FIELD TRIAL FOR RESISTANCE TO PIERCE'S DISEASE

Principal Investigator
Thomas A. Miller
Department of Entomology
University of California
Riverside, CA 92521
thomas.miller@ucr.edu

Co-Principal Investigator
Matt Daugherty
Department of Entomology
University of California
Riverside, CA 92521
matt.daugherty@ucr.edu

Collaborator
Peggy Mauk
Agricultural Operations
University of California
Riverside, CA 92521
peggy.mauk@ucr.edu

Reporting Period: The results reported here are from work conducted October 2013 to February 2014.

ABSTRACT
The development of new plant varieties that are less susceptible to infection by pathogens is an important element of plant disease management. In the case of Pierce's disease, caused by the vector-borne pathogen *Xylella fastidiosa*, multiple mechanisms have been identified that may allow vines to resist or tolerate infection by this pathogen. The purpose of this project is to provide support for field trials with these new grapevine varieties in Riverside County, where vector and disease pressure are high. Four grapevine plantings have been established during the project, the latest of which occurred last summer. These plantings continue to be maintained as would vines in a commercial setting, including regular irrigation, weeding, fertilizer additions, fungicide applications, and pruning. Many of the vines, especially in the earlier plantings, have shown symptoms and mortality in a manner that is consistent with Pierce's disease. Monitoring of the vector populations from an adjacent vineyard suggests that, although vector pressure may be somewhat low over the last season due to attempts to control the Asian citrus psyllid, significant sharpshooter populations remain in the area of the trial.

LAYPERSON SUMMARY
A major focus of Pierce's disease management includes attempts to develop new grapevine varieties that are less susceptible to the pathogenic bacterium *Xylella fastidiosa*. This project was initiated to oversee experimental vineyards in Riverside County to evaluate some of these new varieties. Four sets of vines have been planted since 2010 and continue to be maintained as would occur in a commercial vineyard. Some of these vines, especially in the oldest plantings are showing evidence of Pierce's disease. Although populations of the primary vector, the glassy-winged sharpshooter, are down somewhat compared to previous years they are still fairly abundant in the area.

INTRODUCTION
Host plant resistance to pathogens has long been recognized as a valuable tool for limiting disease in many agricultural systems. For example, resistance breeding programs have been successfully applied to the control of wheat leaf rust (Kolmer 1996) and rice diseases (Leung et al. 2003). Recently there has been substantial research related to the development of Pierce's disease resistant or tolerant grape cultivars.

Pierce's disease occurs in grapevines following infection by the pathogen *Xylella fastidiosa*. Multiplication of this xylem-limited bacterium in vines plugs xylem vessels, which precipitates leaf scorch symptoms and typically kills susceptible vines within a few years (Hopkins and Purcell 2002). Historically Pierce's disease prevalence was moderate in the Western US. However, in the 1990s severe outbreaks of PD occurred in southern California that were attributed to the invasion by the glassy-winged sharpshooter, *Homalodisca vitripennis* (Almeida et al. 2005).

Since the invasion of the glassy-winged sharpshooter much effort has gone into developing strategies to mitigate the impact of this vector and pathogen. One of the longer-term solutions is expected to be the development of novel grapevine varieties that are less susceptible to infection by *X. fastidiosa*. To this end, multiple research groups have identified different molecular mechanisms that may increase vine resistance or tolerance (e.g., Aguero et al. 2005, Lindow and Chatterjee 2007, Dandekar et al. 2012). These transgenic mechanisms have shown promise in reducing Pierce's disease severity in a laboratory

setting. Now these novel varieties are being evaluated in field trials to understand how they perform under more real world conditions.

OBJECTIVES

The Riverside County field trial is intended to duplicate a commercial operation to determine how grapevines will fare in the presence of pressure from the sharpshooter leafhopper vectors that transmit the pathogen causing Pierce's disease. The specific objectives of the project are as follows:

1. Maintain the grapevines as handled by commercial vineyards.
2. Dispose of plants at the end of the trial as required by permit
3. Post-removal monitoring for recruitment as required by permit

RESULTS AND DISCUSSION

Objective 1.

