Title of report:
Evaluating Potential Shifts in Pierce's Disease epidemiology

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Reporting Period: The results reported here are from work conducted between November 2015 and February 2016.

Abstract
Pierce's disease of grapevine (PD) has reemerged in Napa and Sonoma counties, where disease incidence has been much higher than usual and the distribution of sick vines within vineyards often does not fall within expectations. These field observations taken together with the very high number of vineyards affected in the region indicate that a PD epidemic is emerging. The goal of this proposal is to determine what factors are driving this epidemic, so that ecology-based disease management strategies can be devised and immediately implemented, as was successfully done in the past when disease drivers appear to have been different.

Lay Summary
A PD epidemic is emerging in Napa and Sonoma counties. Very high PD prevalence is being reported throughout the region, with a large number of stakeholders reaching out to UCCE Farm Advisors. In summer 2015, the project team held a series of joint meetings/field visits with the Farm Advisors. Two observations have been made that raised our concern about the problem. First, high prevalence of PD in the North Coast is usually below 1-2% per vineyard; several vineyards visited had over 25% of vines symptomatic. Second, historically PD is closely associated with riparian zones in the North Coast; we have visited several vineyards where PD does not appear to be associated with riparian zones. We have observed these greater rates of disease incidence and dissociation with riparian areas throughout Napa and Sonoma counties—they are not district specific. The goal of this proposal is to determine what factors are driving this epidemic, so that ecology-based disease management strategies can be devised and immediately implemented, as was successfully done in the past when disease drivers appear to have been different.

Objectives
We propose a series of objectives that are necessarily intertwined, but are described here independently so that aims and expectations are more clearly described in the methods section.

Objective 1. Vector, pathogen, and host community surveys to inform the development of a quantitative model to assess future Pierce's disease risk and develop integrated management strategies.

Objective 2. *Xylella fastidiosa* colonization of grapevines and the role of overwinter recovery in Pierce's disease epidemiology.

Objective 3. Determine the role of spittlebug insects as vectors of *Xylella fastidiosa*.

Objective 4. Data mine and disseminate existing information on vector ecology, vegetation management, and efficacy of pruning.

Objective 5. Develop a larger extension and outreach footprint with additional seminars, extended interviews made available on the web, and an update to the *Xylella fastidiosa* website, the main online resource for PD information.

Results and Discussion

We provide a brief description of our initial and ongoing activities, as we are currently setting up a large component of this project (i.e. Objective 1).

Objective 1. Vector, pathogen, and host community surveys to inform the development of a quantitative model to assess future Pierce's disease risk and develop integrated management strategies.

In order to quantify disease incidence and improve our understanding of infection patterns, we surveyed 4 and 8 vineyard blocks in Sonoma and Napa counties, respectively, in late summer/fall 2015. The occurrence of Pierce's Disease symptoms (present or absent) was recorded for each vine in all study blocks. We also worked with grower cooperators to identify roughly 30 blocks (12 to 15 in each County) that will serve as our study blocks for detailed surveys to be performed under this objective. Those study blocks are now being established, with insect monitoring scheduled to begin in late February/early March. We have also made arrangements to solicit grower-generated monitoring data from the Oak Knoll PD Task Force, Rutherford landowners participating in the flood control's riparian restoration program (Napa County), and Sonoma County growers. Because our survey work is getting started, we have no results to report.

Objective 2. *Xylella fastidiosa* colonization of grapevines and the role of overwinter recovery in Pierce's disease epidemiology.

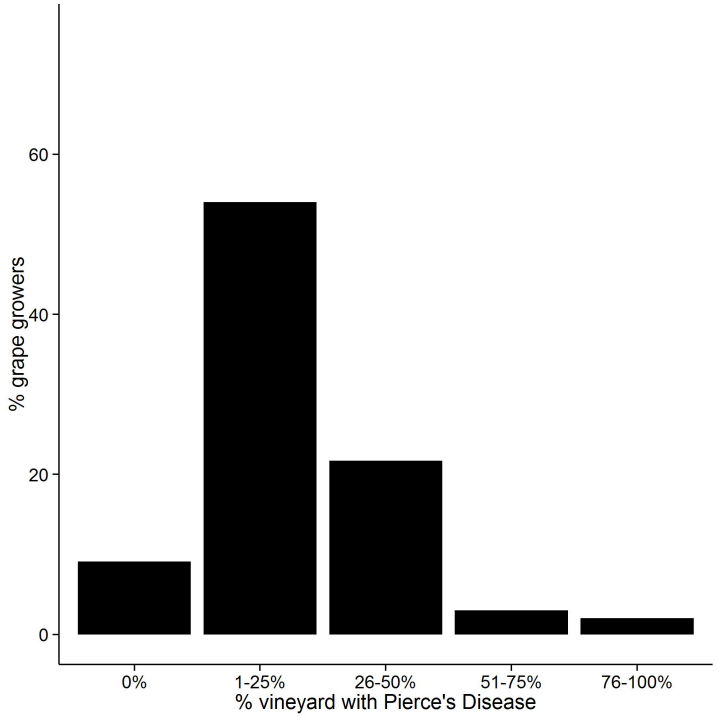
In an attempt to better understand the role of winter conditions on PD epidemiology as well as how growers and managers view the threat of PD and manage the disease, we performed two surveys during extension events conducted on January 13, 2016 (Napa) and February 11, 2016 (Sonoma). In total, 198 growers/managers participated in our surveys: 147 from Napa and 51 from Sonoma. The survey included questions on past and present experiences with PD, management actions, and demographic characteristics.

