifos-ethyl were the most effective larvicides. For three field populations, an inverse relationship between the efficacy of azinphos-methyl and chlorpyrifos-ethyl was observed. To know the role played by detoxification mechanisms, esterase (EST), mixed-function oxidase (MFO) and glutathione-S-transferase (GST) activity was evaluated on L1. Seventy percent of field populations showed a MFO activity significantly higher than the susceptible one, but only one of them also showed higher EST and GST activity.

Molecular detection of pest resistance to insecticides

Myriam Siegwart, Juliette Goussopoulos, Jérôme Olivares ........................................603-606

Abstract: Insecticide resistance occurs at three levels in insects: i) stopping penetration through barrier tissues ii) conjugation, storage, and metabolisation in internal tissues iii) modification of the molecular target site. The detection of these biological adaptations is often realized by the use of bioassays. This technique allows characterizing the resistance level of a population to a given compound, but is not informative on the mechanism. Therefore, it limits the potential of investigation and resistance management becomes more difficult. Molecular detection can be useful, enabling the identification of target mutations, and the modifications in the expression or the structure of detoxifying enzymes. Acetylcholine esterase and the sodium channel are two important molecular targets of organo-phosphosphates (OPs), carbamates and pyretroids, respectively. The study of gene sequences allows the development of molecular tools in order to screen field populations.

We have already developed some molecular tools to detect pyrethroid resistance in Cydia pomonella. We are now investigating the molecular structure of target sites in other pest species, including Cydia molesta aiming to define new molecular tools for resistance detection. The first results are presented and discussed.

New isolates of CpGV overcome virus resistance of codling moth

Daniel Zingg .............................................................................................................607

Abstract: Since 2004 codling moth (Cydia pomonella) populations with resistance towards the Mexican isolate of Cydia pomonella granulovirus (CpGV) have been found in Austria, France, Germany, Holland, Italy and Switzerland. In the following years Andermatt Biocontrol developed Madex Plus and several other new virus isolates, which can overcome the resistance. The new isolates were selected on virus resistant codling moth populations in the laboratory. The virus isolates were tested on sensitive and virus-resistant codling moth populations in laboratory bioassays and in field trials. All tested new virus isolates showed a good efficacy on sensitive codling moth larvae comparable to or better than the Mexican isolate. Also all the new virus isolates gave good control of Mexican isolate-resistant codling moth populations. Andermatt Biocontrol is thus able to offer products based on new virus isolates that present the solution against virus resistance.

Poster Session 2: Plant-Pest Interactions

Peach breeding for multiple resistances to pests and diseases contributes to integrated fruit production

Thierry Pascal, P. Lambert, J. L. Poëssel, V. Decroocq, M. H. Sauge ................................610

Abstract: In spite of the worldwide decline in peach production, a constant stream of new varieties are being provide to fruit growers. For the greater part most of these new varieties being
produced by private peach breeders, and as a consequence very few are selected on the basis of their resistance to pests or diseases, while the demand of consumers continues to be directed towards a quality fruit product which is free of pesticide residues. Within the framework of one INRA multidisciplinary group (Avignon-Bordeaux), we have developed for several years a wide applied breeding program aiming at improving the resistance of the peach tree to three of its main enemies: the green peach aphid (*Myzus persicae*), peach powdery mildew (*Sphaerotheca pannosa var. persicae*) and sharka disease (Plum Pox Virus). This work is globally conducted in a research context oriented towards varietal innovation including fruit quality and durable resistances building. In this way, two complementary approaches have been preferentially held for respectively improving the genetic gain by time unit and a better understanding of peach-enemies relationships. First, a genetic approach integrating the quantitative trait loci or major genes mapping for the development of molecular assisted selection. Second, a functional approach (i) leaning on the study of the insect behaviour and the plant metabolites involved in the resistance to *M. persicae* (ii) coupled to a candidate-genes research mainly developped for PPV resistance. Whole of first results and perspectives are discussed.

