

Practices and Prospects for Eutypa Control

Economic Impact of Eutypa

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Eutypa Dieback (Eutypa) is one of the most important diseases of grapevine worldwide. In a 2001 survey of viticultural and enological research issues conducted by the American Vineyard Foundation (AVF), over 2,000 vintners and growers placed Eutypa research second only in importance to Pierce's Disease in the categories of fungal, bacterial and viral diseases. Eutypa placed equal seventh out of a total of 60 viticultural concerns (www.avf.org). Present and anticipated losses to Eutypa are difficult to calculate because of the long incubation time of the disease. However, an estimate was prepared in 2001 on behalf of the AVF by Jerome B. Seibert, Ph.D., an agricultural economist at the University of California, Berkeley. His calculations were based on the work of Munkvold et al (1994) who characterized the relationship between yield and disease severity in Chenin Blanc (highly susceptible to Eutypa) and Barbera (tolerant of Eutypa) vineyards in Merced County, California (Figure 1). Yields began to decline in the susceptible Chenin Blanc vineyards after 10-12 years, an age associated with rapid increase in Eutypa Dieback. This was compared with healthy, Eutypa-tolerant vineyards (Barbera) where yields increased until vineyards were about ten years old and then were maintained. Munkvold et al (1994) estimated that yield reductions ranged from 30% to 80% depending on the severity of the disease.

Extrapolating from the relationship identified by Munkvold et al (1994), Siebert calculated losses attributable to Eutypa for the most important California wine grape cultivars (Siebert 2001). Overall, the loss in net income for wine grapes in California was estimated to be greater than \$260 million. Compared to the 1999 crop value at the producer level, this estimate amounts to nearly 16 percent of the gross

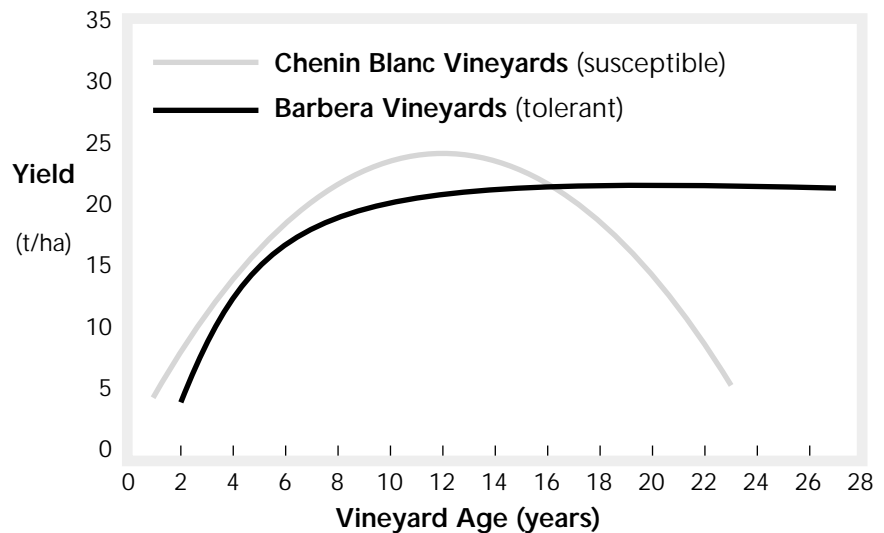


Figure 1: The relationship between vineyard age and yield as summarized for six Chenin Blanc vineyards (Eutypa-susceptible) and eight Barbera vineyards (Eutypa-tolerant). Modified from Munkvold et al 1994.

producer revenue of \$1.672 billion.

Studies in Australia have revealed significant yield losses to Eutypa (Wicks and Davies 1999). In a comprehensive study of Shiraz (Syrah) vineyards, Eutypa reduced bunch numbers from around 150 per vine in healthy plants to less than 50 in severely affected vines. Yield losses ranged from 1.3 lb to 19 lb/vine, respectively, for mildly and severely affected plants. The authors noted that in vineyards where an average of 31% of vines were infected, yield losses of at least 0.5 ton/acre and 0.3 ton/acre were typical for Shiraz and Cabernet Sauvignon, respectively. In a Shiraz vineyard where at least 47% of vines were infected with Eutypa, yield losses of 0.7 ton/acre were estimated to cost over Aus\$1200/acre (Wicks and Davies 1999).

