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## **Working Group “Integrated Protection and Production in Viticulture”. Proceedings of the Meeting at Staufen im Breisgau (Germany), 01 – 04 November, 2009**

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### Session 1: Integrated pest management and host-pathogen-interactions

#### Distribution and host plant preferences of *Hyalesthes obsoletus*, the vector of bois noir disease, in Switzerland

*P. Kehrl, S. Kessler, S. Schaerer, N. Delabays* ..... 3-8

**Abstract:** In Europe, the polyphagous planthopper *Hyalesthes obsoletus* Signoret (Hemiptera, Cixiidae) is assumed to be the most important vector of the grapevine yellows disease bois noir, which is caused by phytoplasmas of the stolbur 16Sr-XII-A group. For a better understanding of the epidemiology of bois noir in Switzerland, distribution and host plant preferences of *H. obsoletus* were studied in the field as well as in the laboratory. A national survey revealed that *H. obsoletus* is present in vineyards of southern, western and northern Switzerland; however, no specimens were caught in the east of Switzerland, where evidence for the disease is lacking. Even though field bindweed (*Convolvulus arvensis* L.) was much more abundant in vineyards than stinging nettle (*Urtica dioica* L.), *H. obsoletus* adults were captured almost exclusively on the latter. A second, more targeted field study confirmed *H. obsoletus*' clear preference for *U. dioica*. From June to September 2008, adults of *H. obsoletus* were primarily captured on *U. dioica*. However, few individuals were also caught on *C. arvensis*, hedge bindweed (*Calystegia sepium* L.) and four other dicotyledons. Emergence traps set up above *U. dioica* and *C. arvensis* highlighted that significantly more nymphs emerged from stinging nettle than field bindweed. Besides, a clear association between the distribution of *U. dioica* patches and the incidences of bois noir infected vines could be observed in a commercial vineyard. In conclusion, there is good evidence that *H. obsoletus* is also the most important insect vector of bois noir in Switzerland and that the insect prefers to feed and develop on *U. dioica*. Stinging nettle therefore plays a major role in the epidemiology of bois noir in Swiss vineyards.

#### Adult monitoring improves control of the flavescence dorée leafhopper

*Scaphoideus titanus* in Gironde (France) while using less pesticide!

*M. van Helden, E. Fulchin, A. Verpy, F. Gil, C. Garcia* ..... 9-16

**Abstract:** The flavescence dorée is caused by a phytoplasme spread by the leafhopper *Scaphoideus titanus* and is present in the south of France. Leafhopper control is based on up to 3 obligatory insecticide sprayings (T1; T2; T3) using neurotoxic insecticide compounds over large areas (Imposed Sprayed Area = ISA). Spraying dates are defined according to the observation of the first larvae (T0) at T1= T0+4 weeks, T2 = T0+6 weeks (T1 and T2 aim the larvae) and T3 = T0+10 weeks (aiming at adults). Such schedules and area definition are very efficient but lack scientific basis on insect dynamics and migration and encounter opposition from farmers.

Over the last 5 years progress was made to reduce pesticide use while maintaining sufficient vector control. A project was launched in the Saint Emilion region after two plots were found contaminated in 2006. 13000ha of vineyards entered the ISA. Farmers and regional Plant protection service organised into a small association to test a more 'integrated' approach for vector control.

Spraying zones were limited to a buffer zone of 2 Km around the contaminated plots. Farmers between 500m and 2 Km were allowed to reduce sprayings to only 1 single application at T0 + 5, while adult trapping was used to monitor overall results. Traps were yellow delta traps (Piège Tri-Δnglué) that are highly efficient. In most of this zone a single insecticide spray reduced trap catches to almost nonexistent, considered as a proof of sufficient control of the vector. In some areas trap catches were considered too important (>3 adults on a single trap in a single week) and a second spraying (T3) was imposed. This was probably due to some farmers either not spraying at all or organic farmers that only were allowed Rotenone, that is rather inefficient. This approach was repeated in 2008.

Total cost of trapping and monitoring of larvae (traps, technicians, monitoring) is around 3 to 4 Euros per ha. These costs were largely compensated by the reduction in spraying (64 and 72 percent reduction in 2007 and 2008 compared to the traditional approach). Moreover, the combination of reduced spraying and vector monitoring seemed well accepted by the farmers.

In addition all plots were monitored for plants showing symptoms of phytoplasma, around 1200 samples were analyzed first year. Over 80% of the samples appeared to be 'Bois Noir' phytoplasma but some Flavescence Dorée samples were found in both 2007 (2 samples) and 2008 (6 samples). Scouting and analysis costs were around 25 Euro per ha.

In other areas where spraying frequency was reduced simultaneously but without vector monitoring, a strong increase in FD symptoms was observed, together with high insect populations. This probably reveals that many farmers do not apply the single imposed spraying. The trapping seems a useful tool both to show efficient vector control and to incite farmers to respect the minimal spraying frequency.

#### Effectiveness of hot water treatments against the eggs of *Scaphoideus titanus* Ball

*C. Linder, L. Schaub, F. Klötzli-Estermann* ..... 17-20

**Abstract:** The leafhopper *Scaphoideus titanus* (Hemiptera: Cicadellidae) is the principal vector of flavescence dorée, a severe grapevine disease spreading in Europe. The project PROPSAPH united four European research institutes in order to improve risk management schemes against the spread of flavescence dorée's vector on propagation material. Amongst others, the impact of the standard hot water treatment against the disease on the development of the *S. titanus* eggs was studied. In autumn 2008, one-year-old and two-year-old cuttings were collected in *S. titanus* infested vineyards in France, Italy and Switzerland and sent to our institute. After storage in a cold chamber until March 2009, half of the cuttings were exposed for 45 minutes to a hot water treatment at 50°C. Thereafter, treated and untreated cuttings were placed in cages and the hatching of *S. titanus* nymphs was assessed. At least 10-times more nymphs hatched from two-year-old cuttings than from the one-year-old cuttings. This confirmed the ability of *S. titanus* to lay eggs on propagation material. However, hot water treatments significantly reduced the number of hatched nymphs, e.g. the exposure to hot water killed about 80% of deposited eggs. In conclusion, hot water treatments do not only have a major impact on flavescence dorée, they also kill most of its vector's eggs. Thus, the hot water treatment of rootstocks and scions before grafting is strongly recommended in order to reduce the risk of *S. titanus*' propagation. Before commercialisation grafts should be hot-water treated once again, since the chemical protection of rootlings is not always 100% effective in the nursery fields. All these measures together will ensure the propagation of plant material free of flavescence dorée and they will minimise the risk of disease's and vector's spread.

#### Downy, powdery mildew and botrytis risk assessment by climate parameters, pest and spores monitoring in Rioja Alavesa vineyard (Northwest of Spain)

*A.-M. Díez-Navajas, A. Ortiz-Barredo* ..... 21-29

**Abstract:** The integrated production Regulation for grapevine in the Basque Country was published in 2004 (BOPV 221/2004, official bulletin). A previous 3-year study was carried out to evaluate the real situation of growers to assume this regulation in their exploitations. Several deficiencies were reported, including technical and management aspects. This work is focused in Rioja Alavesa, an area with 12,869ha of vineyard in the Northwest of Spain producing

81,325,000 wine grape kilo. Integrated disease control interest is rising, although the number of fungicides applications in the last two years against downy mildew and other fungal diseases reached up to 12 treatments, being usual 5 or 6 per season. These data prompted us to implement the strategy of fungal disease control. We installed 12 monitoring weather stations in different trials, according to different environment and geographical characteristics. The stations were equipped with sensors of temperature, relative humidity, leaf wetness, soil temperature, radiation sensors, rain gauge, and an anemometer. Registered data can be discharged and recuperated from internet, at the same time that the risk assessment for downy and powdery mildew and botrytis diseases. In parallel, one sticky glass trap to capture spores by impact was installed near each station and two more traps in each field. Pheromone traps to capture *Lobesia botrana* were also distributed in the fields close to the spore traps, as the abundance of this insect gives an idea of the possible future botrytis damages and spread. After these assays we would be able to validate the stations for each studied zone and assure that the risk assessment made by climate parameters follows a real model, taking into account the disease incidence in the field as well as the spore and vector populations.

