Title
Evaluating Potential Shifts in Pierce's Disease epidemiology

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Reporting Period
The results reported here are from work conducted March 2018 to June 2018.

Abstract
In this report we present data on sharpshooter natural infectivity as well as the currently available data on spittlebug vector populations. Other aspects of this project have been summarized in previous reports.

Lay Summary

A PD epidemic emerged in Napa and Sonoma counties. Very high PD prevalence was 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.

Introduction

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. In this report we summarize progress made trying to understand the biology of spittlebug vectors and seasonality of blue-green sharpshooter natural infectivity.

Objectives

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

As part of our monitoring activities, we are regularly collecting BGSS from the nearly 400 sticky traps placed throughout vineyards and on the border with neighboring habitats. These insects are then being assayed via qPCR to estimate the fraction that is positive for *X. fastidiosa* (i.e. natural infectivity). Thus far, more than 600 unique BGSS have been assayed from collections made at more than 30 vineyard sites between December 2016 and July 2017.

Of the insects tested, 13.1% (80 of 611) were positive for *X. fastidiosa*, those this value varied seasonally (Figures 1, 2). Specifically, overall, estimated BGSS natural infectivity declined from a winter peak upward 40 to lows in the summer of less than 5%. There was little difference in natural infectivity between those BGSS collected from traps bordering adjacent habitat, such as riparian, oak woodland, or ornamental plantings (13% overall) and those from traps within the vineyards (13.2%). The exception might be some apparent differences in December and January, though the sample sizes for those months are insufficient to be conclusive (Figure 1).

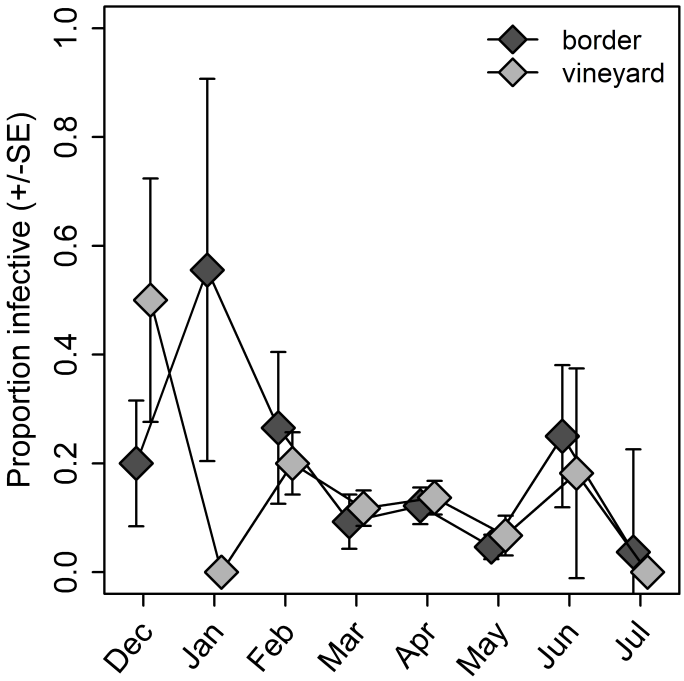


Figure 1. Seasonal patterns in natural infectivity of BGSS adults collected from traps within vineyards or on the border of vineyard and other habitat.

With respect to those sites bordering riparian habitat versus some other non-riparian habitat (e.g., oak woodland, ornamental plantings, other vineyards), there was little overall difference in natural infectivity (13 vs. 14.1%, respectively). However, seasonal patterns differed between riparian and non-riparian sites with notably higher natural infectivity for BGSS at riparian sites over the winter (Figure 2).