Eutypa Dieback: The Nature of the Disease

Symptoms associated with Eutypa Dieback tend to be observed only in vineyards greater than 6-8 years old and become noticeable in early spring when new shoots on contaminated vines become severely stunted. Stunted shoots with misshapen, chlorotic leaves with tattered edges tend to be obscured by the growth of adjacent healthy shoots as the season progresses. Grape maturation and yield can be severely affected. Vegetative symptoms become more exaggerated with successive seasons until the arm or sector of the vine subtending the shoots fails to initiate new growth the following spring. If vines are left untreated they will die over the course of several years.

There is no published evidence to-date to suggest that stunted spring shoots are themselves contaminated with *Eutypa*. Rather, at the point of infection, usually the pruning wound from several seasons past, a wedge-shaped canker develops, and the fungal mycelium associated with this structure is thought to produce toxins that are translocated in the vascular system to induce shoot stunting in vine tissues above the canker. It is the sectorial shape of the canker that allows non-affected vascular tissues to support normal shoot development, while adjacent infected xylem delivers toxins, such as eutypine, only to those parts of the shoot infrastructure that are directly served by (and above) them.

Eutypa Dieback, caused by the fungal pathogen *Eutypa lata*, affects all varieties of grapevine, but Cabernet Sauvignon, Grenache, Syrah, Chenin Blanc and Petite Sirah are particularly susceptible showing more symptoms than varieties such as Riesling, Semillon, Chardonnay and Merlot, which are considered tolerant. Differing tolerances to *Eutypa* may involve differences in sensitivity to toxins produced by the fungus, different rates of toxin degradation by the plant, or differences in vine vigor. Vigorous varieties usually show more symptoms than less vigorous varieties. This may be because vigorous vines necessarily require more dormant pruning thereby creating greater surface area for infection by airborne *Eutypa* spores.

European studies have identified some relationships between rootstock variety and susceptibility to *Eutypa*. In a trial in France with the obscure grapevine cultivars Gramon and Chenanson grafted to six different rootstocks, it was observed that vines grafted to 41B were the most susceptible and those grafted to 110R the most tolerant (Peros 1999). Peros hypothesized that the vigor conferred by the rootstock and the related balance between yield and vegetative growth affected symptom expression.

Spread of *Eutypa*

The disease is spread through the infection of pruning wounds by ascospores (sexual spores) ejected by rain drops from perithecia ('fruiting bodies') found on dead or decaying grapevine wood. Infected vine wood left on the vineyard floor over winter is especially suitable for the development of stromata, the fungal tissue that gives rise to the perithecia.

In regions with temperate winters such as coastal California, *Eutypa* perithecia reach maturity in early spring, releasing ascospores with each rainfall of more than about 1 mm

(Carter 1988). Toward the end of the growing season, few spores are left within the perithecia, but they are enough to infect vines pruned in the following dormant season.

After pruning, and under favorable conditions, ascospores are drawn into the exposed xylem vessels at the surface of the pruning wound and germinate 2-4 mm below the wound surface. At optimum temperature, 20-25°C, ascospores germinate in about 12 hours. Ascospores may be carried by wind more than 100 km and remain viable. Germination may be reduced by periods of dryness or intense sunlight after ascospores have been released. The susceptibility of pruning wounds to infection by *Eutypa* spores diminishes significantly during the two weeks following pruning, and it is unlikely that infection will occur more than four weeks after pruning.

In a California study (Munkvold and Marois 1995), pruning wound susceptibility was greatest when vines were pruned early in the dormant season (November or December) and lowest when pruned later in the dormant season (January or March). Wound susceptibility declined significantly during the 28 days following pruning. The decline in susceptibility was correlated with an increase in suberin and lignin deposition at the pruning wound, and with degree-day accumulation. Non-pathogenic microorganism populations found at the pruning wound increased more rapidly when vines were pruned in early spring than in fall or early winter. It is hypothesized that these organisms compete for nutrients or inhibit pathogenic species such as *Eutypa*. Following germination, fungal hyphae grow through the xylem, spreading into the wood and eventually killing vine tissues.