**Biological control of *Heliococcus bohemicus* Sulc. (Hemiptera: Pseudococcidae) with the natural enemy *Ericydnus sipylus* (Walker) (Hymenoptera: Encyrtidae) G. Sentenac, P. Kuntzmann, L. Perez, A. Gili, P. Kreiter ..... 31-40**

**Abstract:** The control of mealybugs by growers currently relies on the use of neurotoxic insecticides. The possible use of the predator *Chrysoperla lucasina* (Lacroix) is the unique alternative method. We propose to evaluate the biological activity *in situ* of the bred *Ericydnus sipylus* (Walker), major parasitoid of *Heliococcus bohemicus* Sulc. The releases of parasitoids were carried out in 2007 and 2008.

During the 2007 season, the first three releases of *E. sipylus* did not appear to have any effect on the population of mealybugs. However the fourth and fifth release made later in the season did show significant differences between the experimental plots. The biological control showed positive results in 2008 and 2009, as the number of *H. bohemicus* in the “release” blocks was significantly lower than those of the “control” blocks. A reduction of 50 to 60% of the number of *H. bohemicus* was found for the 2007 winter generation and from 75 to 85% for the 2008 summer generation. Despite of stopping the release of *E. sipylus* rates of 80% were found in the 2008 winter generation, and 80% in early 2009 summer generation.

If the difference of the population of *Pseudococcidae* between the experimental plots was due to the introduction of the parasitoid *E. sipylus*, the lower level of the population found in summer 2008 and 2009 in the “control” blocks was probably due to: a) the presence of other parasitoids like *Anagyrus szodensis* or predators like *Exochomus quadripustulatus* (Linné), *Hippodamia variegata* Goeze, *Harmonia axyridis* (Pallas), *Coccinella septempunctata* Linné, *Nephus quadrimaculatus* (Herbst) and *Chrysoperla carnea* (Stephens) b) the dispersion and activity of *E. sipylus* beyond the plots where it was introduced.

**Experiences about the effect of growth regulators on cluster structure and fruit rot diseases of the vine varieties Pinot Meunier, Pinot Blanc, Pinot Noir and Rhine-Riesling K. Bleyer and W. K. Kast ..... 41-47**

**Abstract:** In field trials, effects of the growth regulators Gibb 3 and Regalis® on cluster structure of grapes and the reduction of botrytis disease and sour rot disease were evaluated. Gibb 3 can only be used on Pinot-varieties. Regalis® also can be used on Rhine-Riesling. The growth regulators Gibb 3 and Regalis® were very effective in loosening the cluster structure at Pinot-varieties. Reduction of botrytis disease was compared to fungicide treatments. In most cases, the yield of grapes decreased without an increase of the sugar content. Results of Regalis® on Rhine-Riesling varied greatly without relevant reasons. No differences were found when Regalis® was applied with different amount of water and at different development stages. Gibb3 proved to have a better effect if applied with greater amounts of water. The quality of red wines increases

because of higher anthocyan- and phenol-contents. White wines produced from grapes treated with Regalis® didn't show better tasting results in spite of lower yield.

#### Control of grey mould by application of gibberellin acid inhibitor (Regalis®) and management practices in *Vitis vinifera* (cv. Riesling)

O. Baus, A. Reineke, and B. Berkelmann-Löhnertz ..... 49-53

**Abstract:** Grapevine varieties with tight clusters are extremely susceptible to infection by grey mould (*Botrytis cinerea*). Severe pathogen attack leads to reduced yield and affects wine quality. A couple of management practices can reduce tightness of berry clusters, among them moderate defoliation and the use of plant growth regulators. Prohexadione-Calcium (trademark Regalis®) is a gibberellin acid biosynthesis inhibitor with low toxicity and persistence in the plant. Over a period of three consecutive years the effect of prohexadione-Ca on grape cluster architecture was tested in cv. Riesling and combined with anti-*Botrytis* fungicide applications and leaf removal measures. While prohexadione-Ca treatments significantly increased the flexibility of grape clusters in 2007, no significant effects were evident in 2008 and 2009. However, even a minor reduction of index values of 0.2 – 0.3 may have an influence on the tightness of clusters and thus on the susceptibility to *B. cinerea* infections. In all three years severity of *B. cinerea* was significantly reduced in Riesling grapes when the following measures were combined: application of Regalis®, fungicide treatments and moderate defoliation. Therefore, future strategies to control grey mould should aim at a combination of different management strategies.

#### Variety-dependent responses of seeded vine cultivars to different growth regulators

S. Böll, T. Lange, H. Hofmann, P. Schwappach ..... 55-61

**Abstract:** GA-levels and turnover rates during early berry development were much higher and longer lasting in developing berries of Pinot gris compared to Sylvaner and were negatively related to their sensitivity to exogenous applied GA<sub>3</sub>. Anthers and pollen are known to be major sources of endogenous GAs during prebloom, and as such a higher pollen tube abundance could be responsible for higher endogenous GA levels during early berry development. Pinot gris and Sylvaner showed the expected differences in pollen tube abundance that corresponded to the observed endogenous GA levels. Furthermore, pollen tube analyses of a broad spectrum of additional cultivars with known GA-sensitivity support the hypothesis, displaying a broad range of pollen tube abundance that correlates negatively with the known sensitivity of the cultivars to GA<sub>3</sub> applications.

The observed variety-specific pollen tube abundance seems to lead to differential developmental patterns: postbloom, Pinot gris had no unfertilized ovaries while in Sylvaner up to 35% of the ovaries were unfertilized. Furthermore, there were variety-specific differences in the degeneration of ovules: Pinot gris had on average 3-4 fertilized ovules per ovary while Sylvaner only had 1-2 fertilized ovules per ovary. However, during further berry development endosperm development was aborted in about half of the ovules in Pinot gris, while in Sylvaner all fertilized ovules developed into seeds. Also in shattered berries the percentage of unfertilized ovaries was much higher in Sylvaner than in Pinot gris. Altogether, variety-dependent effects were much stronger than treatment effects.

The results imply that a simple microscopic pollen tube analysis of varieties with hitherto unknown gibberellin sensitivity might predict the sensitivity to exogenous GA<sub>3</sub>-treatment including possible adverse side effects.

#### Monitoring nematode populations to adapt fallow periods against

*Xiphinema* vectors of Grapevine fanleaf virus (GFLV)

M. van Helden, L. Villate, C. Laveau, E. Morin, G. Darrieutort, C. van Leeuwen ..... 63-67

**Abstract:** The nematode *Xiphinema index* is, economically, the major virus vector in viticulture, transmitting specifically the Grapevine fanleaf virus (GFLV), the most severe grapevine virus disease worldwide. A second virus (ArMV) and its vector (*X. diversicaudatum*) do exist in the Bordeaux region but seem of lower importance. Plots that have become completely infected, no longer providing sufficient yield or quality, have to be uprooted to be replaced by new healthy plants.

Increased knowledge of the spatial distribution of this nematode, both horizontally and vertically, and of correlative GFLV plant infections, is essential for efficient control of the disease. Vertical distribution data showed that the highest numbers of individuals occurred at 40 to 110cm depth, corresponding to the layers where the highest densities of fine roots were observed. Horizontal distribution revealed a significant aggregative pattern with patches of 6 to 8m diameter, together with a significant neighbourhood structure of nematode densities, thus identifying the relevant sampling scale to describe the nematode distribution. Nematode patches often, but not always, correlate significantly with those of GFLV-infected grapevine plants. The nematodes are able to survive in the soil even without food for several years. Since nematodes live deep in the soil, they cannot be attained by nematicides (that are, anyway, progressively forbidden). Because of this lack of efficient control measures of the vector, a fallow period of 7 years is advised to farmers but rarely observed for economic reasons. In some cases, high re-infestation levels have occurred with short fallow periods but this does not always occur.

