STEPHEN AUSMUS (D493-2)

At the Corn and Soybean Research Unit in Wooster, Ohio, molecular geneticist Rouf Mian (left) and technician Tim Mendiola rate soybean plants for bean pod mottle virus symptom severity 2 weeks after inoculation.

Antiviral Vigilance

Team Keeps Tabs on the World's Emerging Corn and Soybean Viruses

It's thought that the first aphid to square off against soybeans attacked in Asia, thousands of years ago. Now the Agricultural Research Service (ARS) is mounting a defense against this ancient soybean pest, *Aphis glycines,* first spotted in the United States in the spring of 2000. It has since spread to at least 24 states, the latest being Maine. Besides reducing yields by as much as 50 percent by feeding on plant sap, aphids are a significant soybean threat because they can transmit deadly viral diseases.

Soybean aphid populations seem to fluctuate on a 2-year cycle, with high numbers every other year. With each cycle, the aphids are spreading farther across the United States, headed, some say, towards an inevitable infestation of every soybean-growing region. That's why they have the rapt attention of a "viral strike team" in Wooster, Ohio.

This group of scientists, located at the Ohio State University (OSU)-Ohio Agricultural Research and Development Center, serves as the front line for spotting viral attacks on soybeans and corn in the United States and on corn worldwide. The team is supported by ARS and OSU, with the ARS part—the Corn and Soybean Research Unit—led by Roy Gingery.

The team is being kept busy because Ohio has faced an increase in soybean diseases in recent years. To help curb the aphids, ARS molecular geneticist Rouf Mian is crossing aphid-resistant soybean lines (recently identified at the University of Illinois and Michigan State University) with high-yielding Ohio lines to develop new resistant lines adapted to Ohio.

Resisting Another Enemy

The latest threat to soybeans to emerge in Ohio is bean pod mottle virus, which lowers yields and discolors the beans. The disease has been associated with increased numbers of the bean leaf beetle that transmits it.

To develop soybeans resistant to the disease, Mian is working with ARS plant molecular biologist Peg Redinbaugh, who says preliminary data indicates that using soybeans resistant to bean leaf beetles reduces the disease's spread in the field.

"We've never found complete resistance to this virus in any cultivated soybean germplasm," she says, "but we've found partial resistance in some soybean accessions. We want to see if this partial resistance can be combined with beetle resistance from other lines to further increase resistance."

"We've developed a visual scoring system for screening lines from the USDA Soybean Germplasm Collection," says Mian. "We grow the plants in greenhouses, infect them with the virus, let the disease

STEPHEN AUSMUS (D496-82)

The Mexican bean beetle, *Epilachna varivestis* (6-7 millimeters long), is used by scientists at Wooster to help identify soybeans that resist it and other bean leaf beetles. Resistance can help prevent beetles from inoculating the plant with bean pod mottle virus.

develop, and rate symptom severity on a scale from 1 to 5. This technique has been helpful in assessing resistance to various viral diseases in corn and soybeans."

Using Other Innovative Tools

The Wooster unit's invention of the vascular puncture inoculation (VPI) technique and extensive knowledge of most of the world's corn virus diseases led the Serbian government to ask Redinbaugh and Gingery, along with Richard Pratt from Ohio State, to come to their country in the summers of 2004 and 2005 to help them identify a new—possibly viral—disease wiping out 30 to 70 percent of corn crops in some fields.

"VPI allows us to inoculate plants with viral diseases without knowing the insect carriers," says ARS technician John Abt, who worked alongside VPI's inventor, retired ARS plant pathologist and research collaborator Ray Louie. "This makes it an excellent tool for emerging diseases work, when we don't know what the viral disease is—let alone, the insect carrier," says Abt. "If we can transmit the virus with VPI, we can produce more infected plants to work with."

The Serbs call the unknown disease "corn redness syndrome" because cornstalks often turn red and die when the plant is mature enough to flower. They call another symptom "Grandma's teeth," because the seed set is so poor that the kernels are few and far between, significantly reducing yields. The corncob also gets rubbery, bending rather than snapping when flexed.

Fortunately, the disease seems to be limited to an area that is surrounded by other crops. This geographic isolation may make it hard to spread outside the "corn island" it's in.

The Wooster team brought Serbian corn plant samples back to their Ohio lab to try to identify the disease using molecular testing techniques. They also used VPI to try to create more infected plants for study but were unsuccessful in reproducing corn redness. This suggests that the disease may not be a viral one.

They did find several common viruses, such as sugarcane mosaic virus and maize dwarf mosaic virus, but these are probably not related to corn redness syndrome.

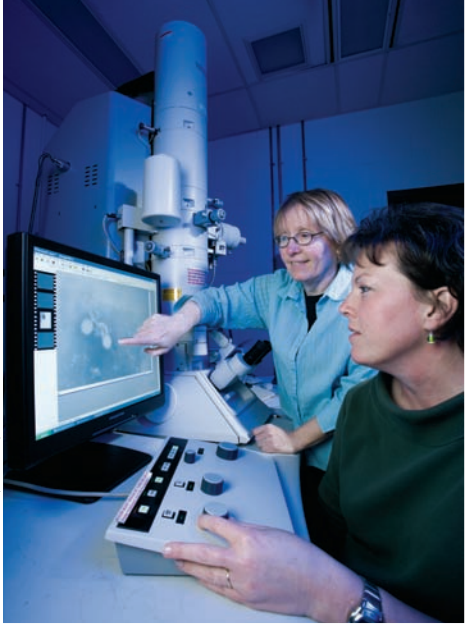
The researchers are also peering at infected plant parts through electron microscopes. "We hope to be able to see things that look like pathogens," says Redinbaugh. "The hard part will be figuring out if what we find has anything to do with this peculiar syndrome."

Discovery's Just the First Step

If they are able to isolate and culture a virus and identify its carrier, the Wooster team must then search corn or soybean germplasm collections for genes conferring resistance to the disease.

There are logistical difficulties as well. For example, if a new disease appears somewhere far away, like Serbia, the researchers have to travel far if invited to help. Last year, they made arrangements to arrive in Serbia about the time that corn plants usually mature and show symptoms. But the unusually cool summer there slowed the corn plants' growth, and the team arrived too early to see many symptoms, limiting the number of samples that could be collected.

Another difficulty in their work is the need to quarantine infected plants to prevent spread of a disease under study. The researchers do this with specially built greenhouses that are certified to safely contain plant diseases and by following carefully developed procedures.—By **Don Comis,** ARS.



STEPHEN AUSMUS (D494-26)

Using a transmission electron microscope at the Ohio Agricultural Research and Development Center in Wooster, Ohio, plant molecular biologist Peg Redinbaugh (left) and technician Jean Vacha look for viruses in corn plants from Serbia that showed corn redness syndrome.

This research is part of Plant Diseases, an ARS National Program (#303) described on the World Wide Web at www.nps.ars.usda.gov.

To reach scientists mentioned in this article, contact Don Comis, USDA-ARS Information Staff, 5601 Sunnyside Ave., Beltsville, MD 20705-5129; phone (301) 504-1625, fax (301) 504-1486, e-mail comis@ars.usda.gov. ✸

STEPHEN AUSMUS (D495-14)

Aphid, *Aphis glycines,* about 1 millimeter long.