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Session 1: Integrated pest management: Biological – Biotechnical control methods – Models

Integrated grape production in Switzerland and its ecological impact in reducing pesticide use

O. Viret 1-9

Abstract: Switzerland (41000 km²) is mostly composed of hills and mountains, with a central plateau (450-550 m elevation) and large lakes. One third is covered with high mountains, the Alps, with summits up to 4600 m elevation. Arable land represents approximately 10% of the surface of the country. The viticulture area represents 15000 hectares under alpine climate. Grapevines can only be planted according to a restricted vineyard cadastre, mostly along the lakesides facing south or in well-exposed valleys.

Swiss viticulture is characterized by very steep vineyards, small plots (national average < 1 ha per grower), intensive labor (400-1000 h/ha/year), high production costs, and difficult processing. A large number of grape varieties are planted depending on climate and historical background.

In the 1970s ecologically aware wine makers and scientists from Agroscope developed the concept of integrated production for sustainable viticulture, according to the definition of the International Organization for Biological Control (IOBC). With respect to regional differences, the general principles of this concept had to be adapted to each viticulture area. Cantonal offices of viticulture are responsible for Integrated Production (IP) organization. In 1993, a head-organization, Vitiswiss, was created to represent the interests of six regional associations. Vitiswiss is composed of a committee of viticulturists from each region and a technical commission of scientists responsible for maintenance and updates to the guidelines, based on new research results.

Swiss IP started with the improvement of pest management by the bio-control of spider mites (*Panonychus ulmi* and *Tetranychus urticae*) with predatory mites (*Typhlodromus pyri* and *Amblyseius andersoni*) and the control of grape berry moths (*Lobesia botrana* and *Eupoecilia ambiguella*) by mating disruption. The number of farmers involved increased, and the IP-concept affected all production steps (soil management, planting material, sprayer calibration, biodiversity, water and cover crop management, education, etc.). Today, no acaricides and very few insecticides are used and predators are protected by applying neutral fungicides. Forecasting systems, available on the internet (www.agrometeo.ch), represent major progress for the control of mildew in accordance with their epidemics, as does leaf area-adapted dosage of plant protection products.

Following basic guidelines of Vitiswiss entitles farmers to financial support by the State government and the Vitiswiss certificate. When additional requirements are fulfilled, the label Vinatura can be used on the bottles. Today, over 85% of the grape-growing area is cultivated

according to IP, indicating recognition of sustainability, respect for the environment, and a guarantee for high-quality wine with reduced chemical applications.

Consumers' perception of sustainability in viticulture

M. Macconi, S. E. Legler, E. Carotenuto, V. Rossi 11-17

Abstract: Different market surveys showed that sustainability is a key aspect for the modern European consumers, but the sustainability concepts need to be communicated in a clear and efficient way. An analysis of the consumers' perception of sustainability in the viticultural sector and their expectations with respect to a "sustainable wine" has been performed. A survey was prepared and submitted through the Internet to different audiences, obtaining 467 answers. The questionnaire results confirmed that consumers are interested in sustainable wines even if the concept of sustainability is not completely clear for the majority of respondents. Despite that, consumers would like to be more informed about grape and wine production methods; the majority of them are interested in reading the most important wine information directly on the bottle label when buying the wine. Finally, respondents are willing to access detailed information on grape production and wine-making consulting firstly on the bottle label and secondly, accessing to the winery web-site or through a QR Code that is linked to the wine technical card.

From vineyard Integrated Pest Management to re-thinking viticultural system study and management

J. Baumgärtner 19-28

Abstract: The paper deals with scientific aspects of viticultural system study and management. It covers the issues of *i*) the promises of Integrated Pest Management (IPM), *ii*) uncertainties imposing limits and providing opportunities, *iii*) multidimensional aspects, *iv*) ecosystem service production, *v*) agroecological and ecosocial system sustainability, and *vi*) integration of viticultural systems into sustainable rural development. These issues require a multidisciplinary approach to viticulture system study and management and show the utility of taking into account systems analysis, modelling, informatics, hierarchy and scale theories, socioeconomic aspects, sustainability sciences and complexity theory. To some extent, the order of the issues reflect the historical development of viticultural system study and management. To a greater extent, however, the order reflects a view that accepts different legitimate perspectives in dealing with complex adaptive systems. The successful integration of different disciplines and scientific areas may continue to produce incremental gains in knowledge and rationalization of management procedures. However, it appears to be unpromising to produce the leaps required to meet the challenges of modern agriculture. The re-thinking of viticultural system study and management leads to ethical reflections that point out the need to complement the predominant utilitarian additional moral value systems with other values systems to obtain a comprehensive basis for decision-taking and actions. It also postulates limits for a comprehensive commodification of good and services. Furthermore, the re-thinking calls into question the modern denial of reality and rejects logical positivism, instrumentalism and philosophical relativism doctrines in agricultural system study and management. The opportunities given by the plurality of different legitimate perspectives and the re-thinking carried out along the lines sketched out in this paper may only have scratched the surface of the problem but appear nevertheless to hold the promise for a fundamental revision of viticultural system study and management.

Disease evaluation of selected cold climate wine grape cultivars in Vermont, USA

L. Berkett, T. Bradshaw, S. Kingsley-Richards, M. Griffith 29-33

Abstract: Cold climate wine grape production is a "new" crop in the diversification of agriculture in Vermont and other northern states. In the past, commercial wine grape production was not recommended in the colder regions of the USA because of problems with winter survival of the vines. However, cold climate wine grape cultivars are now available which survive -34 °C to -37 °C winter temperatures. In addition to cold hardiness, these interspecific hybrids were bred for disease resistance and potentially may require less overall fungicide use to produce high