Two other observations from this survey were interesting. First, 73% of respondents said that PD was one of their top 3 management problems. Second, we gained an understanding of management practice commonly employed for PD with the following question:

Percent of managers responding that they relied mostly on the following management actions:

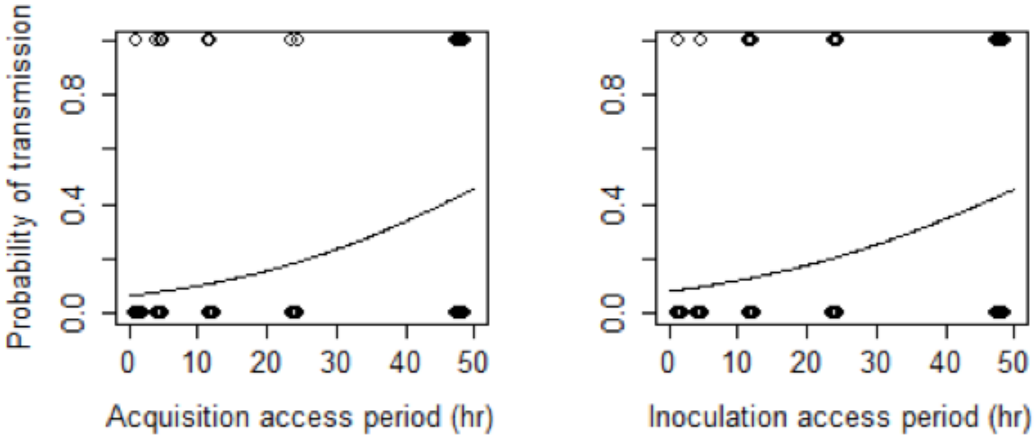
Management action	**% growers**
Insecticides in vineyard	17.67
Insecticides outside vineyard	1.51
Roguing	38.88
Severe pruning	3.53
Weed control	3.53
Riparian management	8.58
Vector or Disease Monitoring	14.64

Lastly, we attempted to estimate current losses due to PD (see figure below). We note that losses appear to be larger than those attributed to PD in the past decade.



Objective 3. Determine the role of spittlebug insects as vectors of *Xylella fastidiosa*.

Initial work on the characterization of the transmission of *X. fastidiosa* by the main spittlebug found in vineyards to date, *Philaneus spumarius*, was done. Data are being analyzed, but we provide initial information on the transmission efficiency of the pathogen from grape to grape by this insect. Work being initiated will focus on spittlebug biology and ecology in vineyards.

