Final Report

Project Title: Control of Eutypa Dieback of Grapes

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Proposed Project: The ultimate objective of this research is to develop practical measures for the control of Eutypa dieback of grapevines by modifying the pruning wound so that infection cannot take place. The original five objectives were 1) investigate the potential of experimental and registered fungicides to control disease, 2) determine the mechanism by which wounds become less susceptible over time 3) determine the potential for chemicals which increase the rate of wound healing to decrease the period of susceptibility of fresh wounds, 4) screen fungi which commonly occur on wounds for their potential to inhibit germination of Eutypa and therefore control disease, 5) test for the ability of nonpathogenic fungi to increase the wound healing response of the vine. Due to progress made to date, we are adding three other relevant objectives to the proposal. The first is based on the findings during this study that cherry is a host for the pathogen (Objective 6). We propose to determine the potential of Central Valley cherry orchards to serve as inoculum sources for Eutypa. The second new objective (Obj. 7) is to quantify the relationship between vineyard age and incidence of Eutypa dieback.

Progress: Objective 1) Two plots were established in the Delta to test the DMI compounds for control of Eutypa. Also, treatments were included to determine the potential of multiple applications of benlate (two weeks apart) to control Eutypa. Fungicides were applied and the Eutypa was placed on the wounds after 1 day or 14 days. We have begun working with Rohm and Haas for registration of Rally.

Objective 2) Through a new approach to data analysis, we found that the rate of wound healing, and thus the reduction in susceptibility to infection, is dependent upon the accumulation of degree days after wounding. This explains why pruning early in the season when the weather remains cold for a longer period results in a longer period of susceptibility (Fig. 1).

Objective 3) Several compounds have been identified which stimulate and increase the rate of wound healing of woody plants (ie ethylene, chitin, chitinase). We established 2 research plots to test several of these types of compounds this past December.

Objective 4) The most promising organisms were tested over a range of inoculum density and their population growth monitored in both field and laboratory experiments. Field plots were established in December and February. In growth chamber and greenhouse experiments, 4 fungi were used that were found to be able to reduce disease in the field, Cladosporium herbarum, Fusarium lateritium, Penicillium spp. and Aureobasidium spp. We found that populations increased rapidly in the experiments and that often noninoculated wounds developed high levels of C. herbarium due to natural colonization. These fungi also restricted the natural colonization of other fungi, thus indicating the potential to manipulate the microbial community so that Eutypa can not gain a foothold. Also we have found that there is more diversity in the bacterial species than in the fungal species, however we have not found many bacterial species which were promising control agents. In related research, we determined that most of the natural colonizers of wounds originated from the bark. If we carefully remove the bark before making the pruning wound, the wound was much less colonized for a longer period of time. This could mean that the Eutypa spores may also reside in the bark for long periods of time and inoculate the wounds during pruning. Doug Gubler has found that cleistothecia of powdery mildew overwinters in bark, and we have isolated Eutypa from bark many times. In the future we want to develop a series of experiments to determine if spores residing in the bark are important sources of inoculum. If so, dormant spray, as with powdery mildew, may be beneficial.

Objective 5) This research has not begun, is dependent upon further work on Objective 4.

Objective 6) We have inoculated cherry trees and grape vines during the past two winters. The 1991 inoculations were read this fall (1992) and indicate that the Eutypa from cherries or grapes is able to infect either host. No indication of host specificity exists, indicating that infected cherry trees are serving as an important source of inoculum for infection of vineyards. The second series of experiments were analyzed this spring and we found that not only did infection occur, but typical canker development and dieback occurred on both grape and cherry, regardless of where the fugal isolated came from originally (Table 1-3).

Objective 7) We found a high correlation with the reduction in yield of Chenin blanc vineyards beginning at 12 years and a corresponding rapid increase of Eutypa symptoms beginning at about 10 years of age. In Barbera vineyards that had little Eutypa infection, the yield increased for the first 10 years and then stayed constant for the next 20 years (that is all the further the data went). This indicates that Eutypa is the limiting factor for long term yield production in many vineyards. (Fig. 2).

Figure 2. Relationship between vineyard age and yield for A, five Chenin blanc vineyards and B, four French Colombard vineyards in Merced County, CA. Data are from 1969-1990.

