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Kern/Tulare

GWSS Update

A project of the Glassy-winged Sharpshooter Task Force of Kern and Tulare Counties. Participants: Agricultural Commissioner Offices of Kern and Tulare Counties, California Department of Food and Agriculture, University of California-Cooperative Extension, U.S. Department of Agriculture (APHIS and ARS Divisions).

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Researchers study alternate plant hosts of the PD bacterium, *Xylella fastidiosa,* in the Central Valley

Control of Pierce's Disease (PD) now focuses on reducing the numbers of sharpshooters carrying the bacterium, *Xylella fastidiosa* (Xf), in vineyards and citrus and almond orchards. Insecticides and biocontrol reduce total glassy-winged sharpshooter (GWSS) numbers. Surround® treatments reduce GWSS attraction to and feeding in vineyards. Removing PD vines reduces the number of GWSS that pick up *Xf* within vineyards.

But what is the role of weeds and other plants in the spread of *Xylella*?

Xylella is unusual in having so many different reported plant hosts. Over the past two years, we have been examining what happens to *Xf* in a variety of common weeds and common crops.

Of the 31 plant species we tested, all but a few supported some multiplication of *Xf*. However, plant species varied enormously in the ease of infection, the populations of *Xf* that developed, and whether or not the bacteria could move systemically within the plant.

Furthermore, in our field experiments, we found that winter and summer conditions can greatly reduce the growth of bacteria within plants compared to the ideal conditions for *Xf* growth in our greenhouse in Berkeley.

Research methods. We inoculated plants with a PD strain of *Xf* by needle puncture or with blue-green sharpshooters (BGSS) and GWSS. Insects were allowed to pick up the bacteria from symptomatic grape vines for four days and then tested for their transmission of *Xf* to grape. We then caged BGSS or GWSS on weeds in groups of two to four insects for two days in small cages. We marked the insects' feeding location with tape.

At one, three and nine weeks after inoculation, we assayed the feeding sites for bacteria by culturing to determine how many live bacteria occurred per gram of plant tissue. Populations of *Xylella* are reported as $\log_{10}$ colony-forming units per gram of plant tissue (cfu/g). Log 6 means six zeros after the one (log 6 = 1 million cells per gram). We also sampled plants away from the feeding (inoculation) site to determine if *Xf* moved systemically within the plant.

For the field studies, we tested three

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— Tina Wistrom and Sandy Purcell, University of California, Berkeley

Table 1: Alternate hosts of *Xf* that are infected greater than 50 percent of the time in green-house experiments and that support bacterial populations throughout the entire plant.

	% plants w/ *Xf* infections	Population [*Xf*]	% plants with systemic *Xf* infections	Inoculation method and # of replications
black nightshade	53% (8/15)	log 6	54% (4/7)	GW; 1 rep.
common sunflower	83% (63/76)	log 6	80% (48/60)	GW, BG, NI; 7 reps.
common cocklebur	58% (65/111)	log 5	62% (40/65)	GW, BG, NI; 7 reps.
annual bur-sage	66% (31/47)	log 6	84% (26/31)	GW, BG, NI; 5 reps.
common morning glory	56% (28/50)	log 5	55% (16/29)	BG, NI; 3 reps
marestail	87% (13/15)	log 4	54% (7/13)	GW, BG; 2 reps
silverleaf nightshade	90% (18/20)	log 6	78% (14/18)	NI; 1 rep.
sacred datura	76% (43/56)	log 6	31% (14/45)	BW, BG, NI; 5 reps.
poison hemlock	65% (24/37)	log 6	67% (16/24)	BG, NI; 2 reps.
fava bean	68% (46/67)	log 6	58% (26/45)	BG; 5 reps.

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winter and three summer annual weeds known to be hosts from our previous greenhouse studies. We kept half the plants in the greenhouse at UC Berkeley and planted the rest inside an outdoor cage at the Kern County UC Extension office in Bakersfield.

