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

Principal Investigator:
Rodrigo Almeida
Dept. Environmental Science, Policy and Management
University of California, Berkeley
Berkeley, CA 94720
rodrigoalmeida@berkeley.edu

Cooperators:
Monica Cooper
Viticulture Farm Advisor
University of California, Cooperative Extension, Napa County

Matthew Daugherty
Associate Extension Specialist
Department of Entomology
University of California, Riverside

Paul Fine
Associate Professor
Dept. of Integrative Biology
University of California, Berkeley

Alexander Purcell
Professor Emeritus
Dept. Environmental Science, Policy and Management
University of California, Berkeley

Rhonda Smith
Viticulture Farm Advisor
University of California, Cooperative Extension, Sonoma County

Lucia Varela
Integrated Pest Management Advisor
University of California, Cooperative Extension, Sonoma County

Reporting Period: The results reported here are from work conducted between March 2016 and July 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

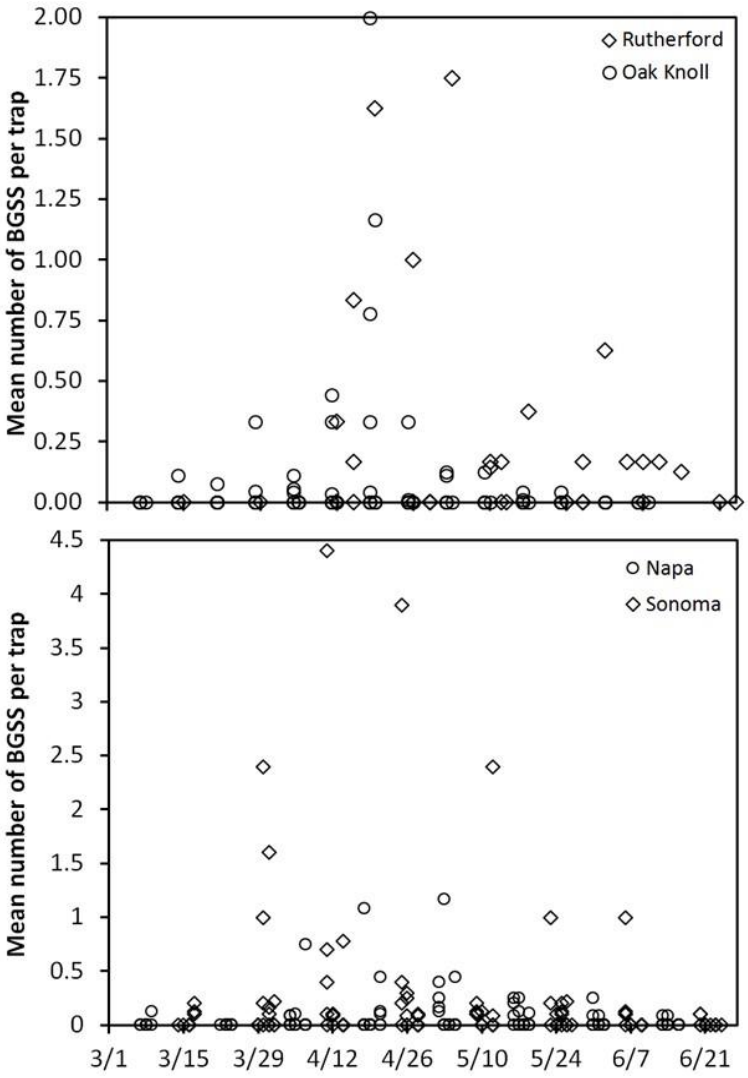
We provide a brief description of our initial and ongoing activities.

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.

We will focus on blue-green sharpshooter (BGSS) monitoring in this report. In the Spring of 2016 parallel monitoring programs were established to quantify seasonal abundance of BGSS in vineyards as well as nearby riparian areas. This has included two grape-grower generated monitoring programs in Napa County – one in Rutherford, for growers participating in a riparian restoration program, and a second for the Oak Knoll growing region. Thus far, 8 Rutherford vineyard blocks are being monitored, with up to a dozen traps per block, at least once a month. For the Oak Knoll program, more than a dozen blocks are being monitored as frequently as weekly. The second set of BGSS monitoring is being conducted by researchers (our team) in 46 blocks spread throughout Sonoma and Napa Counties - 24 blocks in Napa and 22 in Sonoma. Every two weeks 6 – 10 traps are checked at each site, and all BGSS caught are removed and frozen for later determination of whether they are carrying *X. fastidiosa*.

