Suppressing a Serious Citrus Pest

Citrus root weevils can cost growers more than $1,200 per acre. Already, in 1996, they have caused an estimated $72-million loss in Florida, creating economic havoc for some of that state's citrus growers. This weevil has also become a significant pest of ornamental and vegetable crops.

"No part of the citrus tree is safe from this insect," says William J. Schroeder, an ARS entomologist who recently retired but is still working as an ARS consultant. "The adult citrus root weevil feeds on leaves, but its larvae do the most damage by attacking tree roots."

Root damage interferes with the transport of nutrients and water to the rest of the tree, resulting in fewer and smaller fruit and eventually tree death.

The citrus root weevil, *Diaprepes abbreviatus*, first appeared in Florida in 1964. Growers then controlled its spread with strong chemicals, many of which have since been taken off the market because of environmental and human health concerns.

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Adult citrus root weevil, *Diaprepes abbreviatus*. (K7456-1)

For 2 years, Schroeder and ARS colleagues at the U.S. Horticultural Research Laboratory in Orlando have been controlling this pest with a tiny parasitic worm, the *Steinernema riobravis* nematode.

Sprayed on the soil, these nematodes burrow down to tree roots, hungrily seeking weevil larvae. Once inside the larvae, they release a bacterium that kills the larvae within 48 hours.

"The nematodes then reproduce themselves, and the offspring feed on the bacteria, nourishing another generation of juvenile nematodes," Schroeder explains.

But not much is yet known about the bacterium itself.

"We know that a symbiotic relationship exists between it and the nematode," says Heather Smith, a graduate student working with Schroeder. "The nematode acts as both a host and a vector, since the bacterium can't survive outside a host for any length of time."

It gives the bacterium a way to live, and it reciprocates by multiplying itself and becoming food for the nematode. Once the bacterium kills a larva, it releases antimicrobial agents that prevent the growth of other bacteria, so that it can then reproduce without competition.

"The nematodes can survive in a host for up to three generations," says Smith. "Then they leave, with their bacteria ensconced in their gut, to look for a new host."

Schroeder and Smith are working to identify and characterize the bacterium. "We expect it to be of the genus *Xenorhabdus*," says Smith, "because all other symbiotic bacteria associated with the nematode family are of this genus. Also, preliminary results from carbohydrate fermentation tests, fatty acid analyses, protein comparisons, and several other basic microbiological studies point to *Xenorhabdus*."

Smith is doing a final comparison to check similarities in DNA profiles of four other species of bacteria in this genus. "We're also conducting pathogenicity tests to see just how this bacterium kills the citrus root weevil larvae," she says.

Schroeder says that Florida citrus growers routinely use nematodes in an integrated pest management program for root weevil control. "We want to learn more about this bacterium so that we can help growers optimize control of citrus root weevil." He thinks that timing applications might help.

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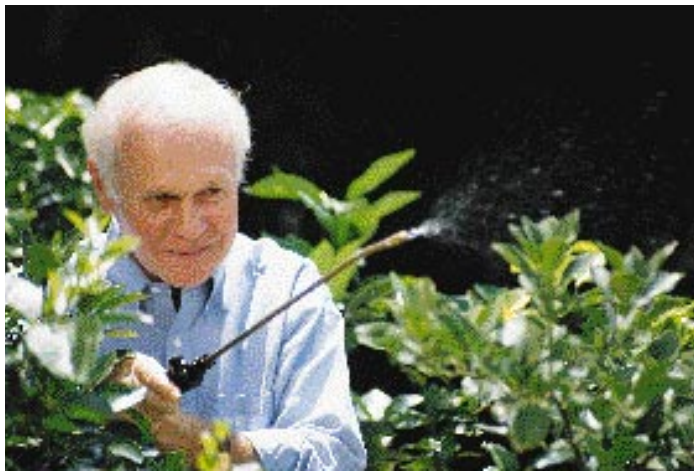

Entomologist William Schroeder applies *Steinernema riobravis* nematodes to citrus foliage to see how well nematodes survive when the leaves dry. (K7458-9)

"We're also investigating other vectors that might develop a symbiotic relationship with the bacterium, giving us another potential biological agent."—By **Doris Stanley**, ARS.

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