detached cane assay where treatments were assessed 4 weeks after application and results suggest it may offer a rapid alternative method of evaluation. Commercial sprayers (air-blast, air-shear, fan and recycle) were evaluated with the aim of improving the efficiency of applying pruning wound treatments. Using tebuconazole, some sprayers achieved control of eutypa dieback similar to hand-application, providing deposition was maximised by focussing spray at the pruning wound zone using water volume of 600 L ha^{-1}. Results will be discussed in relation to optimising management of eutypa dieback.

Effects of cultural practices on grapevine trunk diseases: results of a long-term experiment. V. DUMOT[1], G. SNAKKERS[1], P. LARIGNON[2], P. LECOMTE[3], P. RETAUD[4], S. DAVID[5], E. MENARD[1] and L. LURTON[1]. *[1]Bureau National Interprofessionnel du Cognac, 23, Allées Bernard Guionnet - BP 18 - 16100 Cognac Cedex, France. [2]IFV, Domaine de Donadille, 30230 Rodilhan, France. [3]INRA, ISVV, UMR1065 Santé et Agroécologie du Vignoble (SAVE), 33140 Villenave d'Ornon, France. [4]Chambre Régionale d'Agriculture de Poitou-Charentes, 3, boulevard Vladimir, 17100 Saintes, France. [5]Lycée Georges Desclaude, rue Georges Desclaude, 17100 Saintes, France. E-mail: vdumot@bnic.fr*

A collaborative study was carried out in the Cognac area (France) to evaluate the effects of cultural practices on Eutypa dieback and esca. A vineyard of 2 hectares of cv. Ugni blanc was planted in 1991 and three factors were assessed: training system, fertilization, and rootstock. Two training systems were compared: guyot system and bi-lateral cordon. Three levels of fertilization were applied: no fertilizer, 50N.0P.100K each year, and 100N.0P.100K each year plus basic dressing. Four rootstocks were compared: 41B, Fercal, RSB and Rupestris du Lot. The experimental design comprised 336 plots of ten plants. Each plot was a combination of the three factors. Foliar symptoms and mortality were recorded every year from the date of planting until 2010. The variables used as a result were the proportion of plants that showed one symptom at least one year, and the percentage of dead plants. Results showed significant effects on foliar symptoms and on mortality, but not always in the same way. The training system had a strong effect, especially on Eutypa dieback symptoms, likely linked to the number and the size of the pruning wounds. The guyot system had less foliar symptoms but more dead plants. The higher the fertilization, the more severe the symptoms and the mortality were. Rootstock 41B had less symptoms of Eutypa dieback, but more symptoms of esca. The three other rootstocks had similar results. The mortality was highest for Rupestris du Lot. This study provides information that can assist winegrowers with managing trunk diseases.

Control of grapevine trunk diseases in California. W.D. GUBLER and F. PEDUTO. *Department of Plant Pathology, University of California Davis, One Shields Avenue, Davis, CA 95616, USA. E-mail: wdgubler@ucdavis.edu*

Control of grapevine trunk diseases has been illusive for many years with attempts to find chemical barriers or cultural methods that would stop or reduce spore germination and fungal penetration into the pruning wound . In recent years we have been able to register myclobutanil and thiophanate methyl as a tank mix that can be applied by tractor as an over the vine spray on fresh pruning wounds with multiple applications if necessary. While this treatment is effective in stopping infection, it lasts only 2–3 weeks while pruning wounds remain susceptible for 6–8 weeks during the winter. Due to increased susceptibility of pruning wounds during winter months and decreased susceptibility during late winter and early spring months, we developed the practice of double pruning in order to allow growers with large acreage to be able to wait until late winter or early spring to make the final pruning. This practice of double pruning allows approximately 90–95% disease control simply due to rapid wound healing in late winter and early spring. Followed by a fungicide (myclobutanil and thiophanate methyl) application, this practice should give nearly 100% disease control under California conditions. Further to this new control strategy, we have developed and new product (Vitiseal) that when used alone gave 100% disease control in field and laboratory studies. Vitiseal is an organic treatment when used alone but when applied with fungicide, the fungicide has a longer decay rate thus giving an extra measure of control for a longer duration. In the last year we have tested 2 isolates of *Trichoderma viride* that have shown excellent control of canker diseases when applied in late winter or early spring. One of these isolates was recovered from grapevine pruning wounds 3–4 weeks after pruning and has been documented to be one of the first natural colonizers of pruning wounds. This fungus is highly aggressive and colonizes pruning wounds rapidly. One isolate is being developed into a biocontrol product.