An infected vine may show symptoms of *Eutypa* Dieback for years but never develop stroma from which the ascospore-producing perithecia arise. Stroma only develop on infected vines where the mean annual rainfall exceeds 350 mm. This is why the disease is most common in high rainfall areas. Ascospores are released each time the stroma receives more than 2 mm of rainfall, or the equivalent in overhead irrigation. Ascospores are ejected from mature perithecia within 1-2 hours of the onset of rainfall and may continue to be discharged for up to 36 hours if the stroma remains wet. If rain continues for more than 36 hours, perithecia become temporarily emptied of ascospores, however, more will mature after about 12 days.

Control of *Eutypa*

The greatest challenge in the control of *Eutypa* Dieback is prevention of infection of clean pruning wounds on non-infected vines that are adjacent to, or downwind of, contaminated vines. Until recently, the fungicide Benlate was an effective control option for prevention of infection. Fresh pruning wounds were painted with a mixture containing the fungicide. In 2001, however, DuPont ceased to manufacture Benlate and since then no suitable chemical control methods have been available.

Infection prevention, sanitation and the adoption of clean vineyard practice are the only options for prevention of within vineyard and vineyard-to-vineyard spread of *Eutypa*. *Eutypa lata* has a great number of native and non-native hosts, however, and if vineyards are situated close to natural habitats or cultivated areas with host plants, stringent vineyard sanitation measures may prove futile.

Recommended sanitation measures include removal of infected wood from adjacent grapevine, stone fruit, and other host plants. University of California pest management guidelines (www.ipm.ucdavis.edu/PMG/r302100611.html) recommend that dead arms and cordons are removed by pruning below the canker on the arm or trunk until non-cankorous tissues are found. Pruning should take place after rainfall, when the risk from infection is lowest because spores have been washed from the air, and late in the dormant season when pruning wounds heal more rapidly (UC Pest Management Guidelines 2002).

Double Pruning

Double pruning is a method that can significantly decrease the likelihood of infection by *Eutypa*. Vines are pruned early in the season to remove brush followed by a final late winter pruning. Early season brush removal may be accomplished rapidly and cheaply using machines or non-skilled labor. End of season pruning can occur just prior to budburst when the chance of infection is reduced because fewer spores are available, sap bleeding flushes spores from the pruning wounds, and wounds heal more rapidly. In regions of high *Eutypa* pressure, double pruning may be the only option for large acreages if late season pruning is desirable.

How early can pruning begin after harvest? Earlier pruning dates make investments in mechanical pruning equipment more attractive. Ed Weber, Napa County Farm Advisor, is involved in double pruning trials where vines first pruned in October, November and

December are under comparison. Weber wants to discover whether there are side effects related to pruning in October, for example, when green, photosynthetically active leaves are removed. Weber has observed that early pruning tends to be associated with early bud-break which may present a frost risk. However, if the final pruning is undertaken late in the season, early bud break did not occur, indicating that in double pruning, the final pruning date determines bud break, not the date of the first pruning. Weber is also examining the extent to which Eutypa can grow into the vine by artificially inoculating pruning wounds at different times during the dormant season. Vines will be subsequently examined at the time of late season follow-up pruning to determine whether the fungus has moved past this position.

Treatment of Pruning Wounds

There are no currently registered chemicals for treatment of pruning wounds. Consequently growers in areas of high Eutypa pressure have devised their own methods, sometimes as a result of their collaboration in university field trial studies. It is quite common in northern California to paint pruning wounds with a mixture of boric acid in latex-based paint or paste. One combination that is typical of those used in the industry consists of a 5% by weight mixture of a boric acid containing compound such as MICROSOL B in DOC FARWELL's latex paste. In areas of high Eutypa pressure, growers may treat pruning wounds on both newly planted and established vines. Because of toxicity concerns, some growers have tracked Boron levels in vines painted with MICROSOL B and found that although there was a slight increase after pruning they returned to control levels by the end of the year. Boric acid is registered as a fertilizer, and so its use as a fungicide is not approved.

