Final Research Report, May 1999

Project # 98-AP-00 Correct Project Number: 98-AP-o0

Project Title: Almond leaf scorch epidemiology

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Objectives:

1. Determine if strains of *Xylella fastidiosa* that cause almond leaf scorch (ALS) in the northern Central Valley survive winters in almond at a higher rate than do strains from grape.

2. Evaluate ALS strains of *X. fastidiosa* for their potential to spread more quickly within almond trees compared to reference ALS strains where the disease progresses slowly within the tree.

3. Evaluate the ability of ALS strains of *X. fastidiosa* to infect Bermuda grass.

We investigated the hypothesis that differences among strains of the bacterium *Xylella fastidiosa* may account for the absence of almond leaf scorch disease (ALS) until the past few years from the southern San Joaquin Valley. Specifically, we evaluated the survival of ALS isolates of *X. fastidiosa* after winter dormancy in almond compared to that of strains that cause Pierce's disease of grape (PD). Past research suggests that almond leaf scorch and Pierce's disease can be caused by the same strains, but almond orchards in Kern and Tulare county have been apparently free of ALS even adjacent to vineyards with a high incidence of PD. To test the possibility of strain differences explaining this anomaly, we inoculated four ALS strains and four PD strains by needle into new shoots of mature Nonpareil almond trees in experimental plots at U. C. Davis and Kearny Agricultural Center (KAC) in April, 1997. We cultured the bacterium on artificial media from leaves from inoculated twigs, from mid-July through early October, 1997 to confirm which inoculated twigs were infected. In 1997, the ALS strains had infected a lower percentage of almond stems (33% at Davis, 46% at Reedley) than had the grape strains (63% at Davis, 55% at Reedley). One Central Valley ALS strain (Tulare) infected significantly more twigs than the other ALS strains tested.

In fall of 1998 we recorded symptoms and isolated from all stems inoculated last year to see how many of the infections survived the winter of 1997-98 and to record the extent of spread of ALS symptoms.

The strains we used for mechanical (needle) inoculation of almond were

ALS strains

Manteca	typical ALS (San Joaquin Co.)
Oakley	typical ALS (Contra Costa Co.)
Dixon	severe ALS? (Solano Co.)

Tulare	severe ALS? (Tulare Co.)

Grape (Pierce's disease) strains

Conn	Napa Co.
Traver	Fresno Co.
UCLA	Los Angeles Co.
Traver	Tulare Co.

The 'Dixon' and 'Tulare' strains were used as candidate strains of unusual virulence, based on grower observations.

Both groups of strains (Pierce's disease and ALS) survived the winter of 1997-98 fairly well. At Davis, 42% (18 of 43) of the tested stems inoculated with grape strains were positive again this year, and 56% (15 of 27) of stems inoculated with almond strains were positive. At Kearney, 55% (24 of 44) of stems inoculated with grape strains were positive, and 78% (31 of 40) of stems inoculated with almond strains were positive. There were major differences among strains in percentage survival. Overall, 12 of the 88 positive stems were positive this year but not last year, probably a consequence of culture not detecting all infections last fall rather than the spread of *X. fastidiosa* from infected stems to uninfected stems. From this we conclude that differences between ALS and PD strains of *X. fastidiosa* in overwinter survival rates cannot explain the absence of ALS where PD is a problem in the vicinity.

The winter of 1997-98 was unusually mild, with far fewer freezing days than normal, and previously published survival rates for grape strains of *X. fastidiosa* were much lower than we observed in 1998. The survival rate of *X. fastidiosa* we observed may be unusual. We intend to again assess these infections during fall, 1999 at Davis. The trees at Kearney were removed.

We noticed no differences among strains in severity or extent of symptoms (objective 2). Some symptoms had spread below the point of last year's inoculation. Our results did not support the hypothesis about new ALS strains are more virulent than in previous years.

We infected Bermuda grass with at least one almond strain of four assessed, but the bacterium does not appear to move systemically in Bermuda grass (objective 3). This grass species is an important breeding host for the most important sharpshooter vectors of *X. fastidiosa* in the Central Valley, and so far we have not been able to infect Bermuda grass with most California strains of *X. fastidiosa*.

An objective in last year's project that was not completed in time for last year's final report. The newly introduced glassy-winged sharpshooter (GWSS), *Homalodisca coagulata*, transmitted an almond strain of *X. fastidiosa* from grape to almond. In four experiments with groups of sharpshooters in each test, we got one transmission from a total of the 52 insects used in greenhouse experiments. As expected, this leafhopper is a vector of *X. fastidiosa* to almond but at low efficiency. The potential of GWSS to damage the almond industry centers on two aspects of its known biology in its native region, the southeastern United States. Unlike the situation for all other known insect vectors of *X. fastidiosa* in California, stone fruits (cultivated and wild species of *Prunus*) are preferred host plants of GWSS. Secondly, GWSS disperses more rapidly and extensively than our native species of sharpshooters. We do not know how GWSS will adapt to Central California, where most of the almond production is located. Last fall it was noticed for the first time in the southern San Joaquin Valley in sizable numbers on citrus. I recommend that the Almond Board should keep abreast of developments pertaining to this newly introduced insect.

Not listed among the objectives, but of potential interest to almond growers was our finding that strains of *X. fastidiosa* that cause a new disease of oleander (oleander leaf scorch) can multiply and move systemically in almond. We inoculated almond with 3 potentially infective GWSS, *Homalodisca coagulata* (mentioned above) and a closely related native species, *H. lacerta*, that were still surviving after transmission experiments with the oleander strain from oleander to oleander. We recovered *X. fastidiosa* from this almond seedling over one year later, which indicates that *X. fastidiosa* can multiply and move systemically within almond. In addition, we infected 7 of 10 almond tests plants in the greenhouse by needle inoculation of an oleander stain. Very slight marginal leaf scorch appeared on some of the almond plants, but leaf scorch symptoms have not reappeared this year. We were able to prove infection of almond with an oleander strain of *X. fastidiosa* by culturing the bacterium 16 and 20 months after mechanical inoculation in two different test almond seedlings that have not developed leaf scorch symptoms in the greenhouse. These recoveries of *X. fastidiosa* indicate that oleander strains of the bacterium can survive for prolonged periods (in a greenhouse) and move systemically in almond. Oleander strains of *X. fastidiosa* appears to infect almond without cause symptoms. Several infected trees were shipped to U. C. Riverside for planting outdoors to observe possible symptoms.