So far this season, the BGSS monitoring programs indicate vector populations in vineyards are low. For example, although the grower generated monitoring data showed up to an average of 2 BGSS per trap in late April, approximately 70% (92/131) of vineyard block censuses found no BGSS on that date (Figure 1A). The researcher generated monitoring data showed similarly low BGSS densities, with the highest densities primarily in some Sonoma County vineyard blocks between the end of March and mid-May, but with most vineyard censuses finding no BGSS on that date (Figure 1B).

Figure 1. Number of BGSS caught over Spring 2016 in parallel trapping programs A) conducted by grape growers in two regions of Napa County, and B) by researchers (our team) at sites throughout Napa and Sonoma Counties.



The survey of riparian plant community started in July 2016. We hope to have the survey completed for all sites in Sonoma and Napa valleys completed by the end of this season. Plant community transects are geographically linked to sticky traps near vegetation used to monitor BGSS populations.

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

Analysis of climatic data from Napa and Sonoma Valleys has been initiated.

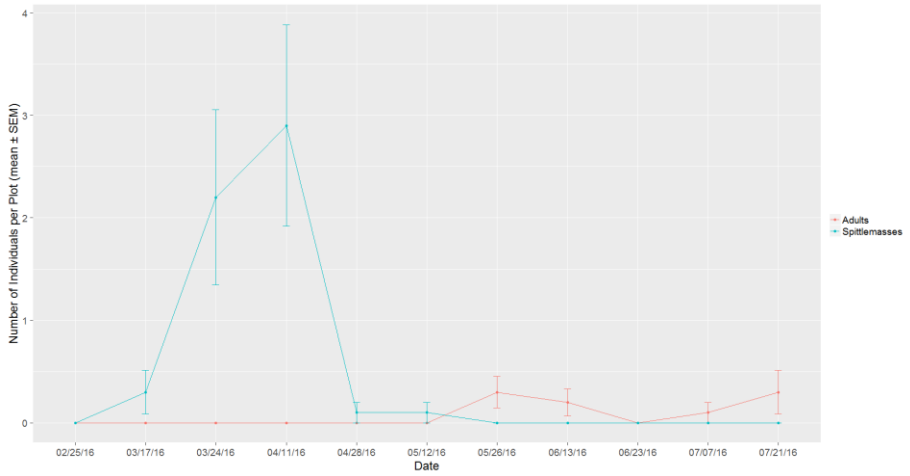
Objective 3. Determine the role of spittlebug insects as vectors of *Xylella fastidiosa*.

Work on the characterization *X. fastidiosa* transmission by the main spittlebug found in vineyards to date, *Philaenus spumarius*, was finished. A manuscript has been accepted and is available online at: http://apsjournals.apsnet.org/doi/pdf/10.1094/PHYTO-05-16-0202-R
As that work is over and the paper published, we will refrain from including the details here, as those can be read in the above mentioned website. Among our findings, we determined that *P. spumarius* transmits *X. fastidiosa* to grapevines with an efficiency of 20%/individual/day.