quality fruit. Few research studies have been conducted to determine their relative disease susceptibility and fungicide requirements. The purpose of this study was to compare disease incidence and severity during the 2010-2012 growing seasons among a selection of wine grape cultivars planted at the University of Vermont vineyard which included: Frontenac, La Crescent, St. Croix, Marquette, Prairie Star, Corot Noir, Vignoles, and Traminette. During each growing season, all cultivars received the same fungicide treatments totaling four to five applications each year. The following fungicides were applied either alone or in combination: mancozeb, mycobutanil, kresoxim-methyl, and captan. At the end of each growing season, disease incidence and severity were determined by examining 20 randomly selected leaves per plot and by visually assessing ten randomly selected fruit clusters per plot. Diseases that were assessed included: powdery mildew (*Erysiphe necator*); downy mildew (*Plasmopara viticola*); black rot (*Guignardia bidwellii*); *Phomopsis* leaf spot and fruit rot (*Phomopsis viticola*); angular leaf scorch (*Pseudopezicula tetraspora*); and anthracnose (*Elsinoe ampelina*). Powdery mildew was the most prevalent disease and was observed on the foliage of all cultivars in each year. Frontenac or Prairie Star ranked the highest numerically in percent leaves infected but were not significantly different from some of the other cultivars. No powdery mildew was observed on any fruit in any year. Downy mildew was also observed only on foliage and not on any fruit over the three years of the study. In 2010 and 2011, the highest foliar incidence was observed on Vignoles; in 2012, the highest foliar incidence was observed on La Crescent vines although Vignoles vines (and Traminette vines) were removed from the study at the beginning of the 2012 growing season and were no longer part of the study. *Phomopsis* foliar symptoms were not observed in any year but fruit rot symptoms were observed in 2010 and 2012. In 2012, Frontenac had the highest incidence and severity, followed by Marquette. Black rot, angular leaf scorch and anthracnose were either not observed or at very low incidence during the three growing seasons. In summary, differences in disease incidence and severity among the cultivars were observed for some diseases. Future research which allows for comparison of multiple fungicide programs during a growing season is needed to determine the innate disease resistance/susceptibility of these cultivars and how best to incorporate this knowledge into effective disease management programs that address economic, health, and environmental concerns.

Potential of the entomopathogenic fungus *Beauveria bassiana* as an endophyte in grapevine *Vitis vinifera* (L.) plants

Y. Rondot, A. Reineke 35-43

Abstract: Fungal entomopathogens are important antagonists of arthropod pests and have attracted increased attention as biocontrol agents in integrated pest management programs. In addition to colonizing arthropods, evidence has accumulated that some entomopathogenic fungi like *Beauveria bassiana* (Bals.) Vuill. (Ascomycota: Hypocreales) can endophytically colonize a wide array of plant species. For a couple of crop plants it has been proved that endophytic *B. bassiana* can provide a systemic protection against damage by various insect pests or might trigger induced systemic resistance mechanisms against plant pathogens. Grapevine, *Vitis vinifera* (L.) is regarded as an extremely input-intensive culture in particular in terms of pesticide application intensities and frequencies. Accordingly, endophytic establishment of an entomopathogenic fungus in grapevine plants would represent an alternative and sustainable plant protection strategy, with the potential of reducing pesticide applications in viticulture. Here, we report for the first time on an endophytic establishment of the entomopathogenic fungus *B. bassiana* in grapevine plants. We used two different commercialized *B. bassiana* strains and applied them as conidial suspensions or as the formulated product on potted grapevine plants. Verification of endophytic establishment of the respective *B. bassiana* strain was achieved by the amplification of strain-specific microsatellite markers. Survival inside leaf tissues was evident at least 21 days after inoculation, irrespective of the inoculum used. No negative effects of endophytic *B. bassiana* on growth of potted grapevine plants were evident. The antagonistic activity of endophytic *B. bassiana* against vine mealybug larvae *Planococcus ficus* was assessed using surface sterilized leaves in a bioassay. Mortality of first instar mealybug larvae was significantly higher during the first week of settlement on endophytic grapevine leaves compared

to leaves from control plants and larvae feeding on endophytic leaves were significantly smaller than those who had fed on control leaves. Overall, endophytic establishment of an entomopathogenic fungus such as *B. bassiana* in grapevine plants represents an alternative and sustainable plant protection strategy, with the potential of reducing pesticide applications in viticulture.

Efficacy of biopesticides against *Scaphoides titanus* Ball in different experimental conditions

N. Mori, D. Tonello, G. Posenato, A. Pozzebon, C. Duso 45-48

Abstract: The *Scaphoideus titanus* Ball is the vector of *Candidatus* Phytoplasma vitis, the causal agent of the Flavescence dorée (FD). In the grape-growing areas where FD is present, insecticide treatments against the vector are compulsory. The Directive 2009/128/EC, establishing a framework for Community action to achieve the sustainable use of pesticides, encouraging the use of alternatives to chemical insecticides. The aim of this work was to study the efficacy of azadirachtin, *Beauveria bassiana*, pyrethrum and spinosad against *S. titanus* Ball in different experimental conditions. The results showed an efficacy against young stage and adults of *Beauveria bassiana* and spinosad both in field condition and in the semi-field trials. Generally for all insecticides, the effect was higher in topical plus residual exposure compare to residual exposure only. Implication for *S. titanus* control of the use of microbial and botanical insecticides are discussed.

Stimulation of conidial germination of the hyperparasite *Ampelomyces quisqualis*

D. Angeli, A. Colombini, S. Siozios, M. Maurhofer, C. Gessler, I. Pertot 49-52

Abstract: This research has focused on novel tools for exploring future application of *A. quisqualis* in biological control of powdery mildew. For this purpose, identification of specific mechanisms to increase the biocontrol efficiency is considered to be a good method. Thus, some attempts were made to enhance the efficacy of different strains of *A. quisqualis*. Conidia of *A. quisqualis* germinate poorly in sterile, distilled water. A procedure to increase the performance of *A. quisqualis* in the biological control of powdery mildews was developed by increasing the conidial germination rate of the fungus before leaf application.

Vineyard landscape and natural pest control services in Bordeaux area

A. Sage, C. Laurent, L. Delbac, D. Thiéry, A. Rusch 53-60

Abstract: Agricultural intensification is recognized as one of the main cause of biodiversity loss in agroecosystems. Increasing the reliance on ecosystem services has been recently suggested as a key step towards ecological intensification of cropping systems. Natural pest control by parasitoids and generalist predators is one of the major ecosystem services. Landscape context is known to affect pest and their natural enemies in most agroecosystems. However, this relationship remains poorly studied in vineyard landscapes. The aim of the present study was to examine the mechanisms between landscape characteristics, several major vine pests (grapevine moths and phytophagous mites), and their biological control by different natural enemies (birds, rodents, parasitoids). Pest population dynamics and natural pest control services (parasitism rates and predation) were monitored in 20 vineyards selected along a landscape complexity gradient in Bordeaux area. Our results revealed a positive relationship between landscape complexity and the grapevine moths (mainly *Lobesia botrana*) parasitism rates at a large scale (1 km radius). Predation by birds at the field edge increased with the proportion of semi-natural habitats in the surrounding environment (250 m radius). Predatory mites' dynamics were mainly affected by within-field variables. Our study demonstrated that natural pest control services are determined by processes acting at multiple spatial scales and depending on species characteristics (e.g., body size, dispersal ability). These results provide guidelines for designing innovative pest management strategies at the landscape scale and will be completed by future research.