Sampling of numerous plots in the Bordeaux region, uprooted because of virus infestations, showed that nematode numbers are unpredictable. No clear relation was found between the percentage of each virus and the population of its vector. *X. diversicaudatum* was rarely present in significant amounts, even though infestation percentage of plants with ArMV could be high. *X. index* was sometimes present in high numbers (up to 300 per litre of soil) in some samples but mostly numbers were quite low or nematodes even not detected. These results suggest that the fallow period can be adapted following nematode sampling. In the case of very low nematode numbers it could be reduced to 1.5 to 3 years whereas longer periods need to be observed when high numbers are found. Nematode sampling grid should be rather dense, and sampling should ideally be done twice, just after uprooting and before replanting. The use of ‘nematicidal’ antagonistic plants against *X. index* is currently being investigated in our lab.

#### "VitiMeteo" – a future-oriented forecasting system for viticulture

*G. Bleyer, H.-H. Kassemeyer, M. Breuer, R. Krause, O. Viret, P.-H. Dubuis, A.-L. Fabre, B. Bloesch, W. Siegfried, A. Naef, M. Huber* ..... 69-77

**Abstract:** Disease management has been greatly improved with the new technologies of the Internet. Current information and forecasting systems have not only a positive ecological, but an economical one for wine growers as well. Now, it is possible to access the "VitiMeteo" forecasting system free twice a day on the Internet ([www.vitimeteo.de](http://www.vitimeteo.de)). The first "VitiMeteo" module created was "VitiMeteo Plasmopara". The core of this system is found in the database "Agrometeo", where all the data from different weather stations are stored. The purpose of "Agrometeo" is to integrate weather data into various other software models. The next component is "VitiMeteo Growth" which was programmed in cooperation with Hans-Reiner Schultz from the Geisenheim Research Center. More software followed, such as "VitiMeteo Insects", "VitiMeteo Oidium" and "VitiMeteo Data Graph". "VitiMeteo Insects" is a programme that simulates the development of insects and other pests. Walter Kast, from the State Institute for Viticulture, Oenology and Fruit Technology Weinsberg, was able to create an algorithm based on "OiDiag-2.2", which calculates which dates the spraying against powdery mildew (*Erysiphe necator*) should begin and the time increments between each spray. Weather data are controlled and presented with "VitiMeteo Data Graph". The VitiMeteo-system is a cooperative project between the State Institute of Viticulture and Enology, Freiburg (Germany), the Swiss Research Station ACW, Changins-Wädenswil (Switzerland), and the company GEOsens, Ebringen (Germany). The company Meteoblue (Basel, Switzerland) has provided weather forecasts, which have been integrated with our software modules since 2009. This is the first time that an actual forecast of biological processes e.g. incubation period or growth was possible. The requirements of the "VitiMeteo" forecasting system can be entered quickly, making it an extremely flexible system.

The expert system OiDiag-2.2 – a useful tool for the precise scheduling of sprays against powdery mildew of vine (*Erysiphe necator* Schwein.)  
*W. K. Kast and K. Bleyer* ..... 79-84

**Abstract:** OiDiag-2.2 is a system of two tools. The first one helps the vine growers to find the date for the start of the sprays against powdery mildew (*Erysiphe necator*). The second tool calculates an index value considering the climatical and ontogenic inputs for the risk of powdery mildew attack. Vine growers should get a table of relevant fungicides with values for the maximal time lag after the spray, which is completely covered by these fungicides considering these index values.

[www.agrometeo.ch](http://www.agrometeo.ch): an interactive platform for a better management of grapevine diseases and pests  
*O. Viret, P.-H. Dubuis, A.-L. Fabre, B. Bloesch, W. Siegfried, A. Naef, M. Hubert, G. Bleyer, H.-H. Kassemeyer, M. Breuer, R. Krause* ..... 85-91

**Abstract:** To control the main fungal diseases in accordance with the epidemiological development of the fungi in viticulture, the use of forecasting systems is one of the major progresses. Agrometeo is an interactive platform ([www.agrometeo.ch](http://www.agrometeo.ch)) and a general tool for agriculture, including actual and historical weather data, modules for field crops, grapevine and fruit orchards. The grapevine module contains forecasting for downy mildew and grape berry moths; leaf area adapted spraying, growth development model, pesticides index, and descriptions of the main diseases and pests. The forecasting modules use data from a weather station network covering the whole viticulture area of Switzerland. Grapevine downy mildew forecasting is done with Vitimeteo, a new expert-system for the forecast of grapevine downy mildew, designed by the research institute of Freiburg (Germany), Agroscope ACW and the company GEOsens. The software generates graphics and tables freely available for the growers on the Internet. Leaf area adapted spraying was developed in analogy to the tree row volume concept on fruit orchards. The experiments show a reduction of about 20 to 30% of the use of pesticides by calculating the precise dose needed for a given leaf area. The module in [www.agrometeo.ch](http://www.agrometeo.ch) allows a ready to use solution for the calculation of the amount of plant protection products based on the width and height of the leaf canopy and the row distance, depending on the registered amount indicated on the package. The number of Agrometeo users is in expansion confirming the grower's interest.

Modelling and experimenting crop protection decision workflows: some lessons from GrapeMilDeWS research  
*O. Naud, P. Cartolaro, L. Delière, B. Léger* ..... 93-100

**Abstract:** The political roadmap about pesticides in France is to reduce quantities by 2, “if possible”, before 2018. Research is needed to design and evaluate new pest management solutions. A decision workflow system, name GrapemilDeWS was designed, at the plot scale, to handle grapevine powdery and downy mildews. GrapeMilDeWS stipulates throughout the season if and when fungicide sprayings should take place. GrapeMilDeWS has been experimented on a network of plots in different French wine regions. We give some results about the number of sprayings generated by GrapeMilDeWS and the crop protection performance obtained. We discuss methodological aspects such as partnership and data required to test and check such decision system.

## Session 2: Biology and epidemiology of pathogens, fungal, bacterial and physiological diseases, including grapevine trunk disease

### Impact des données météo de précision sur l'évaluation locale du risque épidémique modelisé sur le vignoble.

Premiers résultats de validation spatiale des orages de grêle de mai 2009 sur les vignobles de Bordeaux et Cognac

*M. Raynal, C. Debord, S. Guittard, M. Vergnes, J. Congnard, D. Grimal* ..... 103-110

**Résumé:** Les orages de grêle très marqués de ce printemps 2009, nous ont permis de tester sur le terrain, les outils de validation spatiale des données météo pluviométrique à maille fine (1x1km). Ces premiers tests, effectués sur la grêle à défaut de pouvoir les cibler sur des foyers de développement maladie, révèlent la pertinence de ce travail d'enquête dans la mesure où ils peuvent porter sur des phénomènes de type accidentel, ou fortement localisés.

La plate forme de saisie Web, incitant les techniciens et viticulteurs, à partager leurs observations nous a également donné satisfaction car elle a fait l'objet d'un accueil favorable auprès de la profession.

Du point de vue du zonage de la grêle, on retient que l'information radar permet de définir le caractère grêlés ou indemne d'une parcelle avec un taux réussite proche de 75%. Le radar ne permet cependant pas de cerner l'approche quantitative des dommages subis par la vigne. Ce travail d'expérimentation participative en réseau sera prochainement appliqué aux thématiques épidémiologiques liées à la prévision des risques d'épidémie.

### Long-term survival of *Plasmopara viticola* oospores

*T. Caffi, V. Rossi, M. Lusitani* ..... 111-114

**Abstract:** A research was carried out in order to verify the long-term viability of *Plasmopara viticola* oospores. It is commonly assumed that oospores may survive across grapevines growing seasons, but no experimental evidence of this assumption has been provided to date. Grapevine leaves were collected from untreated plants in Emilia-Romagna in fall 2004 to 2008. Fragments of these leaves were kept in soil under natural conditions. In spring 2005 to 2009, part of the leaf fragments collected in the previous autumn were used to evaluate oospore germination using the floating disk bioassay; in spring 2009, the bioassay was also performed using the leaf residue collected in fall 2005 to 2007. Results demonstrated that *P. viticola* oospores remained viable for the whole period considered in this work, i.e., about 65 months (from fall 2004 to spring 2009).