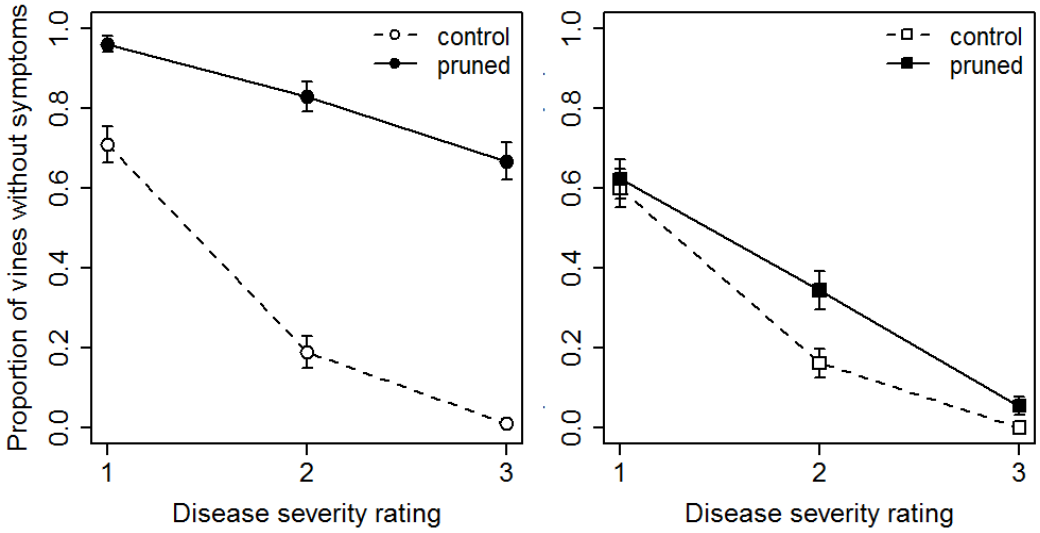


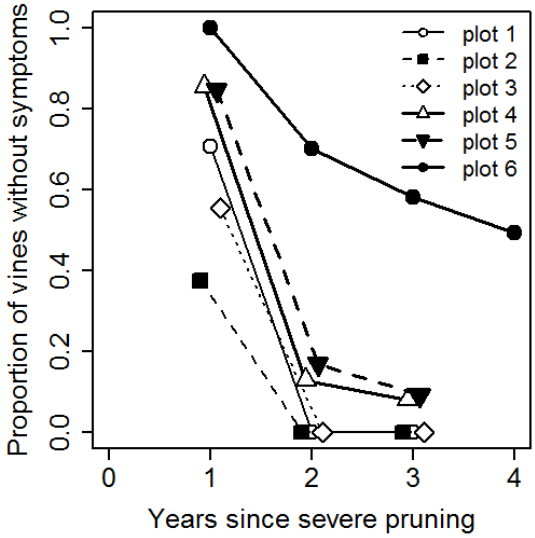
Relationship between model-predicted probability of *X. fastidiosa* transmission by *Philaneus spumarius* and acquisition access period (A) and inoculation access period (B).

Objective 4. Data mine and disseminate existing information on vector ecology, vegetation management, and efficacy of pruning.

Data on the efficacy of pruning generated by Ed Weber and Sandy Purcell about 15 years ago was obtained, organized, analyzed, and a manuscript draft prepared. We are currently editing this manuscript for submission to a peer-reviewed journal. Here we present the two main figures of the manuscript with their respective caption. We are refraining from including other text due to space limitations, editing is ongoing, and the fact that the figures and captions are somewhat self-explanatory. The main conclusion is that severe pruning may work, to some degree, to remove infections in plants with intermediate levels of Pierce's disease.

Symptom return in pruned or control vines from 3 different disease severity categories A) 1 year after pruning, or B) 2 years later.





Rate of symptom return after severe pruning for the six research plots. Some plot symbols offset slightly for clarity.

Objective 5. Develop a larger extension and outreach footprint with additional seminars, extended interviews made available on the web, and an update to the *Xylella fastidiosa* website, the main online resource for PD information.

Extension events:

Sonoma Grape Day
One seminar on PD focusing on management strategies. February 10 - ~200 attendees.

Sonoma Vineyard Technical Group
One seminar on PD focusing on management strategies. February 11 - ~75 attendees.

Oak Knoll PD Task Force formed (35 members); have held 3 meetings since early December. We are working closely with this group on insect detection and disease management.

Presentation by M. Cooper, on Pierce's Disease epidemiology (in Spanish) to 220 attendees, at ROOTSTOCK (11/12/2015), organized by Napa Valley Grapegrowers, and held in Napa, CA.

Napa Valley Vineyard Technical Group; Jan 13, 2016; 234 attendees. Two lectures on PD and PD management followed by Q&A.

"Factors affecting Pierce's Disease outbreaks", presented by M. Cooper to Rutherford Dust Society (45 attendees), Feb. 4, 2016, Rutherford, CA.

Pierce's Disease Vector ID workshop, Feb 18, 2016 (English (37 attendees) and Spanish(18 attendees)), Napa, CA.

Outreach
Rhonda Smith, Monica Cooper, and Matt Daugherty have given interviews to several trade publications (e.g. Practical Winery and Vineyard, Wines and Vines). Rhonda Smith was featured in a The Press Democrat article about PD as well.

Conclusions
There are no conclusions at this stage.

References Cited
None.

Funding Agencies
Funding for this project was provided by the California Department of Food and Agriculture Pierce’s Disease / Glassy-winged sharpshooter Research Program.