The fourth, and final, planting for the Riverside County field trial occurred last season. Prior to planting a trellis and irrigation system was established as occurred for previous plantings. Vines were transported from UC Davis and were transplanted in early summer. The vines appear to have established well, with little to no mortality occurring over the first season.

All plantings continue to be maintained in the same manner. This includes regular irrigation, fungicide applications as necessary for mildew control, fertilizer application, and weed control. In late winter all of the vines were pruned in the same manner.

Several of the vines, especially those in the earliest plantings were showing symptoms in the fall that are consistent with Pierce's disease (Fig. 1). Only the newest planting did not have clear evidence of significant disease.

Sharpshooters were not actively monitored in the research plot during the current project period. However data is available from adjacent vineyard plots approximately 100m northeast (Fig. 2). In these young vineyard blocks both glassy-winged and smoke-tree sharpshooters were present, with trap catches declining over the fall as is typical for this time of year (Fig. 3). Nonetheless these data suggest that, though perhaps reduced compared to previous seasons, efforts to control the Asian citrus psyllid in the surrounding citrus have not eliminated local sharpshooter populations.

Figure 1. Vine in Riverside County field trial showing apparent Pierce's disease symptoms.

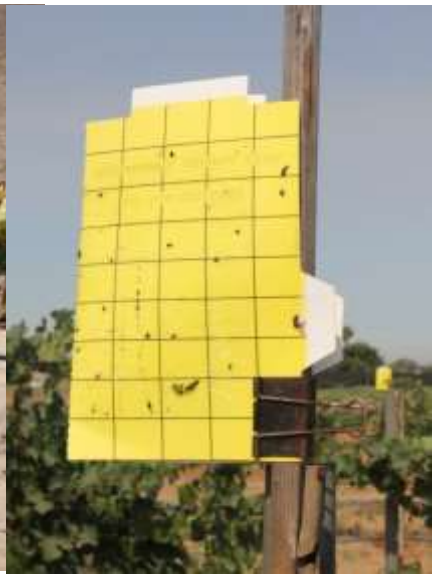

Figure 2. Yellow sticky trap for sharpshooter monitoring in adjacent vineyard plots.