Control of European grapevine moth, *Lobesia botrana* (Lepidoptera: Tortricidae) under two different grape trellising systems

R. A. Van Steenwyk, L. M. Novotny and L. Thayer 61-68

Abstract: *Lobesia botrana* (Denis & Schiffermüller), European grapevine moth, was first discovered in North America in Napa Valley, California, USA in 2009. An eradication program was initiated in the spring of 2010 using insecticides supplemented with pheromone mating disruption. California produces over 83% of wine, raisin and table grapes in the United States with over 350,000 ha under a number of growing conditions and trellising systems. The trellising systems have a major impact on foliage development and airflow within the grape canopy. The foliage development can have an impact on insecticide penetration and fruit cluster coverage. This paper reports on the efficacy of several commonly used insecticides for control of both spring and summer generations of *L. botrana* on two trellising systems. The two trellising systems were Smart-Henry and Quadrilateral. The Smart-Henry system is a two-tier system that is highly manicured that requires leaf removal and provides maximum sun exposure and excellent airflow. The Quadrilateral system is a four cordon system that is minimally pruned and provides excellent shading but little airflow. All insecticides evaluated provided adequate control regardless of trellising system or generation with spinosad providing the highest control. Mortality was significantly higher with the Smart-Henry compared to the Quadrilateral trellising system in the second generation of *L. botrana*. There was greater mortality at the first generation as compared to the second generation with both trellising systems. However, there was a greater difference in mortality between the first and second generations with the Quadrilateral compared to the Smart-Henry trellising system.

Evaluation of the efficacy of first fungicide application on the control of *Erysiphe necator* and the ascospores release on Douro Region

C. Val, F. Alves, J. Manso, I. Cortez 69-75

Abstract: Powdery mildew (*Erysiphe necator*) is the most harmful disease of grapevines in Douro region, inducing a decrease in yield, as well as on the quality of the wine.

An experiment was conducted in the Douro Wine Region (Portugal), in a field plot located at Cima Corgo, with the CV Tinta Roriz (Tempranillo), the second variety most used in Douro, and very sensitive to powdery mildew. The vines of the study were grown in two rows terraces. During the phenological stage dormant bud, on beginning of March, the ascospores release started to be monitored using glass microscope slides placed in the vineyard, one per plant. The slides were replaced always after the occurrence of some rain. The temperature data (°C), relative humidity (%) and rainfall (mm) during these periods were also recorded in order to verify the period of greatest ascospores release to do a better position of the first spraying. The experimental design consisted in four treatments arranged in a randomized block design with four replicates; each plot had 14 vines (10 evaluated). The treatments consist in T1 – (control) with any spray applied; T2 – three fungicide sprays applied before blooming: the first spray was at two to three leaves unfolded, the second at inflorescence clearly visible and the third at inflorescence fully developed; T3 – the fungicide spray started at inflorescence fully developed, which is the common practice in Douro, and the second spray was at pre-blooming and T4 – the spraying started only at pre-blooming with a sterol demethylation inhibitors (DMI). After blooming, all the treatments (T1, T2, T3 and T4), with exception of the control, were sprayed at the same time with the same product. The severity of powdery mildew was assessed in grapes and leaves, based on the scale of OEPP (1981), in all plots in three different periods. The average weight of bunches (AWB), the number of bunches per vine (NB) and the production per vine (YV) were evaluated. The preliminary results reveal significant differences to the control, but no difference was observed between the treatments T2, T3 and T4. This shows that, nevertheless the event of ascospores release initiate early; the beginning of development of disease only starts close to blooming. It is necessary to develop further studies on the powdery mildew control strategies, and confirm the results here obtained in years with different climate conditions.

We can then say that the disease might be controlled as effectively with a smaller number of treatments, positioning the first time only in pre-flowering. The reduction on the number of

treatments (even if only one) can contribute significantly to improving the environment, in particular, through the reduction of residues on grapes, with effective benefits to public-health, the reduction of soil compaction, and pollution of atmosphere, saving costs of the treatment itself (product, labor, machine application and fuel).

Variation in pesticide hazard in integrated viticulture in Trentino from 2002 to 2012

M. Michelon, M. Bottura, F. Penner, V. Mazzoni, C. Ioriatti 77-80

Abstract: In the winegrape production system of Trentino IPM guidelines have been applied since 1990. In order to assess the effective reduction of the environmental hazard due to plant protection strategies, a pesticide risk indicator (newEIQ) has been applied to estimate changes in pesticide risk from 2002 to 2012. The mean newEIQ field rating value ranged from 2602.9 in 2002 to 1699.8 in 2010, with a significant decreasing trend ($R^2 = 0.60$). The decrease in pesticide hazard over the time considered is more related to the use of selective active ingredients rather than to the reduction in the amount of pesticides.

Old problem – new solution for managing the vineyard pest *Lobesia botrana* with pheromones: biodegradable electrospun mesofiber dispensers combined with novel mechanical deployment

H. E. Hummel, S. Langner, M. Breuer, G. Leithold 81-91

Abstract: Finding and selecting suitable dispensers for pheromone disruption studies against a variety of insect pests is a major technological challenge. Our recent efforts concentrate on organic mesofibers with a typical diameter range between 0.5 and 3.5 micrometers. These fibers can either be electrospun onto inert carriers or also onto the growing crop plants. They are based on the biodegradable low cost Ecoflex[®] co-polyester which can readily incorporate up to 33 weight % of the major pheromone component of the *Lobesia botrana* sex pheromone (*E,Z*)-7,9-dodecadienylacetate. Using the well established in-field cage testing technique, mating disruption effects were demonstrated for continuous periods of up to 7 weeks with one single application after which the fiber material slowly decomposes and completely disappears within half a year. The mesofibers are free of any toxicity and eco-toxicity. Their application may be combined with other cultivation measures. They may be applied with modified vineyard cultivation machinery. Mesofibers are a step towards the goal of producing smart, "semi-intelligent" micro-dispensers which may occupy a future innovative place in the emerging strategy of precision agri- and viticultural systems.