**Evaluation of technical scenarios for the peach-brown rot system using a virtual fruit model simulating quality and storage potential**

Caroline Gibert, Pierre Rouet, Claude Bruchou, Gilles Vercambre, Michel Génard, Daniel Plénet, Philippe Nicot, Joël Chadœuf, Françoise Lescourret

Abstract: Improving fruit quality while reducing pesticide and water use supports both consumers’ requirements and environmental and health concerns. This objective promotes some alternative technical scenarios that use more cultural than chemical control for pest management. Our study focused on the peach-brown rot system (*Monilinia laxa*). It aims at determining sets of cultural options providing an optimal trade-off between revenue build-up, consumers’ requirements and environmental impacts. We used a modelling approach to simulate technical scenarios by using a virtual fruit model describing the seasonal changes in peach fruit quality traits during final swelling under the influence of climatic, biotic and cultural factors. We defined 243 virtual scenarios based on agronomical and epidemiological inputs (time and intensity of thinning, irrigation, cultivar choice and disease control). Virtual scenarios were evaluated on a multi-criteria profile of performance integrating storage potential, organoleptic and environmental factors, according to different objectives of profitability, water saving and no pathogen entry (cuticular crack) on fruits. Scenarios including water stress during final swelling are promising while requiring an evolution of market standards.

**Codling moth (*Cydia pomonella* L.) egg-laying behaviour on two Malus sp. preferred and non preferred for egg-laying and leaf surface metabolite signals**

Nadia Lombarkia, Sylvie Derridj

Abstract: *Cydia pomonella* (*C. pomonella*) is the main pest of *Malus domestica* (*M. d.*). *Malus floribunda* (*M. f.*) which is used in orchards to cross pollinate trees, shows no *C. pomonella* damage. We observed on single trees without any alternative that 60% of females may lay eggs on *M. d.* (41 eggs) vs. 0% on *M. f.* After collecting and analyzing, by gas chromatography, leaf surface metabolites, we were able to test the known active metabolite pattern on females to confirm the tree observations. Acceptance and egg-laying was reduced by the *M. f.* metabolite pattern. The gravid female behavior was observed on trees in no-choice controlled conditions. On both *Malus* sp. females preferred to land on the upper side of corymb leaves and on the fruits. Then females generally remained on the site where they had landed. The behavioural difference to both *Malus* sp. was observed at the stage of ovipositor scanning, which was linked to egg-laying. Scanning was dramatically reduced on *M. f.* and the locomotion speed was lower. Host and non-host characters belonged to the egg-laying stage and non volatile metabolites.
Apple resistance to arthropod herbivores: genetic basis and modification by environmental factors
Karsten Mody, Sibylle Stoeckli, Cesare Gessler, Silvia Dorn

Abstract: Arthropod herbivores reduce the quantity and quality of apple yield. Resistant apple varieties hold promise to increase the sustainability of pest management in orchards, but little is known on the genetic basis of apple resistance to most arthropod herbivores. Knowledge on the apple genome and QTL (quantitative trait locus) analysis is now facilitating the identification of gene regions associated with resistance. 160 F1 progeny plants of a cross of the apple varieties 'Fiesta' and 'Discovery' were surveyed at three different sites in Switzerland. Herbivore infestation per genotype as a measure of resistance was quantified for the apple aphids Dysaphis plantaginea, Dysaphis cf. devecta and Aphis pomi, the apple rust mite Aculus schlechtendali, and the codling moth Cydia pomonella. The influence of the environmental factor 'drought stress' on apple resistance to a chewing and a sap-feeding herbivore (caterpillar; aphid) was studied in laboratory experiments considering different intensities of pulsed drought stress. Significant QTLs for resistance to D. plantaginea, D. cf. devecta, A. schlechtendali, and C. pomonella were detected. SSR alleles associated to the QTLs may be applied to identify and breed resistant apple cultivars. Environmental factors such as within-canopy variation in climate, and neighbourhood-effects affected herbivore distribution in the field. In the laboratory, pulsed drought stress resulted in non-monotonic resistance responses of apple trees. Low-stress plants showed the highest and high-stress plants the lowest resistance. The studies revealed the genetic basis of apple resistance to different arthropod herbivores and the modifying influence of environmental parameters that may impede QTL detection.

