STEPHEN AUSMUS (K10879-1)

Entomologists Douglass Miller (foreground) and Gary Miller pull slides from the National Entomological Collection of the National Museum of Natural History to compare with a scale insect photographic database.

On the Lookout for Scaley Invaders

Knowledge is key to keeping foreign scale insects at bay

It's hard enough keeping scale insects out of your garden. Imagine trying to keep them out of the country!

"They're small and evasive," says entomologist Douglass Miller, lead scale insect scientist at the ARS Systematic Entomology Laboratory (SEL) in Beltsville, Maryland. "Many gardeners hardly notice them until they discover the gooey mess many of them make of their plants. In cargo, they're extremely hard to detect, especially when there aren't many of them."

Miller is in a unique position to monitor invasive scale insects. Port managers, ordinary citizens, and officials at USDA's Animal and Plant Health Inspection Service routinely call on him to identify scale insects suspected of being invaders. As "resident expert," he is often the first to tell whether a species is new to this country—or even new to the list of known insects.

"Scale insects are among the nation's most destructive pests," Miller says. "One reason for this is that they often go undetected until they've become established and caused damage." He adds that most pest scale insects in the United States today are invaders.

Miller says that once a destructive invasive scale enters the country, "it's important to know its scientific name, where it comes from, and any other information we can get. That way, if we need to implement a biocontrol or pest-management program, we have the required knowledge."

He cites studies stating that control efforts against scales, plus repairing the damage they cause to plants, cost up to $500 million annually in the United States and $5 billion worldwide. He estimates three-fourths of the U.S. totals are attributable to invaders.

The most common scale insects are identifiable by the scaley, hard cover that's their natural protection. But others are covered by mealy waxes that come in a variety of colors. There are 22 families—with more than 7,300 species—the largest and most common being Diaspididae, or armored scales; Coccidae, or soft scales; and Pseudococcidae, commonly known as mealybugs.

Scale insects' unique characteristics fascinate scientists. They vary in appearance, from tiny organisms whose covers resemble oyster shells to shiny, hard, pearl-like bugs that live in the soil. Females are wingless, with heads that are indistinct from their bodies, and spend most of their lives in one spot extracting plant fluids through a long, thin tube. Meanwhile, tiny male scales have wings and live for just a few days, without ever feeding.

It's their ability to spread quickly, and undetected, to all parts of the world that gets the attention of SEL scientists, especially Miller, who has monitored scales for ARS for 34 years. For about 7 years, he was aided by fellow entomologist Gary Miller, who recently became SEL's main aphid scientist.

They're Everywhere!

Scale insects are most often palaearctic in origin, meaning they come from a region that includes Europe, Asia north of the Himalayas, northern Arabia, and Africa north of the Sahara. But today they are found everywhere, from the tundra to the Tropics.

At least 1,000 species can be found in the United States, 253 of which are invasive. Douglass Miller says 20 of these invaders have established themselves here over the past 2 decades, and 11 of these are now considered pests.

Gary Miller says global trade has been a major factor in their spread. "And when you consider trade, natural insect-migration patterns, and intangibles such as people who sneak fruits into the country, you can see why scale insects slip very easily under the radar."

Scale insects enjoy perennial plants and can devastate nut and fruit trees, greenhouse plants, forest vegetation, woody ornamentals, and house plants. They thrive on nearly all parts of host plants, sometimes settle under bark, and cause a variety of plant deformities.

All that is in addition to their best-known calling card—a sticky, sweet substance called honeydew that many secrete while feeding. The honeydew's stickiness and the black sooty mold that grows on it can make a mess of plants and anything under infested trees.

Among the most serious of recent invasive scales is the pink hibiscus

Q. HOLDMAN (K10880-1)

These invasive scale insects, Citrophilus mealybugs *(Pseudococcus calceolariae),* when disturbed, secrete a red liquid as a means of defense. Note the two droplets on the large mealybug in the center.

R. GILL (K10882-1)

The protective cover of the Calico scale *(Eulecanium cerasorum),* an invasive species, is readily apparent.

mealybug (*Maconellicoccus hirsutus),* an Asian native that affects more than 200 plant species. Another is the vine mealybug, *Planococcus ficus,* a Middle Eastern native that since 1994 has damaged grape crops in some parts of California. Also troublesome is the cycad aulacaspis scale, *Aulacaspis yasumatsui,* which originates in Southeast Asia and attacks Florida's cycads (palmlike trees).

Getting a Handle on Them

In addition to making crucial identifications, Miller and Miller have developed another tool for combating scales: the first known full inventory of them.

This inventory is part of ScaleNet, an ARS-run Internet database that allows clients to use a query system to gather information about scales. Douglass Miller says that ScaleNet, which is about 75 percent complete, is currently accessible at www.sel.barc.usda.gov/scalenet/scalenet.htm. He says full listings for 7,300 species should be available by the end of 2004.

Meanwhile, the watch for destructive invasive scales goes on. Florida alone is home to six of the newest pests:

- litchi scale *(Andaspis punicae),* first found in Florida in 1995
- white mango scale *(Aulacaspis tubercularis),* first discovered there in 2002
- black parlatoria scale *(Parlatoria ziziphi),* first found in 1985
- papaya mealybug *(Paracoccus marginatus),* first discovered in 1998
- lobate lac scale *(Paratachardina lobata),* first collected in 1999
- fig wax scale *(Ceroplastes rusci),* first discovered in 1994.

Gary Miller says the inventory—which not only lists the invasive scales, but provides data about their origins and food choices—will prove invaluable. "It will give us a look at the past as well as future and give us an idea of not only where the insects came from, but where the next invader will come from," he says.—By **Luis Pons,** ARS.

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

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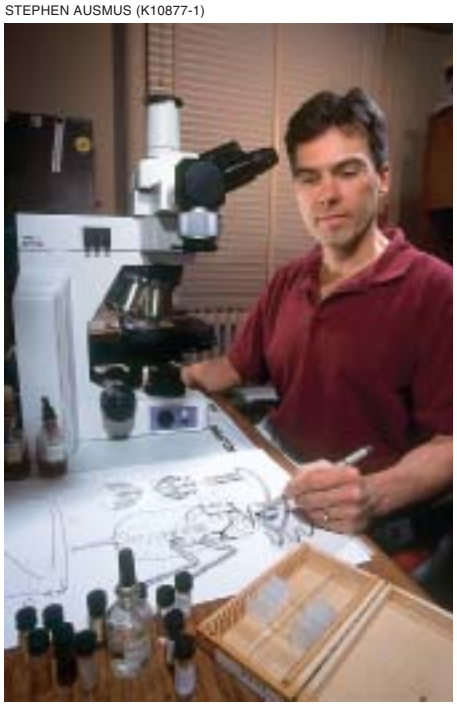
STEPHEN AUSMUS (K10877-1)



Gary Miller illustrates details of an adult male scale insect he is inspecting with a microscope.

STEPHEN AUSMUS (K10878-1)

With a careful eye, Gary Miller takes a closer look at a fern scale *(Pinnaspis aspidistrae).*