Targeting a Threat to U.S. Citrus

Mite-borne disease already has foothold in South America

Trouble in the form of a mite-borne plant disease is on the horizon for U.S. citrus growers, and ARS scientists are involved in efforts to stop it.

Entomologist Ronald Ochoa, mite expert at ARS's Systematic Entomology Laboratory (SEL) in Beltsville, Maryland, says citrus leprosis, a virus that substantially damaged Florida's orange crop in the early 20th century, is slowly progressing northward from its outbreak epicenter in South America. He says the disease's presence in Central America has raised warning flags among U.S. Department of Agriculture (USDA) scientists at ARS and at the Animal and Plant Health Inspection Service (APHIS).

"We all view this as a grave threat to the nation's citrus industry," Ochoa says.

Citrus leprosis has cost millions in damage to crops in South America, where it is well established. Symptoms include small, chestnut-brown spots—commonly referred to as nailhead rust—that appear on fruit, leaves, and green twigs of afflicted trees. The resulting loss of tree canopy growth combined with premature fruit and leaf drop reduce plant productivity. Sweet orange and some mandarin varieties are most susceptible.

"Citrus leprosis causes yield reduction and eventual death of the trees if its mite vectors are not controlled," says Ochoa. "A mite carries the virus from plant to plant, but the mite is not affected. The virus resides in its gut."

SEL is getting assistance in this effort from the Electron Microscopy Unit of the ARS Soybean Genomics and Improvement Laboratory, which is also based in Beltsville.

"The only known vectors of leprosis are species in the flat mite genus *Brevipalpus,*" says entomologist Ethan Kane, who is working with Ochoa. "The history and cost of this disease in South America are alarming, given the fact that other mite species believed to be capable of spreading it are already abundant in California, Florida, and Texas—three states that are the backbone of the U.S. citrus industry."

Ochoa and Kane are collaborating with Florida Department of Agriculture and Consumer Services acarologist W. Calvin Welbourn to clarify differences among the *Brevipalpus* species implicated as leprosis vectors. Ochoa says that while only one species of *Brevipalpus*—*B. phoenicis*—has been experimentally confirmed to transmit citrus leprosis virus, two closely related species—*B. californicus* and *B. obovatus*—are suspected transmitters.

Fast Identification Is Vital

"These three mite species are extremely similar in appearance and have historically been confused and misidentified," says Ochoa. "In an attempt to precisely define their identities, we've examined specimens from outbreak sites and compared them with reference material held in the U.S. National Mite Collection at SEL." Adds Ochoa, "Fast identification of both the mite and symptoms of the disease is vital. This is an adaptable mite that can quickly increase to millions on a tree."

He says *B. phoenicis* is unique in that more than 1,000 plant species can be a host to it. "This is phenomenal," he says. "Most mites have a limited range of hosts."

SEL's role in the fight against citrus leprosis is within its mission to develop comprehensive classification systems for insects and mites on a world basis and to furnish taxonomic services to federal, state, and private organizations involved in research and action programs in agricultural, biological, and health sciences.

The laboratory's work is part of a wider project to minimize the impact of citrus leprosis that's being funded in part by USDA's Foreign Agricultural Service and APHIS.

This project focuses on surveying for *Brevipalpus* mites and perfecting molecular and morphological diagnostic techniques that can precisely identify the leprosis vectors—and in turn lead to more accurate risk assessments. It is headed by renowned acarologist Carl C. Childers, an entomology professor with the University of Florida. Childers's team also includes molecular biologist Maria Gallo-Meagher and plant pathologist José Carlos Rodrigues, also with the university, and APHIS mite specialist Eric McDonald. Working with this