Some growers use a liquid formulation of the detergent DREFT as a post-pruning treatment for prevention of Eutypa infection. As with boric acid, however, the benefits of this treatment are not clear. Other growers have experienced bud burn after using DREFT and have noted that it may easily wash off in the rain.

Vineyard Sanitation

Hector Bedolla, Vineyard Manager with Kendall-Jackson in Windsor, California, stresses the importance of general vineyard sanitation for control of Eutypa. Bedolla uses grapevine-registered dormant copper and oil-based sprays for control of fungal and insect pathogens,

respectively. These are applied around and within the vineyard to maintain a high level of sanitation. Particular emphasis is placed on removal of brush immediately after pruning. As part of his sanitation practice, Bedolla routinely examines vines during the growing season and removes Eutypa-infected canes. Non-productive, heavily contaminated vines are flagged for removal at the end of the season. Partly contaminated vines are pruned to remove infected tissues and left in the ground for further evaluation.

Bedolla has noticed that vineyards at higher elevation are more prone to Eutypa and believes this is related to higher spore concentrations at higher elevations. He has observed that Eutypa is especially of concern in older AxR rootstock-grafted vineyards and in old head-trained Zinfandel blocks, where ancient arms can be a significant source of spores. Sanitation in this kind of vineyard is especially important.

Revitalizing Severely Contaminated Vines

There are two main approaches to revitalizing severely infected vines: top-working and training of basal scion suckers. Benjamin Falk, Vineyard Manager, and Ashley Anderson, Vineyard Technician, at Cain Vineyard and Winery on Spring Mountain in St. Helena, California, have experimented with both methods in the rejuvenation of Eutypa-contaminated Cabernet Sauvignon and Cabernet Franc vineyard blocks grafted to AxR and planted in the early 1980s.

Falk and Anderson believe that Eutypa control is even more important now that they are in the midst of a substantial replanting program where the heads of cane-pruned vines are 24" off the ground compared to 42" for those of the older Eutypa-infected vines. Falk has seen that Eutypa spreads along the cordon to the trunk and down the vine at the rate of several cm per year. As vines can be saved from the disease by drastic pruning to well below the canker, longer trunks provide a greater opportunity to save and restore contaminated vines. Falk cuts back to a point 8-12" below the visible internal canker to ensure complete excision of the diseased tissues and has found this to be effective in curing contaminated vines. Vines so-treated are then top-worked by T-budding new scion stock of the same clone to the upper part of the severed trunk. This procedure has worked well and usually both buds grow. The excision of infected trunk or cordon tissues is a trial and error process with cutting back continuing until at least 8" of healthy, non-cankered tissues have

been removed. Anderson suspects that T-budding fails when sufficient trunk material is not removed and estimates that the procedure is unsuccessful in about 15% of treated vines.

Although Cain's top-working program has been successful, Falk and Anderson believe their highest success has resulted where vines are reworked by training suckers from just above the graft union for 2-3 years (until spurs are established for development of new cordons) before removing all the trunk above the point of sucker development (about 6-12" above the ground). In earlier work they had let suckers grow for 3-4 years before cutting the trunk but found that this method slowed sucker growth and provided too much opportunity for downward spread of the disease through the trunk.

Alternative Strategies

Several growers in northern and central coast California are involved in field trials of a newly registered product called BROTOMAX. Brotomax, registered as a nutritional amendment rather than a fungicide, is an 8-0-0 fertilizer with micronutrients derived from a mixture of naturally occurring compounds that are purported to stimulate a plant's natural systemic resistance response to infection by pathogens. Brotomax is manufactured by Agrometados, S.A. of Madrid, Spain and contains nitrogen, copper, manganese and zinc.