Poster Session 2: Plant-Pest Interactions

MRV-Carpocapsa: a phenological model as decision support system for Codling Moth (Cydia pomonella L.) in Emilia-Romagna (Italy)
Alda Butturini, Rocchina Tiso, Mauro Boselli, Simona Giosuè, Giovanni Burgio

Abstract: A warning Service for pests and diseases of the most important crops was set up in Emilia-Romagna region (Italy) in 1997. Integration of information obtained by forecasting models and fields surveys is used to develop warnings concerning the risk of pest/disease attack. For the control of Cydia pomonella is available a phenological time–distributed delay model. Biological parameters were defined in 1991 in lab-trials. On the basis of hourly temperature, the model can simulate the development of the first and second generation. It gives as output the cumulating percentages of egg-laying, egg-hatching, pupation and adult emergence as well as the age structure of the population. The model has been fully tested over 1992-1998 and therefore has been effectively used for ten years in Emilia-Romagna to optimize control strategies in IPM. From the first application in 1998, it was executed steadily a quality control of simulated data by their comparison to that observed in orchards. As the pheromone traps do not always describe population dynamics properly, it has been chosen to assess the oviposition activity. Weekly field observations were carried out over 1998-2008 in an untreated orchard near Bologna. The eggs were examined for the exact phase of embryonic development determination. Then the egg laying dates were estimated taking into account of specific degree-days for each embryonic phase. Results from the comparison between the simulated data and those observed in field are reported. Altogether, actual and simulated oviposition curves agree fairly well over the last eleven years despite the different climatic condition recorded in this period.
GEP, a tool for helping decision making for pest control advisers in Lleida (Spain)

Manel Ribes-Dasi, Jesus Avilla, Ramon Torà

Abstract: GEP is a new tool developed by the University of Lleida, IRTA and the Catalan Plant Protection Service to furnish Pest Control Advisers (PCAs) with up-dated information on the spatial distribution of pests in the fruit growing area of Lleida. It is the consequence of the work carried out since 1998, which has been regularly presented in the IOBC WG meetings. The Pest Control Advisers maintain and check the net of pheromone traps, send the results to the Plant Protection Service and the UdL, and receive back the processed information within 3 days. The system has been improved by the use of Google EarthTM maps.

Impact of flower strip establishment in apple orchards on natural enemy populations

Jennifer De Almeida, Daniel Cormier, Éric Lucas

Abstract: Composite flower strips were established in 2006 in three commercial apple orchards in Quebec. Strips were composed of the Canadian goldenrod (Solidago canadensis) and the common yarrow (Achillea millefolium), two native plants known to attract beneficial organisms. The aim of the project was to reduce pesticide application treatments directed against orchard pests, more specifically the European red mite (Panonychus ulmi), the two-spotted spider mite (Tetranychus urticae), the green apple aphid (Aphis pomi), the European apple sawfly (Hoplocampa testudinea), the tarnished plant bug (Lygus lineolaris) and the white apple leafhopper (Typhlocyba pomaria). In the present trial, populations of potential natural enemies of these pests were monitored in 2008, using sticky white traps, in both control and managed areas. The most common predator species were Coccinellidae, Syrphidae, Neuroptera (Chrysopidae and Hemerobiidae) and Aranea. Results varied according to the species of natural enemy, the treatment (control versus floral strip) and the distance to the flower strip.

COSMOS, a spatially explicit model to simulate the epidemiology of Cosmopolites sordidus in banana fields

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Abstract: A stochastic individual-based model called COSMOS was developed to simulate the epidemiology of Cosmopolites sordidus in banana fields, based on simple rules of local movement of adults, egg-laying of females, development and mortality, and infestation of larvae inside the banana plants. The biological parameters of the model were estimated from literature. The model was validated at the small-plot scale. Simulated and observed distributions of attacks were similar in twelve out of 18 plots (Kolmogorov-Smirnov test). An exhaustive sensitivity analysis using the Morris method, showed that dispersal and demographic parameters of adults were the most influential parameters.