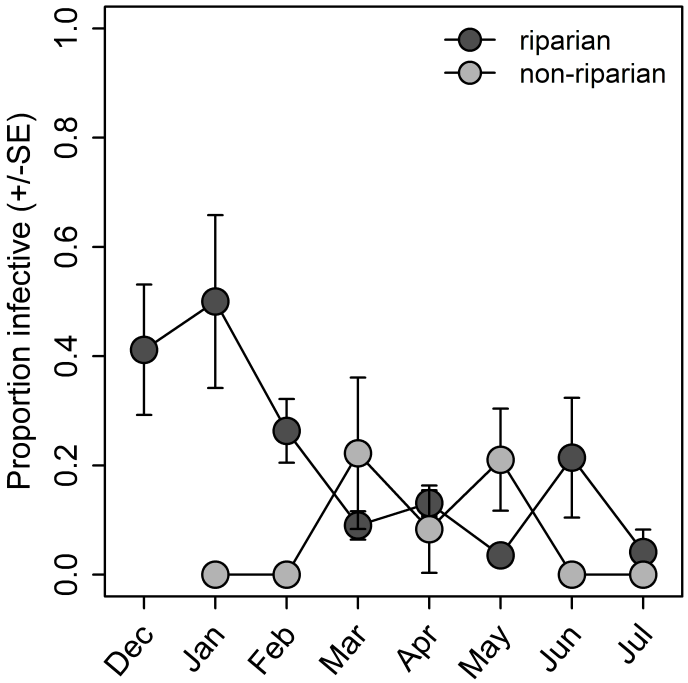
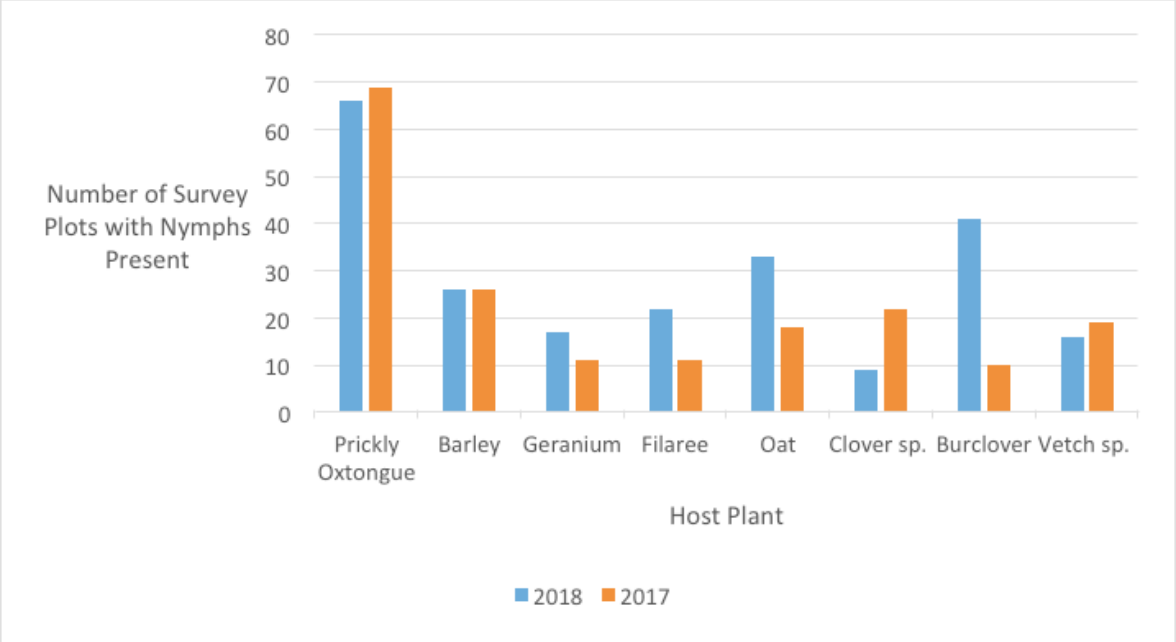


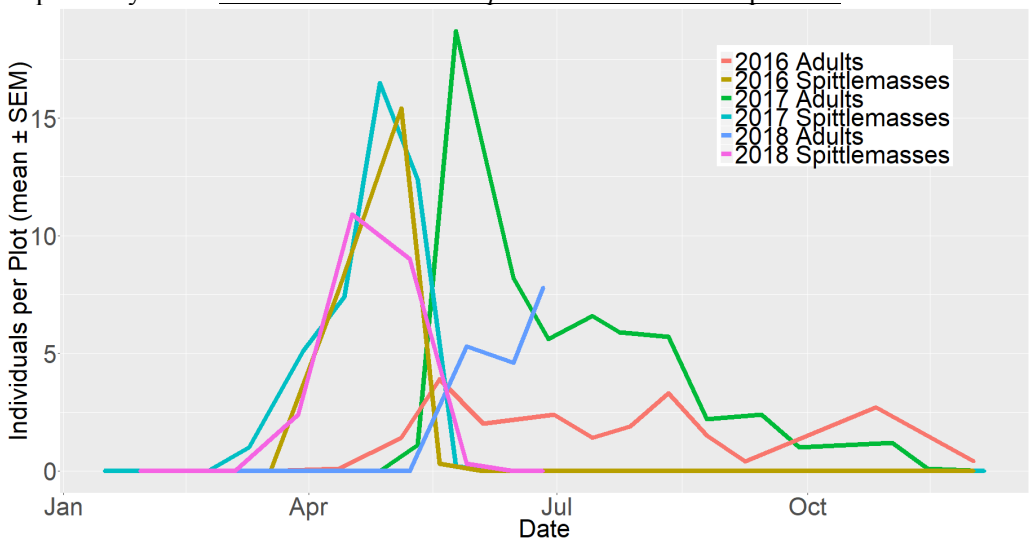
Figure 2. Seasonal patterns in natural infectivity of BGSS adults collected from vineyards adjacent to riparian habitat versus some other neighboring habitat.