In a series of California vineyard trials conducted at several sites during 2002 by the Western Farm Service, Fresno, on behalf of Agrometados, it was observed that yield and harvest brix were consistently higher in Eutypa-contaminated vines of several cultivars treated with Brotomax. Over a series of ten trials, harvest brix was 0.9 points higher from treated vines while yields were significantly improved at an average of 2.6 tons per acre compared with 1.1 tons for non-treated vines. Yields were improved through an increase in the number and size of fruit clusters. Brotomax was applied as a foliar treatment at a 1% dilution in water.

Emerging Strategies in the Fight Against Eutypa

As part of a multi-faceted approach to understanding Eutypa and developing effective control systems, the American Vineyard Foundation in cooperation with the Viticultural Consortium have funded a group of California researchers to the tune of more than \$500,000 over the last two years.

The research program is divided into four broad areas encompassing the development of improved disease monitoring, cultural, chemi-

cal, and plant-related control methods. Discussions with Patrick Gleeson, AVF Executive Director, Mark Greenspan, AVF Eutypa Project Coordinator and Research Viticultural Manager at Gallo Sonoma, and with several of the staff involved in the research effort, have provided insight into the strategies, success and future direction of this program.

Improved Disease Monitoring Methods

Eutypa Toxins as Indicators of Vine Infection

Dr. Russell Molyneux, USDA-ARS, Albany, California is developing analytical methods that can be used routinely to screen different Eutypa strains for the presence and absence of known metabolites. The ultimate objective of his work is the development of a rapid-use field kit that can determine the presence of Eutypa infections in non-symptomatic vines in the vineyard. The working hypothesis behind his project is that various Eutypa-specific toxins are produced in trunk canker tissues and transferred via the vascular system to young growing shoots during the spring. Here the toxins induce stunted shoots characteristic of Eutypa contamination. As the basis for a rapid field test, Molyneux hopes to detect these toxins in non-symptomatic leaf tissues. Using tissue culture systems, research has shown that eutypine is one of the major toxic metabolites produced by Eutypa but that it is detoxified by grape tissues into the alcohol, eutypenol (Molyneux et al 2002), which is found in infected vines at much higher levels than eutypine. This observation has led to the development of sensitive methods for the detection of eutypenol that could be the basis for a Eutypa-detection kit. Several other metabolites have also been identified and it appears that a suite of Eutypa metabolites may be responsible for the development of disease symptoms. Molyneux's group is currently testing the affect of putative toxic compounds in leaf-disc bioassays and they hope to identify the toxins in asymptomatic leaves for the first time in the vineyard this spring (2003).

Because of the close relationship between Eutypa metabolite plant toxins and those isolated from vines contaminated with other grapevine pathogens associated with Black Measles (Esca) and Black Foot disease (Cylindrocarpon), it is hoped that Molyneux's work on Eutypa will help in the understanding and control of other important grapevine diseases. Molyneux is also working in collaboration with the Australian Cooperative Research

Center for Viticulture to compare toxins produced from Australian strains of Eutypa with those from the US.

Direct Detection of Eutypa by DNA-Fingerprinting Technology

Until recently, Eutypa contamination could only be confirmed by the development of symptoms in vines and by culturing cankerous tissues on specially formulated media in vitro (in petri dishes). The latter procedure has several drawbacks in that it is time consuming, necessarily destructive, and depends on the skills of mycologists to distinguish the sexual structures (conidia) of Eutypa from other related grapevine wood-contaminating species. One of the main thrusts of the AVF-funded program, therefore, was the development of accurate, objective, and reproducible techniques for the rapid detection of Eutypa in grapevine tissues. Dr. Doug Gubler, of the University of California, Davis, has developed a PCR-based RFLP (restriction fragment length polymorphism) method for the direct identification of Eutypa lata in grapevine wood, and distinction of the pathogen from the many taxonomically related fungi that infect grapevine. Gubler is using this technology to help understand the epidemiology of Eutypa Dieback and relationships between various Eutypa strains and other species frequently found in association with Eutypa. In related work, Dr. Jean VanderGheynst, also of UC Davis, has used a PCR procedure to determine that Eutypa mycelium travels basipetally within the phloem of the vine's vascular system and can extend up to 14 cm below the trunk canker. Tissues were extracted directly from the vine and then DNA was purified and subjected to PCR amplification to detect any genetic material from Eutypa. VanderGheynst has observed that compounds co-purified from the vines along with DNA may inhibit the PCR assay and so experiments have been established to determine the sensitivity of the assay to these compounds.