Success of mating disruption against the European grapevine moth, *Lobesia botrana* (Den. & Schiff): a whole farm case-study in the Douro Wine Region

C. Carlos, F. Gonçalves, S. Sousa, M. Nóbrega, J. Manso, J. Salvação, J. Costa, C. Gaspar, J. Domingos, L. Silva, D. Fernandes, M. C. Val, J. C. Franco, J. Aranha, H. Thistlewood, L. Torres 93-102

Abstract: The European grapevine moth, *Lobesia botrana* (Den & Schiff.) is the most important pest in the Douro Wine Region (Portugal) and has typically three generations per year, of which the third is the most damaging to grapes. The damage is highly variable amongst years, ranging from 0 to 90% of infested clusters at harvest. The use of mating disruption (MD), an environmentally friendly method to control this pest, is widely recommended in IPM strategies. However, some major constraints to its implementation have been identified in our region: high biotic potential of the moth; high summer temperatures; the steep terrain in many vineyards. Most importantly, the size of the treated area is an important factor for success of the method, which works best in large and contiguous areas. However, the landscape of the Douro Region is very fragmented. The majority of the vineyards are small, often bounded by other crops such as olive groves, and by unmanaged natural or abandoned crop habitats, where alternative plant hosts of *L. botrana* (e.g. *Daphne gnidium* L.) are common. Our objective was to investigate the effectiveness of MD against *L. botrana* within a series of contiguous habitats managed within the

“Quinta de São Luiz”, as a case-study. It also served as a demonstration project and to highlight the importance of applying MD on an area-wide scale. The technique was first applied within the farm in 2001 on 4 ha, and expanded to the present 90 ha. MD was shown to be most effective for control of *L. botrana* after consecutive seasons of application, when large areas were treated, and in years of low pest population density.

The use of pheromone traps to monitoring the vine mealybug, *Planococcus ficus*, and its main parasitoid, *Anagyrus* sp. nr. *pseudococci* in Douro Wine Region
F. Gonçalves, C. Carlos, S. Sousa, M. Nóbrega, J. C. Franco, J. Manso, A. Pinto, L. Torres 103-111

Abstract: The vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) has been increasing its importance as a pest in some vineyards of Douro Wine Region (Portugal). Under high pest pressure and repeated annual infestations, this insect can cause vine decay, not only due to its feeding activity, but also as a result of honeydew contamination of leaves and grape clusters and consequent development of sooty mold. Furthermore, *P. ficus* is known as a vector of Grapevine Leafroll Viruses. In order to better understand the population dynamics of this insect pest, as well as to improve pest control strategies, a study has been carried out in two wine farms from Douro Wine Region. During 2013, the flight curve of *P. ficus* males was monitored using pheromone traps baited with the synthetic female sex pheromone, (S)-lavandulyl senecioate. Moreover, the kairomonal attraction of the females of its main parasitoid, *Anagyrus* sp. nr. *pseudococci* (Girault) (Hymenoptera: Encyrtidae) was explored for also monitoring the activity of this wasp using the same pheromone traps. The first captures of *P. ficus* males occurred in mid-May. However, the increase of captures was observed only by the end of July, with a peak in mid-August. The first captures of *A. sp. nr. pseudococci* females in the pheromone traps occurred in mid-April. The trend of the wasp captures followed a similar pattern that was observed for *P. ficus* males since the end of July onwards.

Presentation of the VitiMeteo forecasting system – current state at the 10th anniversary of the system
G. Bleyer, H.-H. Kassemeyer, M. Breuer, R. Krause, B. Augenstein, O. Viret, P.-H. Dubuis, A.-L. Fabre, B. Bloesch, P. Kehrli, W. Siegfried, A. Naef, G. K. Hill, L. Mattedi, M. Varner 113-123

Abstract: Forecasting systems are basic tools for integrated and biological plant protection. ‘VitiMeteo’ (VM) is an extensive forecasting system for viticulture. It is a cooperative project between the State Institute for Viticulture and Oenology, Freiburg (Germany), the Swiss Research Station Agroscope Changins-Wädenswil (Switzerland), and the company GEOsens, Ebringen (Germany). Basically, the system consists of data sources, a database, expert software and the presentation of data on the internet. The data flow is organized as follows: (i) weather data is stored in a database; (ii) transfer of weather data to the expert models, (iii) publication of main results on the internet using graphs and tables. Core of this system is the database ‘Agrometeo’, where all data from different weather stations and related forecast data are stored.

Over the years VitiMeteo grew step by step. ‘VM Plasmopara’ was the first module, created in 2002; it calculates the most important steps of the infection cycle of downy mildew. Next component was the growth model ‘VM Meteo Growth’, which was programmed in cooperation with H.-R. Schultz (HS Geisenheim). The software ‘VM Oidiag’, based on work of W. Kast (LVWO Weinsberg), is a powdery mildew risk model. Other expert models are ‘VM Insects’ and ‘VM Hyalesthes’. Practical applications are the calculations of the flight start of the grape berry moth and of *Hyalesthes obsoletus*. ‘VM Hyalesthes’ is built on the works of M. Maixner (JKI Siebeldingen). The latest software is ‘VM Black rot’, which models the important parts of the life cycle of Black rot. The software was developed together with D. Molitor (CPR Belvaux), due to his recent work. ‘VM Data Graph’ is an additional, valuable computer program for the visualization and validation of weather data. Linking weather forecast with all models, provided from the company Meteoblue (Basel), marked a milestone in the development of the system. All expert software permits the variation of important model parameters. This parameterization has

proved to be a main advantage in the development of the models. It allows the optimization of the models continually. In contrast to other forecasting systems, research institutions own the complete software. Therefore current research improvements will be integrated quickly. The 'VitiMeteo system' is open, flexible and innovative, because research results and new models can be transferred into practice more quickly than before.

Experience on Vitimeteo-OiDiag in Southern Germany

W. K. Kast, K. Bleyer 125-128

Abstract: In 2010 and 2011, powdery mildew (P.M.) caused severe problems in a lot of vineyards in Southern Germany. About 200 vineyards planted with susceptible varieties were selected randomly and evaluated for P.M.-disease severity. All growers were carefully questioned on their spray schedules and the used spraying technique. Organic as well as non-organic cultural practices ranging from small to large estate vineries were included. Furthermore a broad range of spraying techniques was used. Using data of the nearest representative Vitimeteo-station, we counted the number of gap-days (gap-days = number of days, for which OiDiag-rules were passed) differentiated for the two OiDiag-Tools tool-1: gap days before first spray, tool-2: sum of gaps starting after the first spray. In 2010, no gaps could be detected for tool-1, yet a highly significant correlation between the numbers of gap-days for tool-2 and P.M. severity was found. In 2011, similar results were found for all varieties except Trollinger (= Vernatsch). We suppose that overseen P.M. in the previous year in the neighbourhood of the small scattered Trollinger vineyards caused these problems. Thus, we propose not to use tool-1 until the problems are cleared up otherwise the complete OiDiag system is endangered. Yet, tool-2 proved to be very helpful for the growers and should be consequently applied in future.