In 2016, 2017 and 2018, we surveyed sites in Napa and Sonoma County for nymphs of the meadow spittlebug, *Philaenus 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 ft2. Nymph sampling consisted of randomly tossing six 2x2 ft2 quadrats in each plot and collecting all nymphal spittlemasses within each quadrat. Nymphs were removed from spittlemasses and individually counted back in UC Berkeley. Associated nymphal host plants were identified in the field and any unknown host plants were collected and preserved for identification back at UC Berkeley. For 2017 and 2018, we summarized the most common nymphal host plants across all sites by counting the number of survey plots where *P. spumarius* nymphs were found on a given host plant. In late March to early April of each field season, 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 (weather permitting) for captured adults of *P. spumarius*.

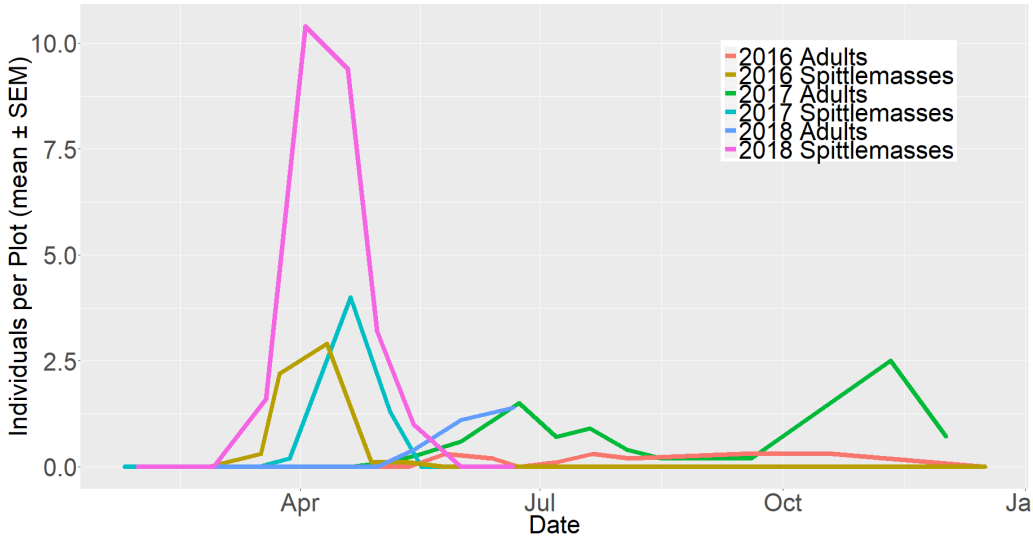
Seasonal Summary of Meadow Spittlebug Nymphal Host Plants



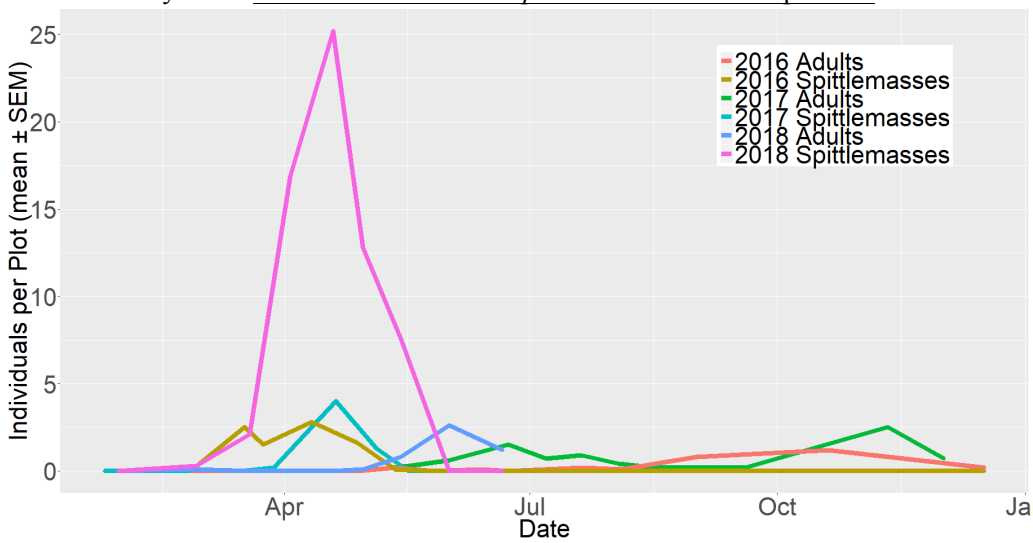
Napa Vineyard 1- 2016-2018 *Philaenus spumarius* Abundance per Plot



Sonoma Vineyard 1- 2016-2018 *Philaenus spumarius* Abundance per Plot



Sonoma Vineyard 2- 2016-2018 *Philaenus spumarius* Abundance per Plot



Conclusions

Preliminary data on blue-green sharpshooter natural infectivity indicates that the proportion of *X. fastidiosa*-positive insects are higher during the winter than Spring and Summer, although samples are still being processed to complete a full season. Trends of spittlebug populations are similar at the 3 sites studied, and did not vary much between locations. Adult spittlebug populations remained low during the summer and winter within vineyards. Finally, prickly oxtongue appears to be a preferred host of spittlebug nymphs in vineyards.

Funding Agencies

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