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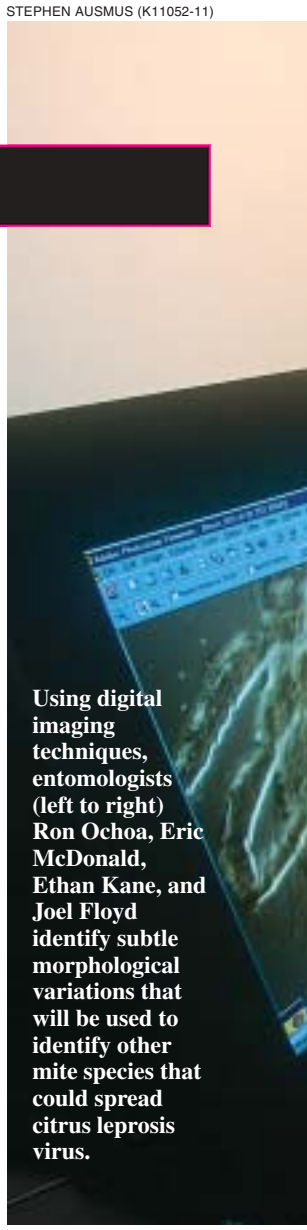
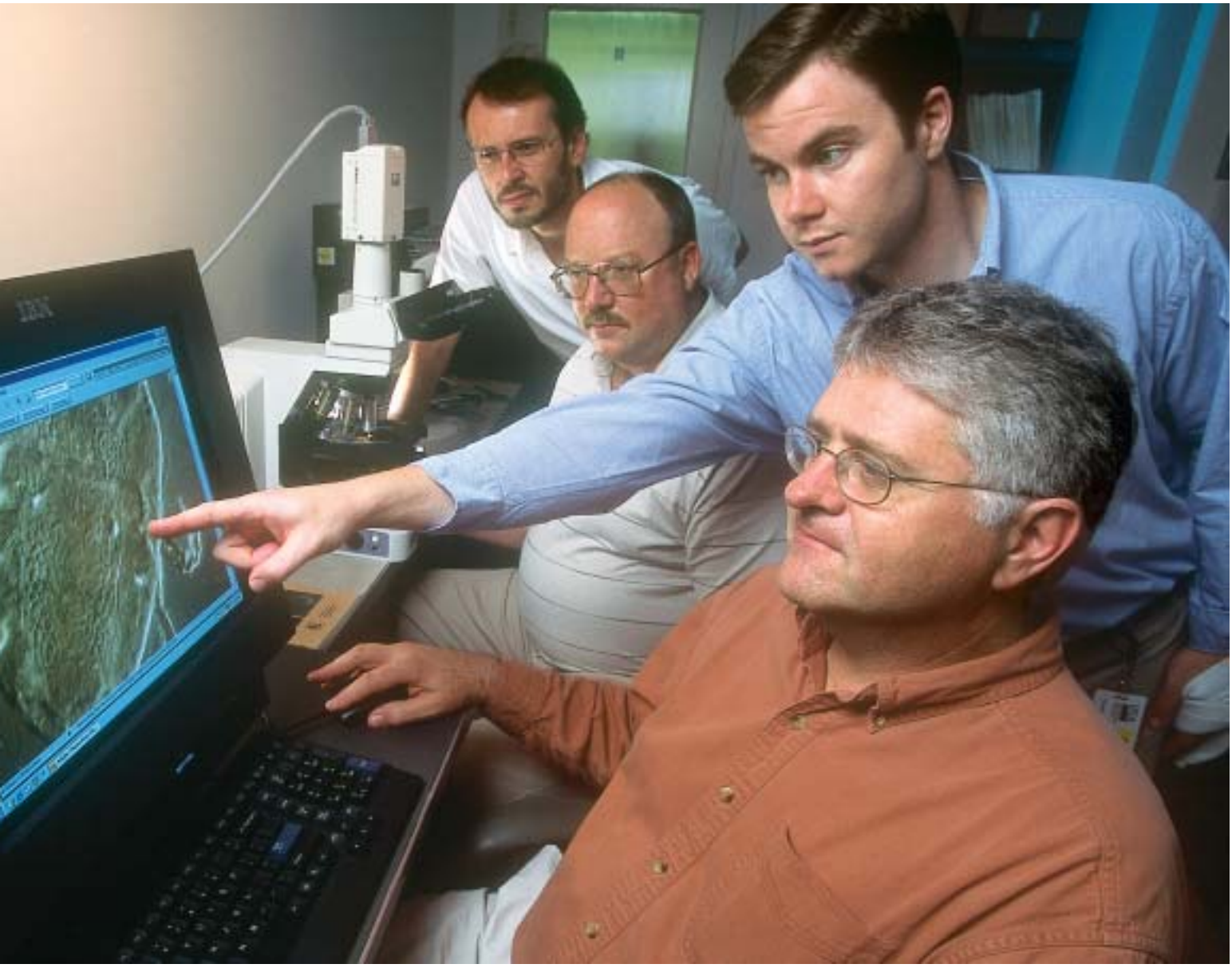


Using digital imaging techniques, entomologists (left to right) Ron Ochoa, Eric McDonald, Ethan Kane, and Joel Floyd identify subtle morphological variations that will be used to identify other mite species that could spread citrus leprosis virus.

ERIC ERBE (K11053-1)

Low-temperature scanning electron micrograph of a flat mite species, *Brevipalpus phoenicis,* known to transmit citrus leprosis virus. (Magnified about 120x.)



group is Joel Floyd of APHIS's Pest Detection and Management Program Planning Staff.

Childers says citrus leprosis was first observed in Florida around 1860 and spread to at least 17 counties there by 1925. It was eradicated when citrus growers planted in new locations and used sulfur for mite control. But sulfur is not recommended for such use, because overuse can kill crops.

Effort Extends Within and Outside ARS

Ochoa's group is using advanced light microscopy techniques and low-temperature scanning electron micrographs provided by ARS botanist Eric Erbe, of the Soybean Genomics and Improvement Laboratory. This work has shed light on the subtle structural differences that separate the three species of *Brevipalpus* considered capable of transmitting leprosis.

"This information will be used in conjunction with data from Childers's team to thoroughly characterize these mite species," says Kane.

According to Floyd, at this time, the only economical way to tell whether mites are carrying the disease is to monitor for plant damage. "The key is early detection," he says. "We need to educate growers to spot disease symptoms. Then we have a chance to break the virus-vector cycle."—By **Luis Pons,** ARS.

This research is part of Plant Diseases (#303) and Crop Protection and Quarantine (#304), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

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