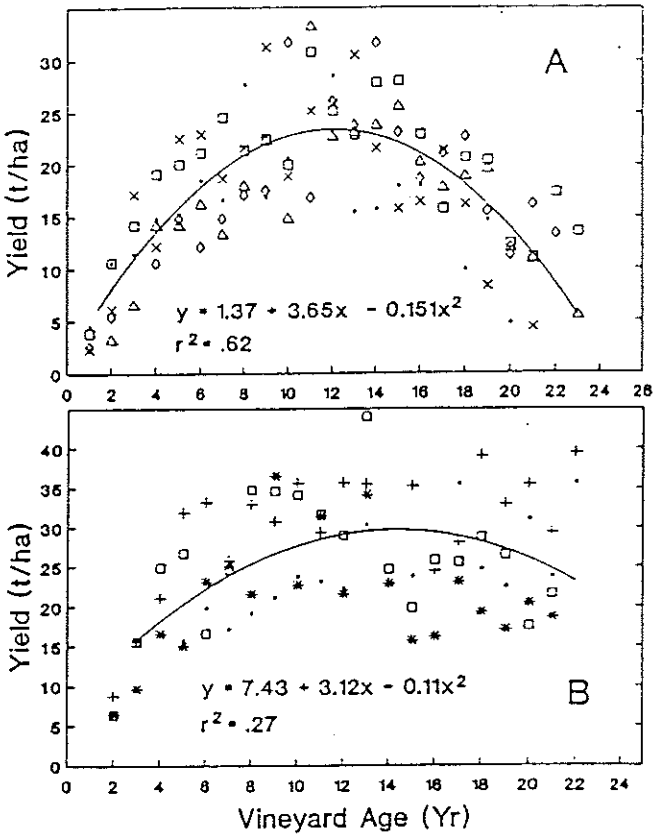

Figure 4. Accumulation of degree-days above 0 C for 28 days after pruning on three different pruning dates during the dormant season, (A) 1989-90, and (B) 1990-91.

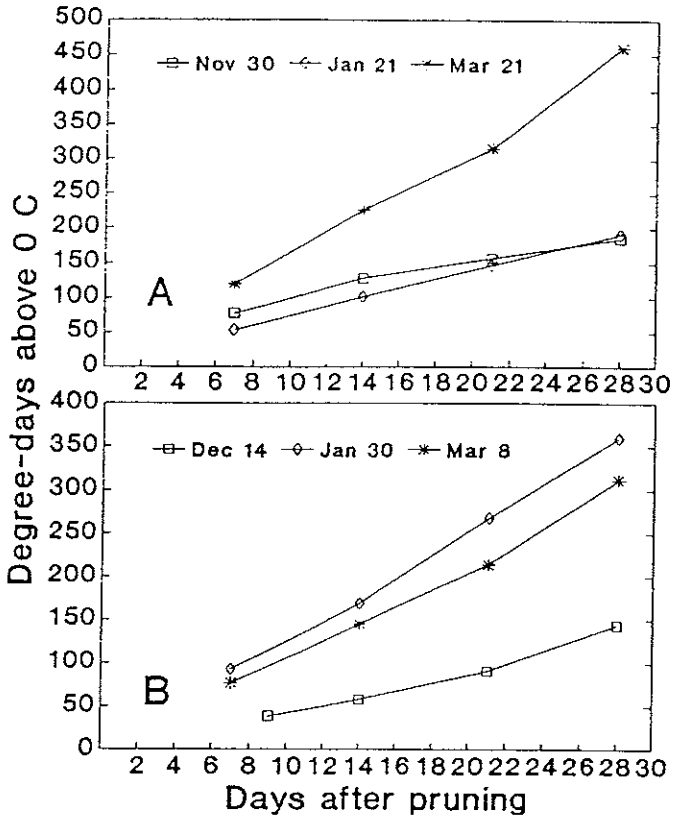

Table 1. Mean lengths of xylem necrosis and frequency of *Eutypa lata* reisolation from cherry and apricot branches and grape cuttings, inoculated April 1990 with *E. lata* from cherry or apricot. Data were collected June 1990. Means are from 10 plants for each treatment.