Large-scale application of a web-based Decision Support System for sustainable viticulture

V. Rossi, T. Caffi, S. E. Legler, E. Carotenuto, G. Bigot 129-136

Abstract: A new Decision Support System (DSS), named vite.net[®], was developed for sustainable management of vineyards and is intended for the vineyard manager (the person who makes decisions about the vineyard management or suggests the proper actions to the grape-grower). The DSS has two main parts: (i) an integrated system for real-time monitoring of the vineyard components (air, soil, plants, pests, and diseases); and (ii) a web-based tool that analyses these data by using advanced modelling techniques and then provides up-to-date information for managing the vineyard in the form of alerts and decision supports. The information is tailored to a vineyard, or part of a vineyard, or a number of vineyards that are uniformly managed throughout the season. In the design and development of vite.net[®], the so-called 'problem of implementation' which frequently leads to under-utilization of the DSSs was specifically addressed by different solutions, including involving potential users. Large-scale application of the DSS started in 2013 and was preceded by: i) expert elicitation (to obtain end-user opinion on the usability of the DSS compared to their standard methods and tools to make decisions about vineyard management); ii) plot-scale application (to evaluate the DSS in comparison with the usual practice in different vine-growing areas of Europe); iii) pilot-scale application (to evaluate the DSS use as a part of the decision processes of growers, taking into account the individual attitude of the users towards the Internet and web-based systems, as well as their attitude toward risk). The DSS vite.net[®] has been made commercially available from January 2013 and during the 2013 season it was used by 47 farmers who applied the DSS on more than 3000 hectares of vineyard across Italy, and to 46 advisors. Statistics about the use of the DSS by these growers based on their access to the web portal of vite.net[®] as well as the feedback collected during the regular contacts with the growers suggested that the 'implementation problem' had been solved by the solutions used for development and delivery of the DSS to end-users.

Modelling of powdery mildew spread over a spatially heterogeneous growing grapevine

A. Calonnec, J. B. Burie, M. Langlais, Y. Mammeri 137-148

Abstract: A PDE-ODE model was developed to describe the spread of powdery mildew on grapevine. The model was able to retrieve the main characteristics of the system: 1) a host growing during the whole season with time evolution in susceptibility, 2) a crop highly structured in rows with potential heterogeneities of plant growth and susceptibility within and between plots. These characteristics are modified by cultural management. Simulations were performed to test the effect of grapevine spatial heterogeneities, within and between plots, on the disease spread. Heterogeneities considered were the plant growth (vigour, earliness), susceptibility (susceptible vs resistant, treated vs untreated) and the spatial arrangements (patches vs rows). The main effect on disease reduction was obtained by arrangement in rows of susceptible and fully resistant plants.

Session 2: Vectors of phytoplasmas

Optimized monitoring of host populations of the Bois noir vector, *Hyalesthes obsoletus*, based on flight phenology observations

M. Maixner, J. Johannesen 151-157

Abstract: The flight activity period of *Hyalesthes obsoletus*, the vector of Bois noir, depends on temperature and on the plant host species. Vector populations associated with the host-plant field bindweed emerge in any given year about two weeks ahead of populations associated with stinging nettle, but the beginning of the flight varies among years by about one month in both populations. A cumulative degree-day model was developed for nettle populations and compared to a previously published model for bindweed populations. With both models, the emergence of adult vectors can be predicted with a sufficient precision to aid the timing of weed control and vector sampling. Monitoring of three complete flight periods of a nettle population suggest that the peak and the end of flight activity are also related to cumulative degree-days. Sampling of live animals is most effective during three weeks around peak flight, while sticky traps are useful to describe the complete flight period. The degree-day models and the results of the flight phenologies of *H. obsoletus* are useful for the integrated control of Bois noir as tools for the timing of weed control and the sampling of vectors.

Validation of model generality: Can habitat models of *Hyalesthes obsoletus*, vector of bois noir, transferred in time, space and to a different pest insect, *Scaphoideus titanus*, vector of flavescence dorée?

B. Panassiti, M. Breuer, A. Verpy, R. Biedermann 159-168

Abstract: Besides emerging evidence of new Stolbur phytoplasma vectors, *Hyalesthes obsoletus* is still considered the main vector of bois noir in Baden region, SW-Germany. Recently, habitat models were developed to study the habitat requirements of the planthopper vector. Vectoring the yellow disease flavescence dorée, surprisingly little knowledge is available about the specific habitat requirements of the leafhopper *Scaphoideus titanus*.

In this study, we address the question of how robust and applicable are the developed models, particularly to new invasive species, such as *S. titanus*, which is expected in Baden region in near future. To answer this question, we first transferred *H. obsoletus* models in time. Secondly, we fitted models with biomonitoring data from *S. titanus*; and thirdly, we developed new habitat models for *S. titanus* to compare habitats requirements between the two phytoplasma vectors.

For model validation we used datasets from i) a biomonitoring dataset of *H. obsoletus* with presence/absence records of four different years in Baden region; and ii) data derived from a long-term biomonitoring network of *S. titanus* in the Libourne region, France. Depending on the dataset and the available predictor variables, the habitat model with highest AUC was used for prediction. All statistical models are based on logistic regressions.

Besides variations in discriminatory ability, four *H. obsoletus* models were successfully transferred in time. We found that models including direct variables such as vegetation structure may be more appropriate to predict time-shifted incidences of Auchenorrhyncha species. Visual comparison of spatio-temporal transferred models to *S. titanus* occurrences showed discrepancies in model predictions. Moreover, new developed habitat models for *S. titanus* within the Libourne region including four bioclimatic variables achieved higher model performances in comparison to transferred models.

Results demonstrate the practical use of previously developed habitat models of *H. obsoletus* for current and future pest management in the Baden region. We highlight that *H. obsoletus* models are of limited use to predict *S. titanus* occurrences in the Libourne region. We argue that ecological insights as well as risk maps of the leafhopper are best realized developing new habitat models based on ecologically relevant predictors, a study area covering an ampler range of environmental gradients and simultaneously accounting for previous insecticide sprayings.