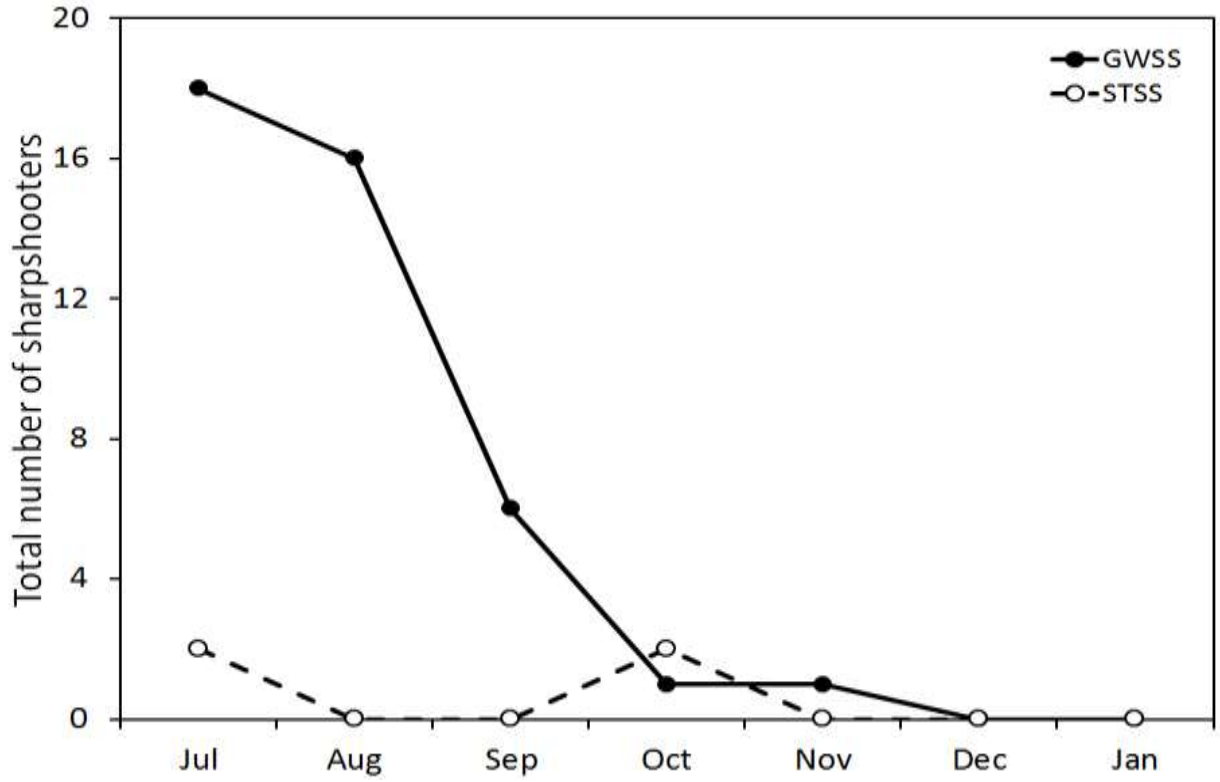

Figure 3. Total number of glassy-winged sharpshooter (GWSS) or smoke-tree sharpshooter (STSS) adults caught on twelve yellow panel traps spread among two small vineyard plots adjacent to the Riverside County field trial.

CONCLUSIONS

Multiple plantings of different transgenic grapevines with reduced susceptibility to Pierce's disease have successfully been made in Riverside County. These grapevines all continue to be maintained using the same viticultural practices. Based on the prevalence of apparent Pierce's disease symptoms in some of the vines and the continued trapping of sharpshooters in the area, these vines appear to be sufficiently exposed to high disease pressure to allow for adequate evaluation of the performance of these novel varieties at resisting or tolerating infection by *X. fastidiosa*.

REFERENCES CITED

Aguero, C.B., Uratsu, S.L., Greve, L.C., et al. 2005. Evaluation of tolerance to Pierce's disease and *Botrytis* in transgenic plants of *Vitis vinifera* L. expressing the pear PGIP gene. Molecular Plant Pathology 6:43-51.

Almeida, R.P.P., Blua, M.J., Lopes, J.R.S. and Purcell, A.H. 2005. Vector transmission of *Xylella fastidiosa*: Applying fundamental knowledge to generate disease management strategies. Annals of the Entomological Society of America 98: 775-786.

Dandekar, A. M., Gouran, H., Ibanez, A.M. et al. 2012. An engineered innate immune defense protects grapevines from Pierce disease. PNAS 109:3721-3725.

Hopkins, D. L. and A.H. Purcell. 2002. *Xylella fastidiosa*: Cause of Pierce's disease of grapevine and other emergent diseases. Plant Dis. 86: 1056-1066.

Kolmer, J.A. 1996. Genetics of resistance to wheat rust. Annual Review of Phytopathology 34:435-455.

Leung, H., Zhu, Y., Revilla-Molina, I. et al. 2003. Using genetic diversity to achieve sustainable rice disease management. Plant Disease 87:1156-1169.

Lindow, S. E. and S. Chatterjee. 2007. Management of Pierce`s disease of grape by interfering with cell-cell communication in *Xylella fastidiosa*. *Pierce`s Disease Research Symposium. San Diego. 12-14 December 2007.*

FUNDING AGENCIES
Funding for this project was provided by the CDFA Pierce's Disease and Glassy-winged Sharpshooter Board.

ACKNOWLEDGEMENTS
Thanks to D. Soto and J. Vazquez for providing the sharpshooter monitoring data.