Improved Control Methods

The Effect of Pruning and Trellising on Eutypa Dieback

It is clear that timing of pruning can have a dramatic effect on the spread of Eutypa. In an effort to better understand the relationship between trellis system, associated extent of pruning required, and Eutypa infection, Dr. Sanliang Gu of the Viticulture and Enology Research Center at California State University, Fresno, is involved in a ten year experiment examining these parameters. The study is based

on Cabernet Sauvignon vines grafted to Freedom rootstock growing in the Central Valley and involves high and low capacity soils, and head-, bi-lateral cordon- and Sylvoz-trained vines as well as minimally pruned and mechanically pruned treatments of bi-lateral-cordoned vines. Head-, bi-lateral cordon- and Sylvoz-trained vines are pruned between November and January; mechanically pruned vines just prior to bud break; and minimally pruned vines are not pruned during the winter at all, but trimmed (skirted) between fruit set and pea-sized berry stage. The upshot of this work is really quite logical. Vines growing on vigorous soils tend to need more pruning management and consequently are more prone to Eutypa infection. Sylvoz- and bi-lateral cordon-trained vines require the most pruning and suffer from the highest Eutypa-infection rates. Head trained vines require fewer pruning cuts and are less prone to Eutypa infection while mechanically pruned vines, pruned just before bud break also have low infection rates because spore counts are low, sap bleeding occurs, and wounds heal more rapidly in early spring. Minimally pruned vines suffered the least infection because they were not pruned during the winter months. To-date, Gu has observed no significant difference in quality or yield from the different treatments. The conclusions to-date are that time of pruning and area of pruning wounds are directly correlated with the occurrence of Eutypa Dieback.

Understanding Eutypa Dispersal

Although the Central Valley of California receives only limited rainfall, Eutypa Dieback is a significant problem for many growers in this region. It has been hypothesized that spores are carried on the wind from northern coastal California but it is not known whether infected plant material used in grafting or replanting programs might also be a factor. Dr. Lynn Epstein, UC Davis, is investigating the epidemiology of Eutypa infection at university field plots by using AFLP-detection technology to determine the genetic identity of separate infections. By doing so Epstein can differentiate between Eutypa colonies and infections that are derived from wind-borne sexually transmitted ascospores and those that might have resulted from vegetative propagation of grapevine wood and fungus. To-date, the work has shown that at least some of the infections at the UC Davis plot were initiated by ascospores rather than by vegetative propagation or conidia, and that the AFLP technology is sufficiently sophisticated to differentiate between sexually related

ascospores while confirming the identical genetic nature of clones.

In related work, Epstein is using PCR methods to test for the presence of *Eutypa* propagules on the external surface of grapevine shoots. Previous *Eutypa* detection methods based on in vitro culture necessitate the sterilization of grapevine wood tissues which, while eliminating potentially competing fungi and bacteria from the petri dish culture, also remove any external *Eutypa* material. This study will help to determine whether it is possible that plant material movement by grafting or planting is a potential source of new *Eutypa* infections.

New Formulations for Pruning Wound Protection

Because there is no registered treatment for the control of *Eutypa*, Gubler's UC Davis laboratory has been testing the efficacy of various fungitoxic chemicals and naturally occurring competitive fungi as pruning wound treatments. In in vitro assays, boric acid has shown excellent *Eutypa* control, but no effective methods of dispensing boron-based treatments to vines have yet been developed. In an effort to develop long acting products that can protect vines through the spring, experiments have focused on fungicidal mixtures that have greater stability and adhesion properties. To-date, two potential boric acid-containing products are under study. A boric acid-containing paste, 'biopaste', has been shown to adhere well to pruning wounds in rainy weather. A second product named 'bioshield' is a mixture of boric acid with a spore suspension of *Cladosporium herbarum*.