### Dispersal of the sexual stage of *Erysiphe necator* in northern Italy

*V. Rossi, T. Caffi, S. E. Legler, R. Bugiani, P. Frisullo* ..... 115-121

**Abstract:** Either by themselves or in combination with mycelium in the dormant buds, ascospores produced in chasmothecia (the sexual fruiting bodies) of *Erysiphe necator* are an important source of primary inoculum for grapevine powdery mildew disease. In northern Italy, *E. necator* overwinters mainly as the sexual stage (i.e., mycelia are not usually present in dormant buds), but no data are available on the abundance of chasmothecia in the vineyards. Therefore, the dispersal of chasmothecia was studied in commercial vineyards of northern Italy, from 2005 to 2007 (16 combinations of 10 vineyards x 3 years); the vines were not sprayed with fungicide during this study. The dispersed chasmothecia were collected on filter papers in funnels that were placed on the trunk of affected grapevines from mid-August to the end of leaf fall. Each filter paper was examined microscopically, and the chasmothecia were counted. The first chasmothecia of the season were dispersed between late August and early October; cumulative numbers of the chasmothecia dispersed subsequently increased (with different dynamics depending on the vineyard and year) but dispersal stopped at the end of leaf fall. Over all three years and 16 vineyards, chasmothecia averaged 3/cm<sup>2</sup> of trap surface, with a maximum of 15/cm<sup>2</sup>. The numbers of mature chasmothecia that dispersed roughly depended on the powdery mildew severity on leaves: high numbers of chasmothecia were associated with disease severity  $\geq 80\%$ . According to estimates based on the current data, vine bark in vineyards trained with a Guyot, Geneva double curtain, or

spurred cordon pruning system could contain till 18, 19, or 44 million chasmothecia/ha, respectively.

#### Modelling the effect of the grapevine growth and susceptibility on the dynamics of a powdery mildew epidemic

*A. Calonnec, S. Schnee, P. Cartolaro, M. Langlais* ..... 123-130

**Abstract:** Simulations are performed to explore the sensitivity of epidemics of powdery mildew of grapevine to variation of parameters related to the pathogen, the plant growth or the crop management. For early inoculation, the three parameters linked to the sporulation ( $\lambda$ ), the dispersion process ( $cid$ ) and the plant vigour ( $vig$ ) are the most discriminating. The parameter of ontogenic resistance ( $\rho$ ) is less discriminating, and the height of shoot topping and the distance between buds are not discriminating. We also examined the relationship between vine vigour and disease variables at key periods in the epidemic process. An increase of the parameter of vigour from 0.2 to 1 amounted to a higher number of leaves at flowering ( $N_{flo}$ ) and a higher rate of leaves emergence (RLE). The RLE was correlated with the rate of diseased leaves emergence and with the severity of the disease at shoot topping, whereas  $N_{flo}$  was correlated to the diseased leaves area at day 240. The percentage of young leaves during first sporulation event ( $s_{1s2}$ ) was correlated to the rate of shoot development (RDS). These two variables from host allowed to discriminate the years. The duration and dynamic of infectious tissue can considerably vary function on the development of secondary shoots therefore on the climatic conditions and vigour.

#### Consideration of dynamical plant-pathogen interactions for an improved management of powdery mildew epidemics in grapevine

*S. Schnee, J. Jolivet, A. Calonnec* ..... 131-138

**Abstract:** The current control of grape powdery mildew requires new strategies, able to limit the pathogen development and requesting a reduced number of chemical sprayings. This study proposes to exploit host plasticity in order to investigate the effect of a plant growth changing on either the epidemic process, or organs susceptibility. An experimental plot combining two cultivars, three rootstocks and two opposite crop management for creating a vigour differential was surveyed regularly during the vegetative growth and different variables were measured to characterise host growth and pathogen. Shoots coming from vinestocks localized in the different vigour area were sampled for organ susceptibility assessment. Two groups of vigour were obtained, not based on the established treatment but on the individual growth potential, that differ mainly by the number of secondary leaves. The vigorous group presents the higher level of disease, increasing with the appearance of secondary leaves. A low vigour modifies the susceptibility of the tissues, by an earlier appearance of ontogenic resistance phenomenon. The relevance of vigour control and the concomitant physiological mechanisms are discussed as integrative strategy in the grape powdery mildew management.

#### Blackrot - downy mildew control in small vineyards in southern Switzerland

*C. Gessler, M. Jermini* ..... 139-142

**Abstract:** Blackrot caused by *Guignardia bidwelli* is causing damages in recuperated vineyards in southern Switzerland planted with the cultivar Isabella. The source of inoculum is attributed to abandoned vineyards. Heavy and prolonged rains may also favor infection by *Plasmopara viticola* on Isabella especially if a heavy load of primary inoculum can be expected. A 6 year experiment was made to test and confirm minimal necessary fungicide applications and timing to control Blackrot and downy mildew. Infection conditions during the period between flowering and up to six week after, have led to heavy losses reaching 100% without adequate control. A combination of the two pathogens was registered, with *P. viticola* bunch symptoms without visible sporulation. We recommend therefore using fungicides or fungicide combinations with an effect on both pathogens. Mostly two well timed sprays with an appropriate fungicide active against both pathogens are sufficient to control fully the diseases on bunches and avoid loss. Under particular rainy situation a third applications gave 100% control. Timing should be before rain events leading to prolonged leaf wetness during the time period between flowering and six

week afterwards. Winegrowers in the area are not professional winegrowers or farmers, having little specific knowledge, therefore they will apply fungicides only at particular date (Saturday) following the instruction of the manufactures. Applications are made by knapsack sprayers and vineyards are usually terraced irregularly often as pergola. Therefore we developed an easy applicable scheme to determine application timing and an instruction system to determine fungicide concentration so to avoid over and under dosaging. Here we present the most relevant points we teach to our winegrowers.

#### First study on the population genetic structure of *Guignardia bidwellii*

*M. Jermini, A. Angst, M. Raynal, C. Gessler, G. Broggini* ..... 143-148

**Abstract:** The ascomycete *Guignardia bidwellii* is the casual agent of the black rot of grape. Native to North America introduced to Europe in the early 19th century and today regularly observed in France, Italy, Germany and southern Switzerland. The black rot is not generally considered as an important disease but it is able to induce heavy crop losses particularly in regions characterised by weather conditions favourable to *Plasmopara viticola*. Present studies focused on the genetic structure of the pathogen population, to get a better understanding of the epidemiology and life cycle of the disease. We successfully extracted and amplified DNA from mummified berries and developed six SSR markers for genotyping of *G. bidwellii* isolates. The SSR markers were used to study the pathogen populations of two Merlot vineyards in France and a mixed variety vineyard (Merlot, Regent, Isabella, Solaris, Bianca and Chambourcin) in southern Switzerland. All three populations were related and shared common SSR alleles. Gene diversity was similar for the two French populations, and the Swiss population was nearly clonal in a genotype frequently observed in France. Only a few private genotypes were found, therefore the populations differed mainly in genotype frequency. Based on our data we challenge the importance of sexual reproduction for the propagation of the fungus. The low genotype and allele diversity observed could be explained either by a generally low genotype polymorphism in Europe or by a low SSR marker polymorphism. More research is therefore needed to assess SSR marker polymorphism on an American population, to develop additional SSR markers for a higher genotype resolution and to understand an eventually difference in the genotype frequency between leaf and berry infections.

#### Methods for screening new *Ampelomyces* strains to be used as biocontrol agents against grapevine powdery mildew

*S. E. Legler, T. Caffi, L. Kiss, A. Pintye, V. Rossi* ..... 149-154

**Abstract:** Grapevine powdery mildew is a key disease all across Europe and is currently controlled almost exclusively using fungicides. To develop a new biofungicide product against this disease, caused by *Erysiphe necator*, a large culture collection of *Ampelomyces* strains collected worldwide from different powdery mildew species was screened to assess for the first time the level of variability of different characteristics of these biocontrol agents known to occur as natural mycoparasites of powdery mildews in the field. This preliminary screening revealed a considerable diversity in many characteristics of different *Ampelomyces* strains including both culture patterns and mycoparasitic activities against the asexual and sexual stages of *E. necator*. The screening protocol developed in this work could be used in further studies on *Ampelomyces* in order to develop new effective commercial biofungicide products against powdery mildew infections of grapevine and other crops.