Temporal dynamics of *Scaphoideus titanus* populations: from annual occurrence patterns to changing climate suitability assessments

I. E. Rigamonti, M. Jermini, L. Mariani, G. Cola, J. Baumgärtner 169-176

Abstract: A previously published model based on a time-varying distributed delay with attrition is used to simulate, at three different temporal scales (one, five and fifty-two years), the dynamics of the invasive grape leafhopper *Scaphoideus titanus* Ball in vineyards located in Southern and Western Switzerland. The model was parameterized with laboratory and field data. Built on population theory principles and driven by daily temperature maxima and minima and grapevine plant phenology it satisfactorily represents annual and multiannual occupancy patterns and hence, is concluded to have satisfactory predictive and explanatory capabilities. The simulations representing canopy occupancy by non-diapausing eggs, nymphs and emerging adults are particularly useful for tactical purposes including the timing of monitoring operations and insecticide applications. The simulations representing canopy occupancies by diapausing eggs, non-diapausing eggs, nymphs and adults are useful for strategic purposes. Growers and extensionists should be aware that rather stable occupancies are maintained once an area suitable for development is invaded and no management operations are undertaken. The simulations by the validated model representing long term dynamics could be useful for strategic purposes, policy design and research work. Namely, the model produces an index that represents the climate suitability of a region for colonization by *S. titanus*. A temporal coincidence was observed between a climate that lifted the temperatures by about 1 °C shift at the end of the 1980s and an abrupt change of the index at the Locarno-Magadino and Geneva sites. If verified at other locations, the climate suitability may have little changed after the introduction and hence, the colonized areas remained relatively constant. At the end of the 1980s, however, new areas were successfully colonized, presumably as a result of now favorable climate conditions and a sufficient dispersal ability of *S. titanus*. Extensionists and policy makers could take note of a future invasion and prepare growers for dealing with a new pest.

Can differences in feeding behaviour between *Scaphoideus titanus* males and females be related to phytoplasma transmission efficiency?

J. Chucho, D. Thiéry 177-183

Abstract: The leafhopper *Scaphoideus titanus* (Hemiptera: Cicadellidae) is a vector of the phytoplasma causing the Flavescence dorée of grapevine which is one of the most economically threatening disease of European vineyards. In plant disease solely transmitted by insects, pathogen transmission occurs during the feeding behaviour, therefore quantifying the different feeding activities is a key to understand the disease transmission process. Feeding behaviour of piercing-sucking insects can be studied using the electrical penetration graph technique (EPG). This technique has been popularized by Tjallingii in the 1980s and further works especially on aphids. By connecting the insect and the plant in an electrical circuit it is possible to monitor electrical resistance fluctuations during probing. These voltage fluctuations occur in a number of

distinctive patterns called waveforms that have been correlated to different behaviours according to the stylets position into the leaf and to feeding activity (salivation, puncture, ingestion, etc...). We have adapted this technique to *S. titanus* in order to investigate if differences in the feeding behaviour between non infected males and females could explain different ability in phytoplasma transmission. EPG waveforms representing probing activities were obtained from adult *S. titanus* probing in Cabernet Sauvignon cultivar. Three waveforms: salivation, phloem and xylem ingestion were characterized in both sexes by comparing them to previously published ones for other Hemipteran species. The first interesting result is that xylem ingestion occurred in both sexes, while *S. titanus* is always described as a phloem feeder. Interestingly, males exhibited more frequent and longer activity in phloem. The number, mean and total durations of each type of waveform differed significantly depending on the sex. Feeding behaviour differences affect the ability to acquire and then to inoculate phytoplasma and may partly explain the higher rates of transmission of Flavescence dorée phytoplasma that were obtained in the laboratory with males.

Notes on distribution of *Scaphoideus titanus*

and “flavescence dorée” phytoplasmas in Tuscany

E. Gargani, S. Paltrinieri, N. Contaldo, A. Bertaccini, P. Braccini, B. Bagnoli 185-190

Abstract: In the last decade, the monitoring of *Scaphoideus titanus* Ball and of the “flavescence dorée” (FD) phytoplasmas, conducted by the Regional Plant Health Service of Tuscany and some technical and scientific institutions, highlighted a rather broad distribution of the leafhopper, not recorded till now only in the south-western provinces of Livorno and Grosseto, and on the contrary, a presence of FD, at epidemic risk levels, merely in some wine-growing areas of the Massa Carrara and Lucca provinces. In order to deepen the knowledge on Auchenorrhyncha fauna associated with grapevine yellows in Tuscany, surveys were conducted in several vineyards of the “Chianti Classico” area in the years 2007-2012. In 45 vineyards located in the territories of Castellina in Chianti, Radda in Chianti e Castelnuovo Berardenga (Siena), one to three monitoring stations, characterized by agronomic and cultural parameters, were set up with yellow sticky traps exposed from the second half of June to the middle of September. During 2009-2012 a similar survey was conducted in 31 wine farms located at Panzano, Greve in Chianti (Florence). The surveys pointed out an increasing trend in *S. titanus* population density in the monitored areas, despite the mandatory treatments against the leafhopper. The percentage of positive records in the Senese area increased progressively from 25% in 2007 to settle at around 60% in 2009-2012; in the Florentine districts stations involved in captures moved from 95.78% in 2009 to 98.97% in 2012. The distribution of *S. titanus* seemed mainly influenced by microclimatic factors and the origin of the propagation materials confirming previous findings. This increasing trend of the cicadellid spread to date has not been followed by an increasing presence of FD. In 2012-2013 other surveys were carried out in a wine growing area of Massa Carrara province, involved in FD infections in 2009, in order to clarify epidemiological aspects of grapevine yellow diseases. This agroecosystem was characterized by agronomical and environmental parameters and intensively sampled. Surveys, including the assessment of the Auchenorrhyncha vectors of grapevine yellows, are still in progress. Molecular studies have revealed that in the face of a fairly limited population of *S. titanus*, a very high percentage of plants are infected by FD. Molecular characterization on the 16Sr gene of FD strains obtained from 2009 and 2012 samples, showed that all belonged to FD-C. However the RFLP characterization on the SecY gene highlighted a polymorphism typically reported in FD-D. This finding shows the possibility to early identify the appearance of new FD strains and allows to manage FD in time.

Dictyophara europaea an alternative host of Flavescence dorée in Switzerland?

C. Linder, M. Cavadini 191-194

Abstract: *Dictyophara europaea* has been recently considered as an alternative host of Flavescence dorée, an important grapevine phytoplasma. Unlike *Scaphoideus titanus*, known so far as the unique vector of Flavescence dorée, its distribution and abundance in Switzerland, as well as its contamination level are unknown. A survey conducted in western and southern Switzerland in 2011 and 2012 using sweep nets, yellow sticky traps and a D-vac vacuum insect

collector showed that *D. europaea* is widespread and common in xerothermic as well as dry ruderal sites close to viticultural areas. However, no insect could be captured inside of vineyards. Moreover, PCR analyses confirmed that none of the 248 individuals tested was harbouring Flavescence dorée isolates. Thus, it is concluded that *D. europaea* is not a major vector of Flavescence dorée in Swiss vineyards and does not, therefore, represent a major threat to Swiss grapevine production.

