BIOLOGICAL, CULTURAL, GENETIC, AND CHEMICAL CONTROL OF PIERCES DISEASE: SIGNIFICANCE OF RIPARIAN PLANTS IN THE EPIDEMIOLOGY OF PIERCE'S DISEASE

Project Leader:
Kendra Baumgartner
USDA-ARS
Davis, CA 95616

Cooperators:
Alexander H. Purcell
Division of Insect Biology
University of California
Berkeley, CA

M. Andrew Walker
Department of Viticulture and Enology
University of California
Davis, CA

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INTRODUCTION

Past research (Purcell, 1976, 1981) has demonstrated the direct relationship between incidence of Pierce's disease (PD) in grapevines and proximity to riparian plants bordering vineyards in the North Coastal grape-growing region of California. Vineyard rows closest to riparian plants experience the heaviest losses, but the concentration of diseased vines decreases with increasing distance away from riparian plants. Riparian habitats adjacent to vineyards contain host plants that serve as feeding and breeding hosts for *Graphocephala atropunctata* (blue-green sharpshooter, BGSS), the most efficient vector of PD in the Napa Valley (Hewitt et al. 1949; Purcell 1975). Not only do many riparian plant species provide habitat for BGSS, but some also serve as reservoir hosts of the causal agent of PD, *Xylella fastidiosa* (*Xf*) (Freitag 1951). A variety of common riparian plants, including native and non-native trees, shrubs, and herbaceous annuals, are capable of maintaining *Xf* infections without expressing disease symptoms. The ability of *Xf* to multiply and spread within a plant host, once it has been infected, varies from species to species. The efficiency of Xf acquisition and transmission by vectors is influenced by the concentration of *Xf* in the plant host during feeding; the higher the concentration of *Xf* in a host plant, the higher the probability of BGSS acquiring *Xf* (Hill and Purcell 1997). Purcell and Saunders (1999) found that *Xf* populations are, generally, lower in riparian hosts than in grape. After screening several breeding hosts of BGSS for systemic movement of *Xf*, Hill and Purcell (1995) found that only two, *Rubus discolor* (Himalayan blackberry) and *Vitis vinifera* (grapevine), supported systemic *Xf* populations. These results imply that some riparian plant species are likely more important than others as reservoirs for the spread of *Xf* to grapevines.

A replicated field experiment was initiated at three commercial vineyards in Napa County, CA, to measure *Xf* populations in five riparian plant species: *Vitis californica* (California grape), *Rubus ursinus* (California blackberry), *Rubus discolor* (Himalayan blackberry), *Sambucus mexicana* (blue elderberry), and *Vinca major* (periwinkle). All five species are breeding hosts of BGSS and systemic hosts of *Xf* (Purcell and Saunders 1999). *Xf* could potentially overwinter in systemic hosts. Overwintering hosts of *Xf* likely play an important role in the epidemiology of PD in providing a source of bacteria for spring infections, especially near vineyards where infective adult BGSS do not survive the winter. BGSS transmission of *Xf* from riparian plants to grapevines in spring is more likely than mid- or late-season infections to result in chronic disease (Purcell 1981). By measuring seasonal populations of *Xf* in riparian plants adjacent to vineyards, we will determine if and when concentrations are high enough for acquisition by BGSS.

OBJECTIVES

Determine the epidemiological role of seasonal fluctuations of *Xylella fastidiosa* populations in riparian host plants of North Coastal California.

RESULTS AND CONCLUSIONS

Populations of *Xf* reached detectable levels in California blackberry, blue elderberry, and California grape by mid summer and increased by early fall (Table 1). *Xf* was not detected in periwinkle until early fall, when populations were found to be as high as that of California blackberry, blue elderberry, and California grape (10^5-10^6 CFU/g of petiole tissue). *Xf* populations of at least 10^4-10^5 CFU/g of plant tissue are required for acquisition by BGSS (Hill and Purcell 1997). Estimated *Xf* populations in California blackberry and California grape in mid summer and blue elderberry and periwinkle in early fall are sufficient for acquisition by BGSS. Our two culture attempts coincided with the emergence and increased flight activity of young adult BGSS, which peaks in mid summer and remains high through early fall (Feil et al. 2000). Assuming BGSS feeds on California blackberry, California grape, blue elderberry, and periwinkle in early fall, *Xf* may be transmitted from infected riparian plants to adjacent vineyards before the end of the growing season. Late season infections of grapevines are unlikely to result in chronic disease and infected canes are pruned out during the winter (Purcell 1981). However, young

adult BGSSs that acquire *Xf* in mid summer to early fall and survive the winter are still capable of transmitting *Xf* the following spring after budbreak.

Our inoculations resulted in a lower then expected number of infected plants. Past research (Hill and Purcell 1995, 1997; Purcell and Saunders 1999) on populations of *Xf* in four of the five riparian species we inoculated showed higher inoculation success (higher number of plants that developed infections out of total plants inoculated). Differences in inoculation method (insect versus mechanical), *Xf* strain (YVPD versus STL), and/or environment (greenhouse versus field) may explain differences in inoculation success.

None of the inoculated Himalayan blackberry individuals developed infections. Insect inoculation of Himalayan blackberry with the YVPD strain of *Xf* in the greenhouse showed that *Xf* populations can reach 10^7 CFU/g of plant tissue at 32 days after inoculation (Hill and Purcell 1995, 1997). Again, this difference may be due to our inoculation method, the strain of *Xf* we used, and/or the fact that our experiment was carried out in the field.

Table 1. Culture of Xylella fastidiosa from riparian plants in the field following mechanical inoculation.

Species	Number Inoculated [a]	Number Infected	Number Not infected	Number Contaminated	CFU/g [b]	Incubation (days) [c]
Himalayan blackberry	29	0	11	18	0	41-54
Himalayan blackberry	26	0	4	22	0	119-124
California blackberry	35	2	11	22	log 3-4	41-54
California blackberry	35	8	5	22	log 4-6	119-124
Blue elderberry	30	1	11	18	log 2	41-54
Blue elderberry	18	1	1	16	log 6	119-124
Periwinkle	31	0	8	23	0	41-54
Periwinkle	30	1	2	27	log 5	119-124
California grape	27	2	11	14	log 2-5	41-54
California grape	25	1	3	21	log 6	119-124

[a] Plants were mechanically inoculated with STL strain of *X. fastidiosa* on 7, 13, and 18 June 2001.

[b] Colony forming units per gram of plant tissue (log scale).

[c] Number of days between inoculation and two culture attempts. The first culture attempt was at 41 to 54 days after inoculation (July 24 to August 8, 2001). The second attempt was from the same plants, but from different petioles, at 119-124 days after inoculation (October 9 to October 15, 2001).

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