#### Water activity at the fruit surface: a potential indicator of grape berry susceptibility to *Botrytis cinerea*

*M. Fermaud, C. Deytieux-Belleau, J. Roudet, G. Darrieutort, L. Geny* ..... 155-161

**Abstract:** Water activity (Aw) is a physical property of a humid solid, which is of prime importance in food microbiology. This parameter is an assessment of available water, unbound to nutrient molecules, which allows damaging bacteria, yeasts and fungi to grow in a food product. As most moulds which do not grow below an Aw level of *ca.* 0.8, *Botrytis cinerea* was unable to grow on artificial media at an Aw of 0.93 and below. In 2008, in an experimental vineyard (*Vitis*

*vinifera* L. cv. Merlot noir) near Bordeaux, *Botrytis* bunch rot development was assessed and the evolution of water activity was investigated at the surface of healthy grape berries during fruit development. Our results showed that  $A_w$  decreased steadily from the berry herbaceous stage to maturity and was correlated negatively and significantly ( $P = 0.01$ ) with disease incidence. Furthermore, an experiment under controlled conditions showed the significant effect of relative humidity (RH) on the water activity level at the berry surface. When healthy berries at two different development stages (“herbaceous” and “beginning of colour change”) remained at 80 % RH for 6 days, the  $A_w$  values decreased significantly ( $P = 0.05$ ). On the basis of the close relationship between water activity and *Botrytis* bunch rot development, the potential of  $A_w$  for use as a new disease indicator is discussed as well as the influence of climatic conditions on water activity measured at the grape berry surface.

### Investigation of contamination pathways of Esca-associated fungal pathogens and of fungicide-based control strategies

A. Kortekamp, J. Köckerling ..... 163-169

**Abstract:** Even though “Esca” may be as old as viticulture itself, new attention has been directed to this disease in recent years due to the dramatic increase in economic importance. A sudden wilting of Esca-affected grapevines, followed by the death of the entire plant, occurs in many grapevine-growing areas of the world. Esca is a complex disease that comprises several symptoms caused by a set of fungal pathogens. Unfortunately, infected plants can often not be cured, since foliar or wood treatments using fungicides do not lead to an effective control of the respective pathogens in the infested wood. Given the large number of wounds made to propagation material during the various nursery stages and also made as a result of repeated pruning, hygiene and wound protection is of particular importance. Therefore, the effect of various chemical and biological treatments on Esca-associated fungi, such as *Phaeoacremonium aleophilum* (Pal), *Phaeoconiella chlamydospora* (Pch), and *Fomitiporia mediterranea* (Fmed), and on the disease progress of artificially infected plants was investigated *in vitro* and in field and greenhouse experiments. For this purpose, several putative contamination pathways and different test systems have been evaluated to verify the ports of entry for fungal spores and the efficiency of fungicides to control the disease.

In the year 2009, vineyards of the DLR research station and of local grape growers were inspected and the impact of Esca in these vineyards was evaluated. As published by other authors, the number of affected vines increased with their age. Furthermore, there are no clear differences in susceptibility and none of the varieties planted in the Palatinate showed any suitable resistance. Plant material of diseased vines was collected and tested for the presence of Esca-inducing pathogens. Mainly *Phaeoconiella chlamydospora* (Pch), *Botryosphaeria* species, *Cylindrocarpon* sp., *Trichoderma* sp. and mould fungi such as *Alternaria* sp. and *Penicillium* sp. were frequently found. All type of wounds created artificially represented suitable ports of entry for all Esca-associated pathogens. Especially, infections with *Cylindrocarpon destructans* significantly reduced viability of the scions and had severe effects on plant growth as tested with infected cuttings. Wound infections caused by polluted water that had been used to soak propagation material led to a reduced growth of cions, especially when contaminated with *Cylindrocarpon* spores.

Growth tests *in vitro* showed that most fungicides tested exhibited antifungal capacities. The *Trichoderma*-based product Trichostar<sup>®</sup> was an effective biological agent in the field, preventing infection of wounds when applied one day before inoculation, whereas most fungicides were not able to sufficiently prevent colonisation of wounds by fungi.

### Impact of biotic and abiotic factors on the development of Esca decline disease

P. Lecomte, G. Darrieutort, C. Laveau, D. Blancard, G. Louvet, J.-P. Goutouly,  
P. Rey, L. Guérin-Dubrana ..... 171-180

**Abstract:** The aim of researches performed by our group is to determine which internal and external factors have a key influence on grapevine wood diseases, especially on Esca. The relationship between Esca leaf symptoms, the size of inner necrosis, the fungal endophytes

associated with the disease and the whole microflora that can be detected from the grapevine wood, is discussed. Recent studies on leaf symptom development showed that summer temperature conditions likely play a major role in the expression of Esca symptoms. Cultural factors, like plant vigor or type of soils, also have presumably a significant influence. Several evidences suggest that other abiotic factors linked to the training systems (e.g. forms with very short cordons) or to pruning decisions (e.g. winter hand pruning characteristic of the modern grape-growing training systems) have also to be taken into account, alone or combined with other factors. Whole data indicate that Esca is a multi-factor disease and that many complex pathological scenarios could explain the grapevine trunk disease expression. A control strategy, mainly based on cultural measures to avoid a too early development of inner necrosis, is proposed.

### Session 3: Biology and population dynamics of insects and moths and modeling

#### Electrospun nanofibers as novel carriers of insect pheromones:

communication disruption strategy against *Lobesia botrana*

*D. F. Hein, M. Breuer, H. E. Hummel, A. Greiner, J. H. Wendorff, C. Hellmann,*

*A. Vilcinskis, A. Kratt, H. Kleeberg, G. Leithold* ..... 183-187

**Abstract:** Using organic nanofibers as dispensers for pheromones and kairomones in plant protection for disrupting insect chemical communication is a novel approach aiming at popularizing this technique in organic and integrated plant production. Expected advantages of the nanofibers are highly controlled spatiotemporal release rates of pheromones / kairomones, improved climatic stability, and mechanized application. Dispenser types used so far show deficiencies in one or more of these requirements. Mechanical application of pheromone dispensers is a new approach to reduce the costs of manual labour. Therefore the environmentally compatible, highly specific and efficient technique of mating disruption may become an alternative to the use of synthetic pesticides in integrated pest management. The electrospun nanofibers are highly elastic, which prevents break-off of smaller pieces, and polymers used are biocompatible. Due to the tiny scale of nanofibers the mass input both for pheromones and for polymeric nanofibers is extremely low. Major environmental benefits are high control specificity, very low concentrations of residues and minimal risk towards development of resistant insect strains. We tested organic polymer fibers, made from the biodegradable polymer Ecoflex<sup>®</sup> (BASF), treated with *Lobesia botrana* (Lepidoptera: Tortricidae) sex pheromone, (E,Z)-7,9-dodecadienyl acetate, in cage tests placed inside vineyards. With this experimental setup it is possible to show the applicability of mating disruption dispensers for the use in plant protection against insect pests in vineyards. We used Isonet LE dispensers (Shin-Etsu) as a positive control. The Ecoflex<sup>®</sup> nanofiber-pheromone-dispensers show a mating disruption effect which is comparable to the efficacy of the Isonet LE dispensers for at least three weeks. After that, the mating disruption effect observed tapers off to a level where it is insufficient for plant protection purposes. But, in principle, our first prototype of a nanofiber pheromone dispenser has proved its efficacy for mating disruption purposes. Modifications of the fibers, currently under development, open up the possibility of extending the disruption effect to a period of several months' duration, enough to cover the entire flight period of *Lobesia*.