It has been known for some time that a variety of bacteria and fungi naturally colonize grapevine pruning wounds and can significantly reduce infection by *Eutypa*. Both *Cladosporium herbarum* and *Fusarium lateritium* were identified as potential antagonists of *Eutypa* that could significantly reduce infection under some conditions (Munkvold and Marois 1993). *C. herbarum* naturally colonizes grapevine wounds and can prevent *Eutypa* infection by competing for nutrients and habitat. Although *C. herbarum* is a good colonizer of grapevine it has been found that *Eutypa* can still infect wounds when populations of the competitive fungi are low. Consequently, Gubler's group devised an application product containing *C. herbarum* spores mixed with boric acid that has been shown to prevent the initial colonization by *Eutypa*. Although *C.*

herbarum can tolerate relatively high levels of boric acid in vitro, 'bioshield' will be formulated with minimal concentrations because of concerns about possible toxic 'wash off' from pruning wounds. Protection against *Eutypa* contamination of pruning wounds has been achieved using both products but their long term effectiveness and potential boron toxicity are still under investigation.

Study of the mode of action of *Eutypa* biocontrol by *Fusarium lateritium* is underway in the laboratories of Drs. Jean VanderGheynst and David Block at UC Davis. They are investigating the hypothesis that antifungal agents produced by *F. lateritium* might suppress *Eutypa* development. In other work, possible competition between the two organisms for limited resources is under study. Studies have shown that *F. lateritium* begins cane colonization before *Eutypa*. When *Eutypa* was inoculated five days after *F. lateritium*, infection by the pathogen was completely averted, but not when they were inoculated simultaneously. The results suggest that pruning wounds should be pre-colonized by *F. lateritium* 7-14 days in advance of *Eutypa* contamination in order to prevent development of the disease.

Improved Genetic Resistance to *Eutypa*

In an effort to provide options for breeding *Eutypa*-resistant grapevines, Gubler's group is studying the biology of canker formation and, in particular, the cellular and physiological processes involved in the degradation of wood tissues. This involves the study of mechanisms by which *Eutypa* brings about changes in grapevine wood cell structure. It is hoped that understanding the biochemical degradation caused by *Eutypa* and the pathogenicity factors involved in canker formation and grapevine tissue death might lead to identification of molecular and enzymatic pathways that could be the target of breeding programs directed toward genetic resistance to *Eutypa* infection.

Work in France by Roustan et al (2000) has shown that it may be feasible to genetically engineer grapevine plants with resistance to *Eutypa*. The group of scientists cloned a gene from *E. lata* whose product is responsible for the reduction of the toxin eutypine to eutypenol, thus rendering it harmless. Using standard Agrobacterium-mediated gene transfer technology, this gene was then inserted into grapevine

tissues from whence whole grapevine plantlets were derived. These tissue-cultured grapevine plants had greater tolerance to eutypine than control plants.

Conclusion

It is clear that a substantial research effort is currently directed to the identification of new methods for controlling *Eutypa* infection and understanding the epidemiology of the disease. In the short term, it is to be hoped that growers will soon have available new tools and management strategies that can be used to prevent infection and spread of disease in *Eutypa*-challenged vineyards. Prospects for *Eutypa* control based on grapevine breeding programs are much further distant, however, but will offer important insights into the biology and epidemiology of *Eutypa* Dieback. In the meantime, until new technologies become available, sensible pruning practices and stringent sanitation measures can help to reduce the incidence of the disease.

If all efforts to control *Eutypa* fail, don't despair. Take heart from the efforts of Australia's McLaren Vale d'Arenberg Winery (www.darenberg.com.au) which produces one of their 'flagship' wines from old Shiraz vines heavily contaminated with *Eutypa*. So contaminated in fact, that d'Arenberg's 'Dead Arm' Shiraz is made exclusively from fruit taken from the good arms of vines that have lost substantial portions of their infrastructure to *Eutypa*. d'Arenberg opines that fruit on the live arms of infected vines have superior flavors to that of healthy vines because such small amounts are produced. It seems that Robert M. Parker of The Wine Advocate agrees, describing d'Arenberg's Dead Arm as "...outrageously rich, spectacular stuff, the likes of which only Aussies seem capable of making." Now there's a challenge! wbm

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