Scientists Target Glassy-Winged Sharpshooter

Just as your home has pipes that move water into it, plants, too, have their own plumbing systems. In plant tissue called xylem, water and nutrients flow from roots to stems, branches, leaves, buds, blooms, and fruit.

But just as household water pipes can clog, so can plants' plumbing. Severe clogs can cause plants to weaken and die.

A half-inch-long leafhopping insect called the glassy-winged sharpshooter can inadvertently plug plants' plumbing. When it shoves its tubelike mouthparts into a plant to suck sap from the xylem, the insect may transmit a deadly plant bacterium, *Xylella fastidiosa*, in its saliva.

This microbe can live in the sharpshooter's gut without harming the insect. But when *Xylella* moves from the sharpshooter into a plant, the bacterium can form colonies or clusters that may eventually shut off the flow of water.

The condition that *X. fastidiosa* causes in grapevines is known as Pierce's disease. Southern California winegrape vineyards got hammered with it in the 1990s soon after this sharpshooter first appeared in the Golden State.

Agricultural Research Service scientists across the United States teamed up to devise environmentally friendly, science-based strategies to help check the spread of the pesky insect and the devastating disease. *(See box, facing page.)*

That work paved the way for new studies that may unlock secrets about the complicated interaction between the insect, bacterium, and vines. An example: the innovative investigations conducted by a sharpshooter squad of scientists with the ARS Exotic and Invasive Diseases and Pests Research Unit, Parlier, California.

"Wired" Takes on a New Meaning

A thin gold wire attached to a sharpshooter's back may enable scientists to zero in on the minute-by-minute actions of the pest as it attacks plants. "The wire carries a low-level electric current," explains ARS entomologist Elaine A. Backus. The plant is also wired, so the circuit is completed when the insect punctures the grapevine to get a drink.

A pattern of electrical waves, somewhat like an electrocardiogram, is recorded as the thirsty insect sips its fill. From these charts, Backus intends to piece together new clues about exactly when, how, and how quickly the *Xylella* microbes in the insect's gut get dislodged and shuttled into the vine.

The work may also shed light on variations in grapevines' natural resistance to the invasive insect and the bacterium. The work may also become the basis for a quick, reliable way to screen vines for superior resistance.

PATRICK TREGENZA (K5633-7)

Grape genes for resistance to Pierce's disease are the focus of some ARS studies in Parlier, California.

Studying Sharpshooter Biology and Ecology

No one can say for certain where sharpshooters are most likely—at any given time of the year—to rest, feed, lay their eggs, or, perhaps most importantly, pick up *Xylella*.

To fill this gap, entomologist Russell Groves is creating a detailed picture of what he describes as "seasonal dispersal of sharpshooters among various kinds of vegetation in the landscape." He has installed an extensive network of traps that he monitors once a week, year-round. The traps consist of bright-yellow cardboard coated with a sticky compound.

"Sharpshooters are attracted to the colored panel," says Groves. "When they fly close to investigate, they can't pull free of the sticky coating."

Groves' traps run in lines from streambanks to weedy fencerows to plants in fields, orchards, and vineyards. "Growers will get the most from their pest-control dollars," says Groves, "if they know what plants are *Xylella* reservoirs and what plants sharpshooters will target next."

Genes May Proffer Protection Against Pierce's Disease

Thanks to their genes, some plants are better able than others to shrug off attack by the sharpshooter and *Xylella*. Genes may cue plants to make natural compounds that repel the insect or blunt *Xylella*'s ability to infect.

Plant physiologist Hong Lin and University of California at Davis co-investigators are hunting for these genes. At a research greenhouse in Davis, they've inoculated hundreds of grapevines with *X. fastidiosa*. "The plants we're using," says Lin, "are already known to be either resistant or susceptible to *X. fastidiosa* infection."

The scientists remove tissue from the grapevines at regular intervals. The sampling spans only 4 to 5 months because by then vulnerable vines have been killed by Pierce's disease. "We're looking at the types and amounts of gene products—such as proteins—these plants form," explains Lin. "We want to see if there's any significant antimicrobial effect in these compounds.

REYES GARCIA III (K10693-1)

The glassy-winged sharpshooter is the culprit behind the spread of Pierce's disease among grapevines. The insect infects the plant with the bacterium *Xylella fastidiosa* when it feeds on the sap from the xylem tissue of a vine.

That could lead us to the genes that direct the plants to make the compounds."

It might then be possible to move those genes into commercial rootstocks, he notes. A rootstock is the bottom, rooted portion of the plant to which the upper, grape-bearing scionwood is grafted.

The search for resistance genes is greatly helped by the availability of worldwide databases that depict the genes responsible for disease resistance in other green plants, says Lin. Using what others have already learned and made available about disease-resistance genes accelerates discovery of similar genes in plants such as grapevines.

The Many Faces of *Xylella*

It's not just grapevines that are beleaguered by *X. fastidiosa*. The microbe occurs in many forms, or strains, that sicken other plants, including almond, peach, plum, and oleander.

So what's the best way to sort out who's who in the world of *Xylella*?

Why not examine their genetic material, or DNA, advises Jianchi Chen, ARS molecular biologist. A test based on *Xylella* genetic material could be ideal for determining which *Xylella*—if any—newly invading sharpshooters are carrying. That "inside" information could give growers a heads up.

Too, such a test could be used to screen imported grapevines to be sure they're free of *Xylella*. Right now, plants sometimes have to be monitored for weeks or months to be certain they're disease free.

The Parlier research weaves together different kinds of scientific expertise to unravel the destructive interactions of an insect, a pathogen, and a vulnerable plant. This research and that at a half-dozen other ARS locations around the nation (see *Forum*, page 2) should yield new, effective tactics to minimize the menace posed by *Xylella* and the sharpshooters.—By **Marcia Wood,** ARS.

This research is part of Crop Protection and Quarantine (#304) and Plant Diseases (#306), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

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Fast-Thinking First-Responders Garner USDA Honor Award

From coast to coast, ARS scientists have pooled their expertise to slow the spread of the glassy-winged sharpshooter and the disease-causing *Xylella fastidiosa* microbes it carries.

The researchers' aggressive, timely responses to the agricultural emergency caused by the invasion of this insect pest into southern California vineyards earned the scientists and their federal, state, and corporate teammates a USDA Honor Award in June 2003.

Honoree Kevin J. Hackett, an ARS National Program Leader in Beltsville, Maryland, helped orchestrate the work of the ARS specialists on the emergency response team.

Edwin L. Civerolo, now director of the ARS San Joaquin Valley Agricultural Sciences Center, Parlier, California, spearheaded a novel collaboration with Brazilian experts to detect the genetic material of the pathogenic *X. fastidiosa* microbe that the sharpshooters transmit. West Virginia-based entomologist Gary J. Puterka codeveloped kaolin-clay-derived repellant, giving growers an environmentally safe compound to discourage sharpshooters from chewing, sucking, or laying their eggs on vulnerable vines.

Entomologists Thomas J. Henneberry and David H. Akey at Phoenix, Arizona, conducted extensive studies that identified the most effective insecticides for killing sharpshooters, including ecologically sound pyrethroids and neonicotinoids familiar to home gardeners.

Studies organized by Walker A. Jones, an entomologist based at Weslaco, Texas, spotlighted beneficial, stingless wasps with impressive potential to clobber the sharpshooter. *(See story, page 18.)*

New studies in progress in these laboratories and others around the country may reveal yet more tactics to trounce the troublesome insect and the *Xylella* disease it spreads.—By **Marcia Wood,** ARS.