***Trichoderma atroviride* SC1 is a good wound colonizer and can protect grapevine from infections of *Phaeoacremonium aleophilum* and *Phaeomoniella chlamydospora* in nurseries and vineyards.** D. PRODORUTTI[1], A. PELLEGRINI[1], A. COLOMBINI[1], B. CHARLOT[2], and I. PERTOT[1]. *[1]Fondazione Edmund Mach, via E. Mach 1, S. Michele all'Adige 38010, Italy. [2]AGR Sarl, 39 rue de Wissous, 91320 Wissous, France. E-mail: daniele.prodorutti@iasma.it*

Phaeoacremonium aleophilum (Pal) and *Phaeomoniella chlamydospora* (Pch) are two of the most important species associated with Esca disease in grapevines. They are frequently isolated from vines showing symptoms

of Esca disease in different countries. Plant colonization by these two microorganisms takes place via wounds. Therefore wound protection during all stages of grapevine propagation and in established vineyards is of extreme importance to prevent infection by these Esca-associated microorganisms. However, products containing either chemicals or biocontrol agents have given inconsistent results so far. The main reason for failure is most likely the short duration of protection. The strain *T. atroviride* SC1 was isolated from decayed wood, it has an outstanding capacity of colonizing wounds and it is a strong producer of hydrolytic enzymes. We evaluated its capability of colonizing wounds and efficacy of preventing Pal and Pch infections either under natural infections and artificial inoculation in established vines. *T. atroviride* SC1 was able to colonize wounds for several months after application and to protect plants along the growing season. When applied in the nursery process it successfully colonized almost all parts of the plants (rootstocks and scions) and prevented infections by Pal and Pch during grafting. The level of colonization was stable during the entire process giving a percentage of colonization of plants close to 100% at the time of commercialization. The trials were carried out for 3 years in several sites in Italy and France, indicating a good adaptability to different environmental conditions and consistency of results. *T. atroviride* SC1 may represent an interesting strain for further developments in the protection of grapevine wounds from Esca-associated microorganisms.

Methodological approach for an effective and reliable field assessment of biological control agents against grapevine trunk diseases. E. PAJOT, E. MOUNIER, C. BRIER, F. CORTES and A. COUTANT. *Agrauxine, 2 Rue Henri Becquerel, 49070 Beaucouze, France. E-mail: emmanuel.pajot@agrauxine.fr*

Esquive® WP is a biological control product containing the fungus *Trichoderma atroviride* strain I-1237. The product was registered in France for the prevention of grapevine pruning wound infection by *Eutypa lata*, the causal agent of Eutypa dieback. Since 2009 Esquive® has been applied to pruning wounds in order to investigate its effect on the expression of dieback symptoms, and on other grapevine trunk diseases such as Esca and Black Dead Arm (BDA). The experimental protocol was improved over two seasons (2010 and 2011), and with the support of statistical analyses (Principal Components Analyses) it was shown that specific experimental plan parameters were important to assess the efficacy of biological control agents (BCA) on trunk disease expression under natural field conditions. Observations and statistical analysis of the 2011 data, supported by results from previous years, allowed us to come to the following conclusion. For a BCA like *Trichoderma* to express significant efficacy, in particular towards complex grapevine trunk diseases, three main experimental factors are required; i) trials spanning multiple years and repetition of treatment; ii) the level of symptom expression during the year; iii) the sample size (number of plants) assessed. For example, on the bases of our observations we can conclude that when you note a sample with a number of plants by modality up to 500, associated with a level of trunk disease expression up to 5% in the control, you can make significant difference between the control and the BCA modality concerning the symptom disease expression. So, under natural conditions, to efficiently assess a new BCA product on grapevine trunk diseases, these parameters should be used.

Biocontrol of grapevine trunk pathogens with vine-specific antagonistic endophytic fungi. V. GONZÁLEZ, M. L. TELLO and P. ANDRÉS. *Instituto Madrileño de Investigación y Desarrollo Rural, Agrario y Agroalimentario (IMIDRA), Finca "El Encín". Apdo. 127, Ctra. N II, Km 38,20, 28800 Alcalá de Henares, Madrid, Spain. E-mail: vicente.gonzalez.garcia@madrid.org*

One of the future challenges related with grapevine disease management will be the implementation of new control strategies, especially after the banning of certain chemical fungicides, traditionally employed for the control and suppression of several important diseases like Esca, Petri or BDA. The present study explores the potential employment of several grapevine fungal endophytes belonging to genera previously reported as antagonists in other plant hosts, to prevent and control the development of grapevine trunk pathogens. Thus, seven endophytic isolates of the genera *Epicoccum* (4) and *Aureobasidium* (3) were tested to control the development of four grapevine pathogens (*Cadophora luteo-olivacea*, *Cylindrocarpon macrodidymum*, *Phaeomoniella chlamydospora* and *Phaeoacremonium aleophilum*) in two experiments. Direct antagonism tests were performed by dual culture of pathogens and endophytes. Potted grapevine seedlings were inoculated with both pathogens and endophytic strains at both simultaneously or by inoculating with the pathogen some days after the endophytic antagonist. In addition, a formulation of different fungal isolates as air-dried hydrogels (sodium alginate beads) was assessed. The capability and degree of control showed by the endophytic strains assayed in both direct confrontation and *in planta* tests are discussed, as well as the suitability of hydrogels to be employed as effective carriers for biocontrol agents.

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