#### Control of grape berry moth larvae using parasitoids: should it be developed?

*D. Thiéry, L. Delbac, C. Villemant, J. Moreau* ..... 189-196

**Abstract:** Besides mating disruption techniques and progress in monitoring techniques (e.g. the use of food traps against females), biological control may reveal itself very efficient at controlling grape moth populations. Parasitoids active to control grape moths are known for long in vineyards; few of them were already described in the middle of the 19th century in French vineyards and their efficiency was already recognized especially against the diapausing and the first spring generations of the moths. Rather numerous attempts to release egg parasitoids have

been done in different European countries using different species of trichogrammas. The results obtained varied a lot and could not yet clearly promote the use of this technique in vineyards. We believe that a biological control based on larval parasitoids could efficiently be developed as a valuable alternative to chemical control. In the present paper, we focus on larval parasitoids among which ichneumonids and chalcidoids (Hymenoptera) dominate, and present results obtained in different French vineyards (Bordeaux vineyard, Perpignan and Montpellier area, Côtes du Rhône and Alsace). We discuss factors that may favour or reduce their efficiency as biocontrol agents.

#### Life history of *Lobesia botrana* on *Daphne gnidium* in a Natural Park of Tuscany

A. Lucchi, L. Santini ..... 197-202

**Abstract:** The life cycle and the ecology of the grapevine moth (GM) *Lobesia botrana* (Den. & Schiff) feeding on *Daphne gnidium* L. (to date considered the original host for *L. botrana*) were investigated in a Tuscan Natural Park in the last 2 years. The studied environment was located 2 km away from the beach and hosted numerous shrubs of *D. gnidium* on which *L. botrana* has been feeding forever, in the absence of *Vitis vinifera*. In the mentioned environment the moth seasonal flights were monitored and the larval feeding behaviour along the whole season was defined.

#### Current status of grapevine leafminers in north-eastern Italy

C. Duso, A. Pozzebon, M. Baldessari, G. Angeli ..... 203-206

**Abstract:** Up to 2007, two species of grapevine leafminers were known in Italy as well as in Europe: *Phyllocnistis vitegenella* Clemens and *Holocacista rivillei* (Stainton). They are usually considered minor pests and do not require specific control measures. However, an increasing importance of these pests has been observed in north-eastern Italy in recent growing seasons. An additional leafminer species belonging to the genus *Antispila* was also detected in 2007 in north-eastern Italy. The origin of this species, which is new for Europe, is still unknown. The phenology, pest status, and natural control of these leafminer species have been investigated in a number of vineyards located in the Veneto and Trentino regions. The implications of leafminer occurrence for integrated pest management (IPM) on grapevines are discussed.

#### Factors affecting the post-release dispersal of *Trichogramma cacoeciae* Marchal in the vineyard

G. Hommay, J. C. Kienlen, C. Gertz, C. Bihry, J. Pizzol ..... 207-214

**Abstract:** Several releases of 20,000 and 40,000 individuals of *Trichogramma cacoeciae* were made at a central point in a vineyard in order to follow the dispersal of trichogrammes and the distribution of parasitism on *Ephestia kuehniella* egg-cards. The dispersal of trichogrammes essentially occurred along the release row and over the nearest rows, since the vine rows formed a plant screen that channelled their dispersion. The daily captures of trichogrammes increased with the number of trichogrammes released and decreased over time. It increased with minimal temperature and solar radiation, but did not depend on other meteorological factors. The number of parasitised egg-cards decreased with the distance from the release point and increased with the amount of wind received at the control points. The doubling of the number of trichogrammes released influenced parasitism by increasing both the discovery rate and the exploitation rate of egg-cards.

#### Mating disruption field trials to control the vine mealybug *Planococcus ficus*

A. Cocco, M. Coinu, A. Lentini, G. Serra, G. Delrio ..... 215-221

**Abstract:** A mating disruption experiment against the vine mealybug, *Planococcus ficus*, was carried out during 2008 in 3 commercial vineyards in northwestern Sardinia. Within each vineyard, 2 adjacent plots of variable size (0.2, 0.4, and 0.5ha, respectively) were established as mating disruption and control plot. Plastic dispensers (Suterra Inc., USA) with 100mg each of the synthetic sex pheromone were deployed in mid-May, before the first flight of adult males, at a rate of 625 dispensers per hectare. The effectiveness of the mating disruption technique was

evaluated by comparing the number of males captured in pheromone traps, the leaf population density, the percentage of ovipositing females, and the crop damage. Male flights were monitored with traps baited with 0.01mg of the sex pheromone. The percentage of females with ovisacs and their fecundity were estimated by collecting adult females after each peak male flight and rearing them individually under laboratory conditions. The mealybug density was assessed from June to September by counting every 2 weeks nymph and female mealybugs on basal leaves of 20-30 vines per plot. The crop damage was evaluated at harvest by assessing the percentage of damaged bunches on the same vines. In all the vineyards, the number of males captured in mating disruption plots was lower by far than in control plots, while the percentage of females with ovisac was significantly different only in the first generation. Females collected from the field after the first male flight produced more eggs than those collected after the second and third flight, with no significant difference between treatments. The density of mealybugs on leaves in mating disruption plots was lower than that in control plots, but the difference was not significant. Also, the percentage of damaged bunches at harvest did not differ between treatments. Mating disruption experiments to control the vine mealybug produced mixed results. This could be due to the limited size of experimental plots and/or the suspected parthenogenetic reproduction of Sardinian populations of *P. ficus*.

#### Biological characteristics of *Heliococcus bohemicus* and

##### *Ericydnus sipylus* in controlled conditions

A. Fleisch, L. Pérez, P. Kreiter, A. V. Odor, G. Sentenac ..... 223-232

**Abstract:** *Heliococcus bohemicus* is an increasing pest in vineyard in the north-east of France. A biological control was initiated in 2007 and 2008. A study in laboratory, to measure the two antagonist biological characteristics, the mealybug and one of its parasitoids *Ericydnus sipylus*, was undertaken. The description of the mealybug life cycle is led under the climatic conditions: 25°C and 60% R. H. It appears that *H. bohemicus* has three larvae instars. Females did not lay off eggs and the larvae hatched after 23.5 days on average. The development of first and second instars lasted near 34 days and for the third instars it was near 14 days. The biological characteristics of the parasitoid were studied at 21°C and 50% R. H. Under these conditions the pre-imaginal development lasted 35 days and the length of adult emergence was 57 days on average. The fertility is equal to 15 individuals. Others parameters are studied and are explained in the article. The method of the mass rearing is developed. The pest insect is developed on potato tubers turned green by light.

#### Survey on *Scaphoideus titanus* egg distribution on grapevine

B. Bagnoli, E. Gargani ..... 233-238

**Abstract:** In the context of the Euphresco-Propscaph project, a survey on *Scaphoideus titanus* egg distribution on grapevine has been under way since January 2009. Samples of one and two to four-year old vine wood of the “Trebbiano Toscano” variety from an untreated vineyard in Latium (Central Italy) and samples of one and two-year old of the “Kober 5BB” rootstock from an abandoned field in Veneto (North Italy) have been analysed. The vine samples, collected during the winter pruning, were stocked at 4°C till the beginning of the experimentation, when the same materials were cut into pieces of different lengths and put into rearing boxes (cm 29x20x12) maintained at 24°C, 75% RH and LD 16:8 photoperiod to obtain the first instar *S. titanus* larvae. In the middle of May in two Latium untreated vineyards, several original capture devices were put on the plants, in particular around the trunk, the cordon, the cane of one-year old and the buds of the vines to survey the emergence of *S. titanus* larvae. Results confirmed that *S. titanus* females prefer to oviposit in the bark of two or more year old wood (0.09-0.31 larvae per cm<sup>2</sup>), even if very few specimens were obtained from the one-year old wood (0.0002-0.0036 larvae per cm<sup>2</sup>) as well. The field experiments with the capture devices evidenced for the first time that even the bark of the trunk is a preferential site of the cicadellid oviposition as well.

