CHARACTERIZATION OF RESISTANCE TO PIERCE'S DISEASE IN *MUSCADINIA ROTUNDIFOLIA* AND THE POTENTIAL FOR CONFERRING RESISTANCE TO GRAFTED *VITIS VINIFERA* SCIONS

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ABSTRACT
Muscadinia rotundifolia is a wild grape native to the Southeast U.S. In field trials, as well as in the wild, this species exhibits strong resistance to Pierce's disease (PD). Incorporating this resistance into *Vitis vinifera* production systems in California will require identifying prime breeding material and increasing our understanding of the mechanism of resistance. The first objective of this study was to determine if resistance to *Xylella fastidiosa* (*Xf*) and PD varies among wild *M. rotundifolia* populations across a natural gradient of disease pressure. Greenhouse trials are underway using material collected in Florida, Georgia and Tennessee. The second objective was to test the common belief that some *M. rotundifolia* cultivars are more *Xf* resistant than others are. Again, trials are currently underway. Thirdly, we want to test if *Xf* resistance in *M. rotundifolia* is consistent when challenged with different *Xf* strains from Florida and California. Lastly, we want to examine the potential for conferring *Xf* and PD resistance to *V. vinifera* scions by grafting them to resistant *M. rotundifolia* rootstocks. This project is ongoing and only very preliminary results are available now. One such result is that even the least resistant *M. rotundifolia* selections are much more resistant than the *Vitis vinifera* cultivars. We have also confirmed that supposed graft incompatibility between the two species can be overcome using green grafting techniques. These grafted plants are entering disease trials now.

INTRODUCTION
Use of resistant plant material is a proven approach to solving crop pest and disease problems. This approach can provide a robust solution that, among other advantages, avoids the potential negative environmental impacts associated with a chemical control strategy. Unfortunately, in the case of Pierce's disease, it appears that all the common cultivars of *V. vinifera* are susceptible to the disease (Raju and Goheen 1981). Historically, breeders and researchers have looked to the wild grape species of the southeastern U.S. for potential sources of PD resistance (Loomis 1958, Mortensen et al. 1978). PD pressure is very high in this region and many of the local species are indeed resistant or tolerant. In particular, *M. rotundifolia* appears to have exceptional resistance and is planted extensively in Florida (Loomis 1958, Hopkins et al. 1974). Efforts have been made to create PD resistant bunch grapes by crossing *M. rotundifolia* with *V. vinifera*. Initial success was limited because of genetic incompatibility, but efforts continue and some fertile hybrids are available (Lu et al. 2000). Such hybrids are also being used in work aimed at identifying the genes responsible for the resistance (Krivanek and Walker 1999, 2000). The current project is aimed at increasing our understanding of how PD resistance (or tolerance) functions in M. rotundifolia with the thought that such knowledge will improve our chances of incorporating resistance into *V. vinifera*. We will also explore the potential for conferring this resistance to *V. vinifera* via grafting.

OBJECTIVES
1. Determine if resistance to *Xylella fastidiosa* (*Xf*) and Pierce's disease varies among wild *M. rotundifolia* populations across a natural north/south gradient of disease pressure.
2. Test the common belief that some *M. rotundifolia* cultivars are more *Xf* resistant than others.
3. Determine if *Xf* resistance in *M. rotundifolia* is consistent when challenged with different *Xf* strains from Florida and California.
4. Determine if there is any potential for conferring *Xf* and PD resistance to *V. vinifera* scions by grafting them to resistant *M. rotundifolia* rootstocks.

RESULT
Variation in resistance in wild M. rotundifolia
We completed a collection trip in June 2003 that covered the range of PD pressure from Florida (high) to Tennessee (low). Replicated potted cuttings from 11 collection sites are now in a resistance trial in the greenhouse (n = 138, including controls). This experiment serves as an indirect test of the hypothesis that *Xf* resistance in *M. rotundifolia* reflects an evolved response to the disease. Results indicating that resistance tracks disease pressure would suggest that resistance did evolve in response to the disease. We would therefore expect the mechanism to be something specific such as an induced defense that results from some chemical elicitor. If resistance does not appear to be an evolutionary response, we might expect a more general mechanism such as basic differences in xylem structure or xylem sap composition.

Variation in resistance in M. rotundifolia cultivars

Past research and 'common knowledge' suggest that some *M. rotundifolia* cultivars are actually quite susceptible to PD (Hopkins et al. 1974, Mortensen et al. 1977). Unfortunately, the studies cited suffered from poor experimental design lacking proper replicates and controls. In another greenhouse trial, we are examining *Xf* resistance in 2 reportedly susceptible cultivars ('Pride' and 'Lucida') and two reportedly resistant cultivars ('Southland' and 'Carlos'). This trial is comprised of 47 potted vines. For comparison, we included the highly susceptible *V. vinifera* ('Chardonnay') and the less susceptible *V. vinifera* ('Chenin Blanc'). Meeting this objective will help us narrow our search for the mechanism of resistance by identifying candidates for comparisons of resistant and susceptible genotypes within *M. rotundifolia*. Preliminary results indicate that even the least resistant *M. rotundifolia* are much more resistant than both *V. vinifera* cultivars.

Resistance to different Xf strains

Xylella fastidiosa and PD are widespread across the warm regions of the Americas and occur in a vast number of host plants including many crops. Genetic work has shown that the *Xf* strains that cause diseases in different crops differ genetically (Chen et al. 1992, Hendson et al. 2001). We also know that different *Xf* strains differ in their ability to produce PD symptoms in grape (Hopkins 1985). We would like to know how the resistance in *M. rotundifolia* holds up across a number of different strains. Identifying selections with broad and robust resistance will be of obvious benefit to the breeding programs aimed at producing resistant grape varieties. This objective is on hold while we await the approval of our APHIS permit application to import *Xf*.

Xf resistance from rootstocks?

The wine grape industry would prefer a solution that allows them to keep pure *V. vinifera* scions. Thus, positive experimental results with this objective would have obvious practical implications and indicate that resistance may be derived from some mobile secondary metabolite. In fact, success with this approach will depend entirely on the mechanism of resistance. Some reasons to be hopeful include two other cases of rootstocks conferring disease resistance/tolerance to scions in grapes: with crown gall (Sule and Burr 1998) and with fanleaf virus (Walker et al. 1991). Furthermore, rootstock choice has been shown to affect xylem chemistry, leafhopper feeding, and the concentrations of *Xf* in peach (Gould et al. 1991). This past summer, we used green-grafting techniques to produce replicated combinations of *M. rotundifolia* selections and *V. vinifera* var. 'Chardonnay' (n = 27 potted vines). To increase the chance of success with this objective, we also created a number of grafts using other *Xf* resistant species such as *V. girdiana* and *V. arizonica* as rootstocks (n = 16 potted vines). These plants will enter a resistance trial including inoculation with *Xf* in November.

CONCLUSIONS

The results of this study will increase our understanding of the mechanism of PD resistance in wild grapes. On a more applied level, the project will identify prime material to be incorporated into breeding programs. Furthermore, testing for graft-conferred resistance from rootstocks could lead to a novel solution to the PD problem in wine grape viticulture.

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Section 1B: Detection and Field Monitoring Methodologies for the Glassy-winged Sharpshooter and Xylella fastidiosa