Development of a dynamic population model as a decision support system for Codling Moth (Cydia pomonella L) management

Marc Trapman, Herman Helsen, Matty Polfliet

Abstract: In 2004 RIMpro-Cydia was developed as a dynamic population model that simulates the within-year biology of a local codling moth population. The model is meant to be used by growers and advisors to optimize the control of codling moth populations in organic and integrated managed orchards. The model is based on literature data and unpublished research data. Fractional boxcar trains are used to mimic the dispersion in the developmental processes. The model is run in real time on the data input of local weather stations, starting on 1 January. The output of the model was compared with the results of field observations in four years in untreated orchards. The progress in egg deposition as predicted by the model was in general agreement with the field data. The start of the egg deposition period was predicted well. The end of the egg deposition period was predicted when, in the field, about 10% of the eggs were still to be laid in some years. There was no consistency in the relation between cumulated pheromone trap catches and the cumulative egg deposition as calculated from the field data.
Effects of thermoperiodic conditions on the developmental rate of the codling moth larvae of resistant and non-resistant strains to chemical and viral (CpGv) insecticides

Ana Scomparin, Marc Saudreau, Hervé Sinoquet, Benoit Sauphanor, Marie Berling, Odair Fernandes, David G. Biron

Abstract: The developmental rate of codling moth, Cydia pomonella (L.) (Lepidoptera: Tortricidae), is supposed to be directly proportional to air temperature between the lower and upper developmental thresholds. However, some review papers suggest that insect species have a higher developmental rate when reared in thermoperiodic conditions as compared with constant temperatures. Thus, in this study, the developmental rate and the zero temperature threshold of codling moth for the larval stage were determined in thermoperiodic conditions for strains resistant and non-resistant to chemical and viral (CpGV) insecticides. Two methods were used to determine the zero development temperature for the four C. pomonella strains: (i) the x-intercept method and (ii) the thermal unit test. Our study supports the “thermoperiod hypothesis” and suggests that the effect of thermoperiod on the developmental rate of C. pomonella larvae should be taken into account in the development of phenological models.

Poster Session 2: Semiochemicals

A field unit for automatic monitoring of insect behaviour

Federica Trona, Gianfranco Anfora, Roberto Oberti, Ezio Naldi, Claudio Ioriatti, Gino Angeli

Abstract: The aim of this work was the development of a field unit for automatic recording and related data analysis of insect orientation towards an attractive pheromone source. Currently the evidence of male behaviour under mating disruption is still speculative, due to the difficulty to conduct field observations which unequivocally show the operative mechanisms. This monitoring system provides behavioural data, in order to optimize the effectiveness of control strategies based on semiochemicals. Specifically, the unit records frequencies of the visits, temporal dynamics and trajectories around the attractive source. The operating principle of the unit is based on the acquisition and real-time analysis of near infrared images relative to an area of 80 x 80cm around the source; the functioning is fully autonomous and remotely controlled via GSM network. We chose as study model the behaviour of codling moth, Cydia pomonella (L.), in an apple orchard managed with mating disruption (Isomate C Plus, 1000/ha). The operation of the unit was verified by analysing the approach of the males toward three different attractive sources: a standard monitoring lure (1 mg of E8,E10-dodecadien-1-ol), an Isomate CP Plus dispenser and two calling females. The infrared camera was placed in the middle of a field tunnel. For each trial 10 virgin, 2-3-day-old males were released. The recordings went on for 2 days, from 7.00 pm to the midnight.