Results. Ten species of plants inoculated in the greenhouse became infected greater than 50 percent of the time (Table 1). In all four replications of the field studies, we recovered consistently less *Xf* from field-grown plants than from the same species of greenhouse-grown plants during the first three weeks. Populations of *Xf* were always much lower and moved less systemically in field-grown plants (Table 2). Generally, sharpshooters begin to acquire Xf from grapes that have populations of more than log 4 per gram. Vector acquisition efficiency increases as *Xf* populations increase within plants.

Another 12 plant species became infected 20-50 percent of the time after being inoculated with *Xf*. These were Johnson grass, cheeseweed, field bindweed, prickly lettuce, southwestern cupgrass, common purslane, California burclover, quinoa, red gum, 'Ace' tomato, 'Violeta Lunga' eggplant and 'Moapa' alfalfa. Plants that became infected less than 20 percent of the time in greenhouse tests were: jojoba, yellow nutsedge, annual sowthistle, whitestem filaree, prostrate pigweed, watergrass, tree tobacco and blue gum.

Four plants had varying results when mechanically inoculated (MI) as compared to infection with GWSS. Cheeseweed developed infections in 51 percent (29 of 57) of needle-inoculated sites but only in 8 percent (one of 12) insect-inoculations. Similar results were seen for sacred datura (MI: 43 of 56, GW: one of seven) and red gum (MI: 12 of 33; GW: zero of five).

It appeared that GWSS are even less efficient at transmitting *Xylella* to alternate hosts than they are to grapes. Interestingly, morning glory was only infected by vector feeding, not by mechanical inoculation.

What does this all mean? Some weeds clearly can be sources of *Xf*, but winter weeds are probably important sources only when milder conditions allow *Xf* infections to persist and multiply. Summer weeds probably are most important when they are oldest—in late summer and fall. Perennial plants that are systemic hosts are likely to be the most important alternative hosts of *Xf*.

Above all, remember that GWSS has to feed on the plants to pick up the bacteria, so the preferred feeding hosts of GWSS will be more important sources of *Xf* than less preferred plants.

For more detailed information and explanations of alternative plant hosts of *Xf*, go to our web site at: http://www.cnr.berkeley.edu/xylella/temp/hosts.htm.

— Tina Wistrom and Sandy Purcell, University of California, Berkeley

Special thanks

A special thanks to the California Table Grape Commission and the GWSS Task Force of Kern and Tulare Counties for their support of this newsletter.

Fax changes? E-mail?

If you'd prefer to receive *GWSS Update* via e-mail or receive it at a different fax number, please contact Catherine Merlo at (661) 588-0561 or cmm55@aol.com.

TABLE 2: Comparison of *Xylella fastidiosa* infection in plants grown in the greenhouse and in the field.

Plant	Location	Season	% plants w/ *Xf* infections	Population [*Xf*]	% plants with systemic infections	Systemic [*Xf*]
hemlock	greenhouse	winter	65% (24/37)	log 7	67% (16/24)	log 6
hemlock	field	winter	23% (12/44)	log 5	0% (0/12)	–
fava bean	greenhouse	winter	50% (14/28)	log 6	36% (5/14)	log 4
fava bean	field	winter	14% (5/37)	log 4	0% (0/5)	–
prickly lettuce	greenhouse	winter	32% (12/38)	log 6	23% (3/13)	log 2
prickly lettuce	field	winter	25% (9/36)	log 4	33% (3/9)	log 2
prickly lettuce	greenhouse	summer	73% (24/33)	log 6	19% (5/26)	log 3
prickly lettuce	field	summer	34% (11/32)	log 6	0% (0/11)	–
cocklebur	greenhouse	summer	60% (26/43)	log 6	48% (11/23)	log 5
cocklebur	field	summer	46% (12/26)	log 4	42% (5/12)	log 5
sunflower	greenhouse	summer	69% (24/35)	log 6	63% (15/24)	log 5
sunflower	field	summer	19% (5/26)	log 4	40% (2/5)	log 4