## Preliminary study of the aggregative behaviour of *Scaphoideus titanus* larvae

J. Chuche, A. Boursault, D. Thiéry ..... 239-244

**Abstract:** The leafhopper *Scaphoideus titanus* is the vector of the Flavescence dorée. In this study, we investigated the aggregative behaviour of the larvae. We conclude from different experiments that larval aggregation occurs at the plant scale and the age and colour of the food source could be factors cueing an aggregation. These aggregation patterns should be studied in more details in order to gain knowledge in the epidemiology of Flavescence dorée and eventually to develop control strategies based on inter-individual epideictic regulation.

## Vibrational signals associated to the mating behaviour

of *Hyalesthes obsoletus* Signoret (Hemiptera Fulgoromorpha)

V. Mazzoni, G. Anfora, C. Ioriatti, M. Virant-Doberlet, A. Lucchi ..... 245-248

**Abstract:** *Hyalesthes obsoletus* Signoret is a vector of the stolbur phytoplasma (group 16SrXII-A), causal agent of the grapevine disease 'Bois Noir'. In planthoppers the intraspecific communication is based on substrate-borne vibrational signals. The aim of this study was to investigate the mating behaviour of *H. obsoletus*. Vibrational signals were detected from nettle cuttings by laser vibrometer. Both male and female can start the mating process by the emission of calling signals. The male calling signal is a single short syllable (Male Syllable 1) whereas the female's is a train of pulses of variable length. Initially, the male/female duet is based on the alternating emission of calling signals (recognition phase). In a second step, the male starts emitting long syllable trains (male courtship signal) in which the female occasionally inserts single pulses (courtship phase). The male courtship signal is made of two different types of syllables (Male Syllable 2 and 3), the switch from one to another often triggered by the emission of a female pulse. When partners are in close vicinity the male emits a specific pre-copula signal that precedes the copula (pre-copula phase). Rivalry tests, either pairs of males or trios, showed a strong competition between males, expressed in the form of chorusing, rivalry signals and aggressiveness.

## A beneficial species becomes a pest - the common earwig

*Forficula auricularia* (Linnaeus 1758)

C. Huth, K.-J. Schirra, A. Seitz, F. Louis ..... 249-256

**Abstract:** The common earwig *Forficula auricularia* has been classified as a beneficial predator in vineyards. Amongst others the insect feeds on grape pests like different tortricids. In recent years within many regions of the viticultural area of the Palatinate the individual densities increased to an extremely high level. Earwigs may cause direct damages such as contamination of the grapes with faeces, eroded berries and transfer of pathogens. The chemical agent 2-methyl-1,4-benzoquinone, released from the abdominal glands while earwigs are menaced and likewise contained in faeces, may have a negative influence on the wine quality. All these facts constitute a deterioration of grape quality for wine-growers. The high number of earwigs in the grapes after vintage causes a negative image by consumers. This study was carried out to investigate possible relations between the population dynamics of earwigs and specific environmental conditions in vineyards. The main focus of the research project was focussed on chemical, ecological and biological strategies to reduce the population densities. Another important point of survey was to study the life cycle of earwigs especially in vineyards. For sampling purposes in the cluster zone a special life trap made of bamboo tubes has been developed. This type of trap showed the highest catch rate of the four trapping types tested. For monitoring the ground dwelling earwigs pitfall traps were used.

## Effects of some insecticides on *Kampimodromus aberrans*:

laboratory and field studies

P. Tirello, S. Vettore, A. Pozzebon, M. Lorenzon, C. Duso ..... 257-260

**Abstract:** *Kampimodromus aberrans* is an important predatory mite in European vineyards and fruit orchards. Pesticides can exert profound effects on *K. aberrans* populations that are influenced by the pesticide experience of predatory mites. Resistance to organophosphates and

dithiocarbamates has been suggested for some Italian populations of *K. aberrans* but this phenomenon has not been shown in the laboratory. The effects of three different pesticides (chlorpyrifos-ethyl, methoxyfenozide and flufenoxuron) on *K. aberrans* were investigated in field and laboratory conditions. In field tests, predatory mites were released at the beginning of February on defined plots. *Kampimodromus aberrans* densities were evaluated on insecticide treated plots and on control plots by examining leaf samples in the laboratory from June to August. The lethal and sub-lethal effects of the same pesticides were tested in the laboratory using a residual bioassay. Field experiments showed some effects of the three pesticides on predatory mite populations. Results of bioassays were partially correlated with those obtained in the field. Implications for IPM are discussed.

#### Development and reproduction of the predatory mites

*Kampimodromus aberrans*, *Typhlodromus pyri* and *Amblyseius andersoni*  
on different food sources

M. Lorenzon, A. Pozzebon, C. Duso ..... 261-265

**Abstract:** *Kampimodromus aberrans*, *Typhlodromus pyri* and *Amblyseius andersoni*, important predatory mites in European vineyards, were reared in the laboratory on five potential food sources: the herbivores *Panonychus ulmi* and *Eotetranychus carpini*, the non-specialized feeder *Tydeus caudatus*, the pollen of *Typha latifolia*, and the mycelium of grape downy mildew *Plasmopara viticola*. Experiments were conducted using grape leaves as a substrate. The developmental times, survival and fecundity of predatory mites were determined on each food type. None of these species developed on *T. caudatus*. Developmental times of *K. aberrans* and *T. pyri* were faster on pollen than on spider mites or *P. viticola* mycelium. The fecundity of *K. aberrans* and *T. pyri* was higher on pollen than on other foods. *Amblyseius andersoni* developed faster on pollen than on *P. ulmi* or *P. viticola* mycelium, and showed a low fecundity on *P. viticola* mycelium.

#### Susceptibility and sensibility of grape cultivars to the leafhopper *Empoasca vitis*

D. Fornasiero, A. Pozzebon, F. Pavan, C. Duso ..... 267-270

**Abstract:** The leafhopper *Empoasca vitis* (Göthe) (Homoptera: Cicadellidae) is a serious pest in European vineyards. The assessment of economic damage caused by *E. vitis* was associated with no definite results probably because of a different susceptibility and sensibility of grape cultivars to the pest. *Empoasca vitis* abundance and symptoms associated with the activity of this pest were evaluated during three years on 10 grape cultivars grown in collections located in north-eastern Italy. *Empoasca vitis* densities were estimated from May-June to September by sampling leaves every 7-10 days. At vintage time, the percentage of leaf surface with symptoms caused by *E. vitis* feeding was estimated. Carménère, Sauvignon Blanc and Tocai Friulano showed to be very susceptible and very sensible, whereas Cabernet Sauvignon, Chardonnay, Verduzzo Friulano and Pinot Gris showed an opposite behaviour. However, such correspondence was influenced by meteorological conditions and plant stress factors. These results may be useful for establishing economic thresholds and sampling plans for *E. vitis* in vineyards.

#### Can *Harmonia axyridis* affect the taste of European wines?

C. Linder, F. Lorenzini, P. Kehrlí ..... 271-274

**Abstract:** The multicoloured Asian ladybeetle *Harmonia axyridis* Pallas is now established in Central Europe and is likely to spread soon over the whole continent. In the United States, *H. axyridis* moves to vineyard shortly before harvest. When disturbed or crushed during vinification, the ladybeetles release alkylmethoxypyrazines, which can strongly affect the quality of white and red wines. In Europe, wine growers are beginning to worry about the impact of *H. axyridis* on the quality of their processed wines. In this study we artificially contaminated harvested grapes of the variety 'Chasselas' and 'Pinot noir', the two main varieties of Switzerland, with three different densities of *H. axyridis* and determined the impact of crushed ladybeetles on the taste of processed wines. The addition of ladybeetles did neither affect fermentation nor the basic chemical properties of processed wines. However, at the organoleptic level the contamination of

grapes had a significant effect. Contaminated 'Chasselas' wines were of lower fruitiness, fineness, structure, acidity, equilibrium and exhibited a "rancid oil" odour. Moreover, the quality of contaminated 'Pinot noir' was rated low, in particular, its fruitiness, spiciness, fineness, structure, softness, robustness as well as intensity and quality of tannins was poor. Even though *H. axyridis* is rarely present in vineyards of Western Switzerland, our results emphasise that there is a risk of wine contamination. Thus, the evolution of the multicoloured Asian ladybeetle in European vineyards should be carefully monitored in order to anticipate future problems.