		Inoculated	Noninoculated
Apricot isolate			
Apricot	Mean length (mm)	68.0[a]	26.2
	Reisolation	10/10	0/10
Cherry Isolate			
Apricot	Mean length	62.4	26.2
	Reisolation	9/10	0/10
Cherry	Mean length	46.4	24.1
	Reisolation	10/10	0/10
Grape	Mean Length	28.9	16.8
	Reisolation	10/10	0/10

[a] Means for inoculated plants were all significantly greater than means for noninoculated plants ($P \leq .001$).

Table 2. Mean lengths of xylem necrosis and frequency of *Eutypa lata* reisolation from grape cuttings, inoculated April 1991 with *E. lata* from cherry or grape. Data were collected November 1991.

	Inoculated	Noninoculated
Cherry Isolate		
Mean Length (mm)	72.6[a]	13.6
n[b]	18	17
Reisolation	16/20	0/20
Grape Isolate		
Mean Length	71.0	13.6
n[b]	17	17
Reisolation	20/20	0/20

[a] The effect of inoculation on xylem necrosis was significant ($P \leq .001$); the effect of isolate was not significant ($P > .05$).

[b] n = number of plants used to calculate means. This number varied among treatments due to death of some of the plants.

Table 3. Canker development on cherry branches inoculated with *Eutypa lata* from cherry in April, 1991. Data were collected in May, 1992.

	Inoculated	Noninoculated
Cork Borer Wound		
Cankers	9/15	0/15
Canker Length[a]		
Range (mm)	30-199	-
Mean (mm)	129	-
Xylem Necrosis[b]		
Range (mm)	50-286	10-20
Mean (mm)	143	15
Reisolation	14/15	0/15
Pruning Wound		
Cankers	4/5	0/5
Canker Length[a]		
Range (mm)	32-130	-
Mean (mm)	83	-
Xylem Necrosis[b]		
Range (mm)	32-240	20-35
Mean (mm)	127	28
Reisolation	4/5	0/5

[a] Canker length ranges and means included only those branches with external cankers.
[b] Xylem necrosis ranges and means included all branches that received each treatment.

Executive Summary

"Control of Eutypa Dieback of Grapes"

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The ultimate objective of this research is to develop practical measures for the control of Eutypa dieback of grapevines by modifying the pruning wound so that infection cannot take place. The original five objectives were 1) investigate the potential of experimental and registered fungicides to control disease, 2) determine the mechanism by which wounds become less susceptible over time 3) determine the potential for chemicals which increase the rate of wound healing to decrease the period of susceptibility of fresh wounds, 4) screen fungi which commonly occur on wounds for their potential to inhibit germination of Eutypa and therefore control disease, 5) test for the ability of nonpathogenic fungi to increase the wound healing response of the vine. Due to progress made to date, we have terminated objectives 2, 3, and 4 and added three new objectives. Objective 6 is to determine the potential role of Central Valley cherry orchards to serve as inoculum sources for Eutypa. The second new objective (Obj. 7) is to quantify the relationship between vineyard age and incidence of Eutypa dieback.

We found that wound healing was dependent on a degree day relationship, which explains why late spring pruning results in a reduced period of susceptibility to infection. Using historical yield data and current disease assessment of different aged vineyards, it was found in vineyards with susceptible varieties of grapes that peak Eutypa dieback was (90% of vines infected with 40% of the spurs diseased) after 20 years correlated with a decrease in yield commonly observed beginning at about the same age vineyard. This relationship was not found in a resistant variety. Cross inoculations resulted in typical dieback symptoms of both grapes and cherries when inoculated with Eutypa fungus originating from either host. Thus, cherry orchards in the Central Valley are a likely source of inoculum for vineyards. For ongoing research, we established two plots to determine the efficacy of Rally and multiple applications of benlate (0 and 14 days after inoculation) to control disease. Degree of control achieved will be determined in the winter of 1994. We also established two field plots to test our most promising biological control agents (2 saprophytic fungi originally isolated from wounds) at two rates. We also are conducting extensive ecological studies of the microbial community on the wound service to further increase the efficacy of the biological control agents.