Session 3: Biology and population dynamics of insects and moths

Temporal differences in *Lobesia botrana*'s lifecycle at local scale, the example of the Saint Emilion vineyard

A. Verpy, F. Gil, S. Mary, L. Delbac, D. Thiéry 197-204

Abstract: The temporal differences in *Lobesia botrana* lifecycle were studied at the local scale of the Saint Emilion vineyard during the spring generation. Comparisons between sites are based on trap catches during the emergence flight thanks to a 230 classical sticky delta trap network and on head capsule width determination of the first generation larvae. 56 temperature sensors were placed next to sticky traps to explore the link between temperature and start of the emergence flight. Results demonstrated the existence of clear temporal variation in 2013, with a time lag of 34 days between extreme values at the start of the first flight. This trend was also spatially defined; its distribution being modeled by kriging. Head capsule width measures confirm the existence of temporal differences in the phenology of *L. botrana* in this vineyard. Although defined by a temporal pattern, the flight onset did not occur at the same degree-days between sites. This result requires further investigation but highlights the difficulty to extend modeling result obtained on a precise location to a wider scale. It permits to improve winegrower practices by scheduling insecticide spraying with better precision.

Effects of rearing host species and oviposition experience on host preference of *Leptomastix dactylopii* (Hymenoptera: Encyrtidae)

P. M. Marras, A. Cocco, A. Mura, E. Muscas, T. Nuvoli, A. Lentini 205-210

Abstract: The koinobiont endoparasitoid *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae) has been widely used as a biological control agent of the citrus mealybug, *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae), in citrus orchards and ornamental greenhouses. Previous studies showed that the vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae), is a suitable host for the parasitoid to complete its development. In the current experiment, the preference of *L. dactylopii* for the two hosts was investigated in a two-choice test. Newly-emerged parasitoid females, reared on one of the two mealybug species, were mated and exposed to third-instar nymphs and young adult females of both *P. ficus* and *P. citri* in an experimental arena. In order to investigate the influence of a previous oviposition experience on the host preference, the experimental wasps were naïve (inexperienced) or had oviposition experience with one of the two hosts before the release in the test arena. The foraging behavior of female wasps was observed for 30 minutes. *Leptomastix dactylopii* females reared on *P. ficus* showed a strong preference for vine mealybugs, irrespective of the oviposition experience, while those reared on *P. citri* did not show a clear preference. The oviposition experience before the two-choice test did not affect the percentage of *P. ficus* encountered and examined by parasitoids; on the other hand, *L. dactylopii* females experienced on *P. ficus* probed and laid eggs preferentially on vine mealybugs. During the test, *L. dactylopii* females were observed feeding on mealybug fluids exuding from oviposition wounds (host-feeding), although rearing host species and oviposition experience did not affect the wasp behavior. Further experiments on host-parasitoid interactions under field conditions are being developed in order to verify the effectiveness of *L. dactylopii* in controlling *P. ficus* infestations in vineyard agroecosystems.

The importance of *Drosophila suzukii* for grapevine production

P. Kehrl, P. Richoz, C. Linder, C. Baroffio 211-218

Abstract: The spotted-wing drosophila, *Drosophila suzukii*, is a vinegar fly native to Asia that has recently been introduced to Europe. Unlike most other drosophilids, *D. suzukii* females lay their eggs thanks to their serrated ovipositor in healthy fruits. Besides berries and stone fruits, table and wine grapevine production might also be at risk, since the pests' development in grapes has been reported. The economic importance of *D. suzukii* for grape production is, however, still unclear and debated. By an electronic questionnaire we assessed in the framework of Euphresco the threat that *D. suzukii* poses to European vineyards in 2012. We received 22 responses from 14 different vineyards that covered about 10% of Europe's viticultural area. At eight locations the population of drosophilids consisted of an assemblage of *D. suzukii* and native species with *D. suzukii* nowhere dominating the community of drosophilids. Although *D. suzukii* was present, it did not cause any major damages to table and wine grapes in 2012. Its management was based on sanitation measures and winegrowers renounced almost completely from the use of insecticides. Most respondents scored the potential of *D. suzukii* as an important viticultural pest therefore as low to medium. This is in contrast with respondents' assessment of the situation in other late-maturing crops such as raspberry, blackberry and blueberry. At present *D. suzukii* is therefore considered as a minor pest of table and wine grapes in Europe. Yet, time will tell if this first assessment of the general situation was accurate or if this new pest will nevertheless be able to cause occasionally major damages in grapevine production.

Susceptibility of various grape cultivars to *Drosophila suzukii* and other vinegar flies

C. Linder, C. Martin, S. Laboisse, P. G. Chatelain, P. Kehrl 219-224

Abstract: In 2011, the spotted-wing drosophila *Drosophila suzukii* native to Asia has been identified for the first time in Switzerland. Since then, this vinegar fly has established itself all over the country and it has also been observed in many vineyards. It has been reported that *D. suzukii* is able with its long, sharp, serrated ovipositor to attack healthy grapes just before harvest and that the level of infestation depends on the grape cultivar. It is assumed that in particular red and thin-skinned cultivars are of higher susceptibility. Our laboratory studies confirmed that *D. suzukii* was able to lay eggs within grape berries. However, almost none of the eggs laid at the beginning of grape ripening allowed the development of adults. In subsequent tests, oviposition was highest on the red and thin-skinned cultivars Bondonetta and Gamay followed by the red cultivars Pinot Noir and Divico, and the two white cultivars Müller-Thurgau and Chasselas. Yet, the development of adults remained very low and did not exceed 9% of eggs deposited, which is considerably less than on an artificial diet. These results, as well as field observations, confirm the lesser attractiveness of white compared to red grape cultivars and the importance of the thickness of the skin. Moreover, observations in the field and preliminary laboratory experiments indicate that grape infestation by *D. suzukii* does neither considerably favor the development of other Drosophilidae nor rot diseases within grapes. Overall, our various observations confirm that grapes can be damaged by *D. suzukii*, but they are probably not very suitable for larval development and the buildup of large pest populations. Nonetheless, it cannot definitely be excluded that *D. suzukii* favors the infestation of grapes by native vinegar flies and pathogens and its development in vineyards should therefore be followed carefully.