#### Feeding behaviour of *Lobesia botrana* on leaves and shoots of grapevine

A. Lucchi, E. Pozzolini, G. Anfora, V. Mazzoni, M. Tasin, E. Leonardelli,  
C. Ioriatti ..... 275-280

**Abstract:** The larval feeding behaviour of the grapevine moth *Lobesia botrana* (GM) on grapevine leaf and shoot tissues in the absence of grapes is described. GM larvae were obtained from eggs laid on the grapevine leaves in a field cage covering two rows of a Chardonnay vineyard in which all the bunches were previously removed. Larvae developed till pupation feeding only on leaves and shoots and showed the characteristic leaf rolling habit of the Tortricidae. All of them were able to pupate and to give adults that mated in laboratory conditions. Females laid fertile eggs and gave rise to a new generation of larvae. Pupal weight, number of eggs laid, and longevity of leaf/shoot fed insects were compared with those of the insects reared on berries and artificial diet.

#### Attractiveness of different colours to *Scaphoideus titanus* Ball

(Hemiptera: Cicadellidae) adults

V. Mazzoni, F. Trona, C. Ioriatti, A. Lucchi, A. Eriksson, G. Anfora ..... 281-284

**Abstract:** Laboratory and field tests were performed to ascertain a possible role of visual cues for *Scaphoideus titanus* during the location of a host plant. In laboratory, two choice colour tests were made in a Y-tube to compare the attractiveness of blue (peak wavelength: 475nm), green (521nm), yellow (573nm) and red (650nm). The observed preference order was yellow > red > green > blue for males and red > yellow > green > blue for females. In field, nine groups of three coloured (yellow, red, blue) sticky traps were positioned in an organic vineyard and replaced once a week, for two summers (2008 and 2009). In both seasons the yellow traps captured significantly more individuals (either males or females) and had the highest sex rate (percentage of males on the total captures) followed by red and blue. Our investigation suggests that, despite a partial different response between laboratory and field tests, *S. titanus* adults are influenced by visual cues present in their habitat. The possible reasons of the different responses observed in lab and field are discussed.

#### The impact of a number of insecticides on *Empoasca vitis* populations in north-eastern Italy

A. Pozzebon, M. Pederiva, R. Moret, C. Duso ..... 285-288

**Abstract:** The green leafhopper *Empoasca vitis* Goethe (Homoptera: Cicadellidae) is an important pest of grapes in Europe. Its feeding activity may cause a reduction in photosynthesis, mesophyll conductance and transpiration rate with implication for yields. For these reasons insecticides are widely used to control this pest with potential effects on beneficial arthropods. Field experiments were conducted to evaluate the impact of a number of insecticides (chlorpyrifos, flufenoxuron, thiamethoxam, and indoxacarb) on *E. vitis* populations. Pesticide side-effects on the predatory mite *Typhlodromus pyri* were assessed. Thiamethoxam was the most effective towards *E. vitis*. Pest population levels were slightly reduced by chlorpyrifos, suggesting that this strain was resistant to organophosphates. Indoxacarb and flufenoxuron were associated to intermediate effects. The predatory mite populations were affected especially by thiamethoxam.

### Small insect enclosure field cages: A simple method to assess mating disruption

F. Briand, C. Vergely, P.-J. Charmillot, P. Kehrlé ..... 289-293

**Abstract:** Mating disruption is an effective and sustainable integrated pest management technique that is now established in a broad range of cropping systems. For example, it is a popular alternative to insecticides for controlling the grape berry moth *Eupoecilia ambiguella* Hb. (Lepidoptera, Tortricidae), a main pest of European vineyards. A downside of this environmental friendly pest control technique is the challenging assessment of its efficiency in the field. In order to obtain reliable results, newly processed pheromone dispensers have to be tested at a large spatial scale where pest densities, crop variety, cultural practices, microclimate etc. can vary considerably among trial sites. The realisation of statistically sound results therefore asks for numerous independent replicates, which are time-consuming, space-demanding and expensive. The aim of this work was to facilitate the evaluation of the efficiency of mating disruption. We tested the suitability of small insect enclosure field cages for a pre-evaluation of the impact of sex pheromones on insect mating. Our enclosure field cages consisted of a cubic metal frame of 35cm side length that was covered with gauze tissue. Cages were installed in the centre of pheromone treated and untreated vineyards. Thereafter, various numbers of grape berry moth couples were exposed for 1, 2 or 3 days. The impact of pheromones was assessed by counting the number of mated females, e.g. the number of dissected spermatophores. Our data showed that mating was significantly lower in pheromone treated compared to untreated vineyards. Moreover, there were significant differences among pheromone dispensers tested and mating disruption generally increased with the amount of pheromone diffused. Overall, the exposure of eight couples for one night seemed to be optimal for comparing different control schemes. Our study showed that small insect enclosure field cages offer a fast, simple, cheap and reliable method to measure the impact of pheromones on insect mating. Data obtained in such trials may therefore help predicting the value/use of setting-up large-scale field trials. In conclusion, small insect enclosure field cages may facilitate the development and assessment of semiochemical lures.

### Influence of nettle control along a ditch on spatial distribution of *Hyalesthes obsoletus* Signoret in a neighbouring vineyard

N. Mori, N. Reggiani, A. Pozzebon, C. Duso, F. Pavan ..... 295-298

**Abstract:** The nettle (*Urtica dioica* L.) is the most important host plant for the phytoplasma associated with the Bois noir (BN) disease of the grapevine and for its vector, *Hyalesthes obsoletus* Signoret. A higher abundance of the vector inside the vineyards is favoured by the nettle growing in edge rows and surrounding ditches. Foliar applications of insecticides appeared not an effective measure for vector and disease control, whereas nettle control could be useful to reduce BN incidence in vineyards. In particular the efficacy of nettle control by selective herbicide applications in early autumn and early spring was demonstrated. Many authors have suggested that the nettle control applied during *H. obsoletus* flight could have negative effects, because the vector adults could be forced to migrate onto grapevines. The aim of this research was to evaluate if nettle cutting during the adult flight favours the colonisation of the vineyards by the vector. For this purpose, three different weed managements (no cut, one cut during adult flight, frequent cuts) were applied on the herbaceous vegetation of a ditch bordering a vineyard. In this ditch, nettle was one of the principal components. The flight dynamic of *H. obsoletus* was recorded by yellow sticky traps placed on herbaceous vegetation along the ditch and at different positions inside the vineyard. Results showed that nettle cutting induced a reduction in vector presence in the ditch, but favoured its dispersion inside the vineyard. The implications of these observations on disease control are discussed.

### Electropenetrography, a tool to investigate the feeding behaviour of sucking insects: development of this technique to *Scaphoideus titanus*

J. Chuche, N. Sauvion, D. Thiéry ..... 299-303

**Abstract:** The leafhopper *Scaphoideus titanus* is the vector of the Flavescence dorée and transmits the phytoplasma causing the disease while feeding. To better understand the transmission process, we developed for this leafhopper the electropenetrography technique which

allows studying the feeding behaviour. We used the direct current method (DC system) to study the fundamental processes of the *S. titanus* feeding behaviour. We present the first results of the characterization of the electrical patterns obtained with this insect.

Gaps in knowledge for modern integrated protection in viticulture:  
lessons from controlling grape berry moths

*Denis Thiéry* ..... 305-311

**Abstract:** Viticulture has an impressive range of progress for the future years concerning the use of integrated pest management. This can be illustrated by insect pest management for which several tools have been developed or could be developed rather soon for an integrated protection management. The present talk aims at presenting through the experience gained in on insect pest or vectors management gaps and potential progress that can be achieved. The European grapevine moth *Lobesia botrana* can serve as a case study to analyse the different possibilities that can be used in IPM. Few existing examples of IPM compatible techniques will be presented: use of behaviour modifying chemicals in push-pull strategies, monitoring techniques, mathematical models, biotechnical insecticides (*Bt*) and natural enemies.

The different advantages and limits are discussed, and we attempt to identify gaps where scientific or development efforts are required to progress.