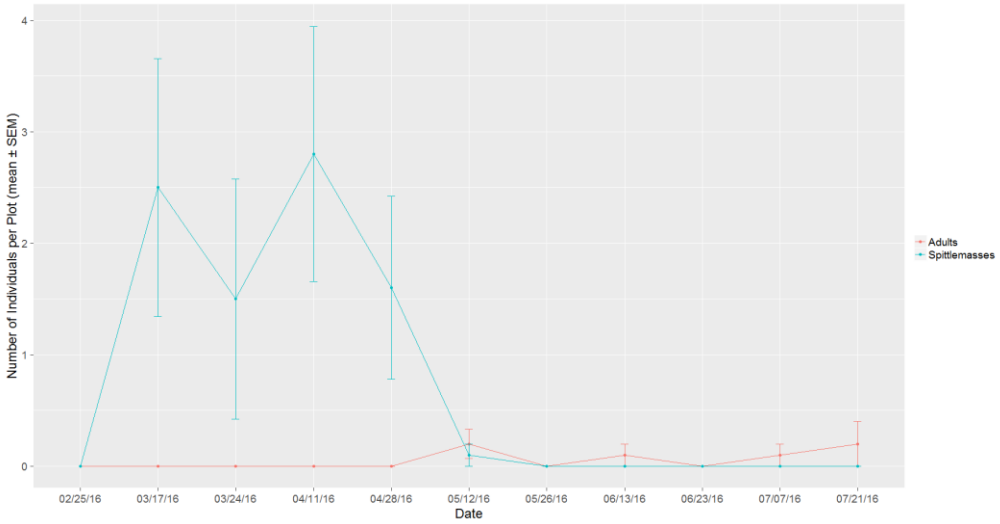
To study spittlebug phenology in the North Coast, a field project was initiated. Starting in February 2016, we surveyed sites in Napa and Sonoma County for nymphs of the meadow spittlebug, *P. spumarius*. At the site in Sonoma, two vineyards were surveyed while at the Napa site, one vineyard was surveyed. Except in cases of extreme weather, the vineyard sites were surveyed biweekly. These surveys consisted of randomly selecting 10 plots in each vineyard during each sampling period. Each plot consisted of two vine-rows and one inter-row and had an approximate area of 7x15 ft^2. Nymph sampling consisted of randomly throwing six 2x2 ft^2 quadrats in each plot and collecting all nymphal spittlemasses within each quadrat. Nymphs were removed from spittlemasses and individually counted. Associated host plants of the nymphs were identified in the field and any unknown host plants were collected and preserved for later identification. In late March to early April, biweekly surveys for the adult *P. spumarius* began at our two sites in conjunction with observations of this species' phenological development. In each of the 10 plots, the two vine-rows and the inter-row were each subjected to 25 sweeps with a sweep net. Additionally, a yellow sticky trap (*Seabright Labs*) was hung on the middle trellis wire of each plot's two vine-rows and checked biweekly for captured adults of *Philaenus spumarius*. Every four weeks the yellow sticky traps were collected and replaced.

Preliminary data are presented here.

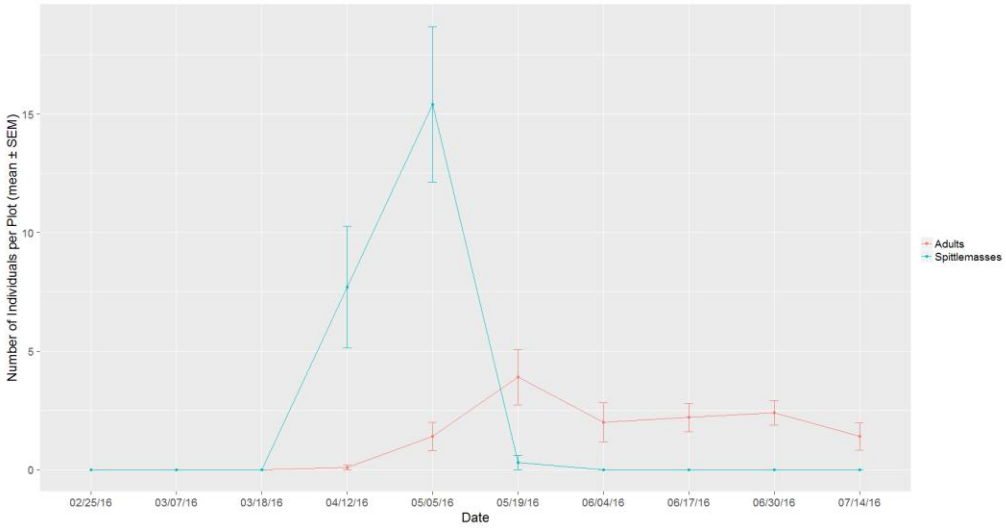
<u>Sonoma Site 1 Vineyard 1-</u>



Sonoma Site 1 Vineyard 2-



Napa Site 1 Vineyard 1-



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. The relevant data were included in the previous report, we are now working on the manuscript itself.

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: "Sampling for PD vectors and treehoppers", whicht was attended by 134 people, at the UC Oakville field station on June 1, 2016.

Outreach: Rhonda Smith, Monica Cooper, and Matt Daugherty have given interviews to several trade publications.

Website: the *Xylella fastidiosa* website has been redeveloped. Among the updates, it is now easier for visitors to reach PD management information. Content for the disease management sections is still being developed, although an early version focusing on southern California is already available. We have also added a News section, and a 'Ask Sandy' component – which we hope visitors will use to ask questions directly to Sandy Purcell, with answers posted on the website. Content, links and other components are being updated/modified to optimize visitors' experience and better deliver information.

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.