The effect of *Drosophila suzukii* attack during grape drying process in Veneto Region (north-eastern Italy)

N. Mori, S. Vincenzi, E. Marchesini, A. Curioni, C. Duso 225-228

Abstract: The presence and harmfulness of *Drosophila suzukii* (Matsumura) on grapes was noticed in Veneto Region (north-eastern Italy). For red wines obtained using dried grapes, the damage caused by *D. suzukii* can be intense due to the possible increase in pathogen infections during the withering process. In order to evaluate the effects of *D. suzukii* infestation during the withering process, two autochthonous varieties, i.e. Rondinella and Corvina, used for the production of the well-renowned Amarone and Recioto wines, were considered. Berries showed a

natural weight loss during withering, but a further decrease was observed in damaged grapes, which was positively correlated with the intensity of the Drosophilidae attack. Moreover, *D. suzukii* infestation influenced the acetic acid bacteria and *Botrytis cinerea* development. In Rondinella a high acetic acid production and a putative development of *B. cinerea* in the “noble rot” was observed. In Corvina the lower amount of fungal metabolites suggested a development of sour rot instead of *B. cinerea*. Implications for *D. suzukii* management in the storage house during the drying process is discussed.

Drosophila suzukii (Matsumura) a new pest of grape in Veneto Region (north-east Italy)

E. Marchesini, N. Mori, F. Aldrighetti 229-232

Abstract: The vinegar fly *Drosophila suzukii* (Matsumura) (Diptera Drosophilidae), spotted wing drosophila (SWD), is a highly polyphagous invasive pest endemic to Southeast Asia, which has recently invaded Italian regions. Serious economic losses were reported on soft fruits; furthermore damage was expected in late-maturing crops, such as grapevines, which are not protected by insecticides. For this reason the presence, ecology and harmfulness of *D. suzukii* was monitored in a grape growing area where late-ripening red grape varieties are cultivated (Verona district, Veneto Region). SWD adults were captured in all investigated vineyards, the larger populations were observed in higher hill sites compared with foothills and plain. The adult presence in the vineyards is influenced by the existence of other SWD host plants both cultivated or wild, on the areas surrounding vineyards, especially cherries: infested fruits left on the trees after harvest constituted a source of re-infestation. The larvae infestations occurred only in high hill sites on grapes ripening for the late vintage. At harvest, more than 60% of bunches were infested, with 1-2 infested berries per bunch on the autochthonous varieties Rondinella and Corvina, while on the international varieties Merlot and Cabernet sauvignon less than 30% of bunches were infested, with 0.5 infested berries per bunch. Implications for *D. suzukii* control on grape are discussed.

Response of vine mealybug populations to cover crop management in vineyards

A. Cocco, A. Lentini, A. Mura, E. Muscas, T. Nuvoli, G. Serra, G. Delrio 233-236

Abstract: The influence of different ground cover management systems on the development of the vine mealybug, *Planococcus ficus* Signoret (Hemiptera: Pseudococcidae), was evaluated in a commercial vineyard (cv. Carignano) in north-western Sardinia within an ongoing multi-year project. In this paper, preliminary results of the first year of observations are reported. The field trial was arranged in a randomized block design, comparing traditional tillage and three different cover crops: natural self-regenerating (legume-grass mixture), grass (*Dactylis glomerata* L.) and legume (*Trifolium yanninicum* Katzn. & Morley). In each treatment, some life parameters of the vine mealybug (survival, development time from egg to ovipositing female and fecundity) and the nitrogen content of grapevines, measured by a SPAD meter, were recorded. The ground cover management systems affected the vegetative growth of grapevines. In fact, the SPAD values were significantly higher on tillage and legume cover crop, while grass and self-regenerating soil covers negatively affected the nitrogen concentration on grape leaves. The mealybug development was significantly longer in the self-reseeding ground cover plots, while survival and female fecundity did not vary significantly among treatments. The results obtained in the first year are not conclusive, because differences in grapevine physiology due to soil management strategies increase in the long-time period, thereby modifications in *P. ficus* life parameters could become clearer in the next years.

Grape phylloxera infestation rate in Switzerland

J. Fahrretrapp, L. Müller, P. Schumacher 237-239

Abstract: Grape phylloxera (*Dactulosphaira vitifoliae*) was introduced into Europe from North America. Swiss viticulture had nearly broken down due to phylloxera outbreak and different grape diseases in the late 19th and early 20th century. The pest was controlled successfully by grafting scions of *Vitis vinifera* grape cultivars on American rootstocks. Today, many producers

report on newly occurring leaf infestation in hybrid vines but also in European grapevines. We investigated the distribution of grape phylloxera in Swiss vineyards by collecting infested leaves and catching individuals with emergence traps. *D. vitifoliae* was found in most grape growing regions.

Ladybirds in Tuscan vineyards (Coleoptera: Coccinellidae)

R. Canovai, A. Loni, L. Gandini, A. Lucchi 241-244

Abstract: Ladybird (Coccinellidae) populations of three vineyards located in the Province of Pisa (Italy) were investigated in 2012 using Malaise traps. A total of 4,057 ladybirds were collected and 38 species identified, 24 of which were present everywhere. Most of the specimens were aphidophagous (almost 80%), 8.50% coccidophagous, 8.11% mycophagous, 2.86% acarophagous and 0.12% aleurodophagous. Each vineyard was characterized by a quite different ladybird population as regards the list of the collected species as well as their numbers.

Aphidophagous insects in differently managed vineyards

A. Loni, R. Canovai, L. Gandini, A. Lucchi 245-248

Abstract: In this study we investigated the communities of three taxa feeding on Aphids (Diptera: Syrphidae, Coleoptera: Coccinellidae and Braconidae: Aphidiinae) in three vineyards, differently managed with regard to the grapevine moth control. Vineyards are classified as MD (Mating Disruption vineyard), O (Organic vineyard) and C (Conventional vineyard). Captures were carried out with two Malaise traps per vineyard from May to September 2012. The vegetation (trees, shrubs and herbs) growing around the traps was recorded along the whole growing season. From the data analysis it is possible to infer that the populations tend to spread in the environment (in space and time) in a manner which is consistent with the trophic resources available. Syrphidae and Coccinellidae resulted in the most abundant groups, each one with over than 4,000 specimens captured. Syrphidae and Braconidae: Aphidiinae were mainly present in the first part of the grape production season, Coccinellidae for all season long. Populations of Braconidae: Aphidiinae and Syrphidae benefit of the herbaceous layers surrounding the trap sites. Coccinellidae occurrence seems linked to the presence of bushes.