Raspberry cane midge Resseliella theobaldi: 3 years of flight monitoring in Swiss raspberry cultures

Catherine Baroffio, Charley Mittaz

Abstract: The raspberry cane midge Resseliella theobaldi is a major pest of Swiss raspberries. The midge population dynamics have been studied for 3 years in the Valais region using a sex pheromone identified and synthesised by EMR and NRI. Four generations were observed in the low altitude and three in the mountains. Based on these observations and in order to find a substitute to diazinon, the only registered insecticide, an efficacy trial was conducted in 2008. Besides diazinon, two insecticides were tested. Only thiacloprid and diazinon showed a significant difference compared to control. The trial will be repeated in 2009.
Management of Oriental Fruit Moth and Codling Moth with spray application of microencapsulated sex pheromone

Daniele Demaria, Manuela Cigolini, Graziano Vittone, Fabio Molinari ..............653-656

Abstract: Codling moth (Cydia pomonella L.) and oriental fruit moth (Grapholita molesta (Busck)) are the main pests of apples and peach, respectively. Various formulations of synthetic sex pheromones of both species have been developed in order to manage these pests in apple and peach orchards. The most common use of sex pheromones has been with hand-applied dispensers, but their application is labour intensive and growers are interested in alternative approaches. Two sprayable microencapsulated formulations of sex pheromone have recently been commercialized. They can be applied either alone or mixed with different chemicals. Our studies, conducted in 2007 and 2008, showed that this method was very effective for both codling moth and oriental fruit moth and achieve the same results as insecticides and hand-applied pheromone dispensers.

Isomate C Plus Dispensers as an Alternative Means for Control of Codling Moth, Cydia pomonella L., in Apple Orchards of Bulgaria

Hristina Kutinkova, Jörg Samietz, Vasilii Dzhuvinov, Vittorio Veronelli, Andrea Iodice .................................................................657-662

Abstract: In the years 2006-2008, trials on the control of codling moth (CM) by mating disruption (MD) using Isomate C plus dispensers were carried out in an isolated 1-ha apple orchard in South-East Bulgaria. Dispensers were hung in the upper third of tree canopies at a density of 1000 pieces per ha before CM flights started. Dynamics of CM flights was monitored by pheromone traps installed in the trial plot and in a conventionally treated reference orchard. Fruit infestation was periodically assessed till harvest time. Hibernating population of CM was estimated in autumn by counting diapausing CM larvae in corrugated cardboard bands. In each of the years, Isomate C plus dispensers completely inhibited CM captures in pheromone traps in the trial plot. Fruit damage remained at low levels till late July and increased slightly only in August. At harvest the percentage of damaged fruits was below 1%. The hibernating population also stayed at low level. In the reference orchard, in spite of numerous chemical treatments, the final fruit damage was high (5.5-28.4%), apparently due to resistance of CM to insecticides. It has been concluded that mating disruption may serve as an alternative means for control of codling moth in Bulgarian apple orchards. Contrary to reports from other countries, this study has shown that good results from MD can be obtained even on a small-size plot, if isolated from external sources of infestation and if initial CM population is low.

Correlation between maturity of female R. cerasi, oviposition, larval development and ripeness of cherries

Kirsten Köppler, Barbara Féjoz, Heidrun Vogt.................................................................663-667

Abstract: The European cherry fruit fly Rhagoletis cerasi L. (Diptera: Tephritidae) is the most serious pest in European cherry production. The control of the pest is difficult, especially against the background of EU wide reduction programs for broad spectrum insecticides. To find alternative control measures, the biology and behaviour of the fly must be known in more detail. One option to control the pest might be bait sprays, which have to be applied repeatedly during the main infestation period. To achieve the optimal efficacy and with respect to the costs, timing and number of applications are important questions. For this reason we investigated the correlation between the maturity of female R. cerasi by analysing the ovary status of flies caught with yellow sticky traps, oviposition, larval development and ripeness of host fruits (varieties Sam, Van and Hedelfinger) by measuring colour, sugar content as well as solidity, recorded as pressure resistance.

The 1st fly was trapped on May 9, whereas the 1st ripe eggs after dissection of ovaries were found on May 13. According to the cherry variety, the first deposited eggs were detected between May 28 and June 2. During this time, the cherries turned their colour from green to yellow/orange, pressure resistance ranged between 4.0 and 6.3kg/cm² and sugar content between 8.4 and 13.8 Brix. Newly deposited eggs were found until mid of July, whereas 3rd instars occurred from mid of June until mid/end of July, depending on cherry harvest and variety.