

Getting Atop Climbing Fern

A team of two tiny moths might help stop the spread of Old World climbing fern, an aggressive vine that's on the march in central and south Florida. With further research, a third moth, a hungry mite, a small beetle, and perhaps other hard-working organisms as well may qualify to join the coterie of pint-sized weed-eaters.

Known to botanists as *Lygodium microphyllum*, Old World climbing fern makes its way up stems and trunks of other plants, forming blankets of light-green vegetation.

On the ground, climbing fern creates tough, spongy mats that can easily smother grasses, low-growing shrubs, and small trees. Today, it infests more than 100,000 acres in Florida and shows no sign of slowing its advance.

ARS scientists based at research laboratories in Florida and Australia are scrutinizing natural enemies of the fern. They're researching the globe for promising organisms, then subjecting them to rigorous tests in their laboratories.

Some of the studies are host-specificity experiments. They are designed to determine whether the moths will munch on climbing fern alone and not harm native ferns or other vegetation.

Other tests reveal whether top-ranked biological control agents—such as the moths—will be effective in attacking the fern. To warrant the time and expense invested in finding, shipping, studying, rearing, and releasing them, every candidate biological control agent must be very good at what it does.

Investigations of the promising moths *Cataglyphis camptozonale* and *Neomusotima conspurcatalis* are under way at the ARS Invasive Plant Research Laboratory at Fort Lauderdale and Gainesville, Florida, and at the ARS Australian Biological Control Laboratory in Indooroopilly, just outside of Brisbane. ARS operates the Indooroopilly laboratory in conjunction with Australia's Commonwealth Scientific and

PEGGY GREB (K8958-6)



Entomologist Robert Pemberton observes invasive Old World climbing fern overtaking cypress trees in southern Florida.

Industrial Research Organization, or CSIRO.

Climbing fern is native to Australia, South and Southeast Asia, and Africa. On its home turf, the fern is not a pest, perhaps because its enemies keep it in check.

Both of the fern-eating moths are

about a half-inch from wingtip to wingtip. *C. camptozonale* is bright white, with some spots and stripes on its wings.

N. conspurcatalis has dark-brown wings that are edged with white and sprinkled with small, white, boomerang-shaped markings.



JASON D. STANLEY (K9670-1)



Larvae, or caterpillars, of the *Cataclysta camptozonale* moth feed on leaves of climbing fern, weakening the plant.

ARS entomologist Gary R. Buckingham and colleague Christine A. Bennett of the University of Florida are conducting the studies.

Candidate Imported From Australia

The insects used in the tests are descendants of those collected by researchers with the Indooroopilly laboratory, located in subtropical Queensland on Australia's east coast. Entomologist John A. Goolsby and coinvestigators there gathered the *C. camptozonale* moth from climbing fern plants in Queensland.

When the moth passed preliminary tests with climbing fern and 28 other fern species, the Indooroopilly scientists sent about 250 moths to colleague Buckingham in Gainesville for further study. *C. camptozonale* is the first insect exported to the United States for possible use in combating Old World climbing fern, according to Goolsby. He directs the Indooroopilly lab.

The Florida team will complete more tests before deciding whether to seek federal and state permission to release the moth at climbing-fern-infested sites in Florida. Those experiments will indicate whether the moth poses a threat to ferns native to nearby countries in the Caribbean and Central and South America. Pemberton ventured to the Dominican Republic and Argentina to obtain several of those fern species for these critical analyses.

C. camptozonale is nearing the end of testing, according to entomologist Robert W. Pemberton, who is with ARS at Fort Lauderdale. Indoor host-specificity tests in Florida encompassed 63 species of native and cultivated ferns and closely related plants called fern allies, along

with citrus and five kinds of familiar vegetables.

Those tests indicated that the moth's slender, wormlike larvae prefer to eat *Lygodium* fronds. Pemberton designed the studies and collected most of the plants needed for testing in Gainesville.

Related Moth Analyzed

The second and closely related moth, *N. conspurcatalis*, is receiving the same intense scrutiny. Pemberton found the moth attacking climbing fern on an island near Hong Kong during an expedition to find fern enemies in 1997. Goolsby's team collected this same species of moth in Australia and put it through a battery of host-specificity tests at Indooroopilly. The moth passed those tests, so the Indooroopilly team sent a supply to Florida this year for final testing. If both moths pass that muster, they should be able to be used effectively together. And both have many generations of young per year, which means that the vines could be under pressure from the moths nearly year-round. If enough feeding occurs, the vines may die.

Three More Possibilities

Another fern foe looks promising too. It is a small moth that Alma Solis of the ARS Systematic Entomology Laboratory in Beltsville, Maryland, and colleague Shen-Horn Yen of London's Natural History Museum have identified as a member of the *Musotima* genus. According to Goolsby's tests, the moth "appears to be specific to *Lygodium* and not tolerant of temperatures below 32°F."

The moth's cold intolerance is important because it means the insect is unlikely to survive cold winters in the eastern and northeastern United States, where a native fern and climbing fern relative called *L. palmatum* occurs.

In addition to the moths, a microscopic mite is making its way through the barrage of tests at Indooroopilly. CSIRO entomologist Tony Wright, stationed at the Indooroopilly laboratory, found the mite on climbing fern during expeditions to Indonesia, Malaysia, and Thailand. It has also been collected throughout Australia, where the fern is native.

SEBAHAT OZMAN (K9668-1)



Scanning electron microscopy image of a tiny mite of the genus *Floracarus*. The mite is under study as a possible biological control agent for Old World climbing fern.

The male *Cataclysta camptozonale* moth has darker brown markings than the female, shown on the cover.

CHRISTINE A. BENNETT (K9669-2)



To learn more about the mite's biology, Wright and Goolsby are collaborating with mite experts David Walter of the University of Queensland in Brisbane and Sebahat Ozman, there from Trakya University, in Turkey.

The researchers have determined that the mite, a member of the genus *Floracarus*, has a short life cycle—about 12 days when kept indoors at 70°F. Female mites feed on young fern leaves, causing them to curl and soften. Then they lay their eggs in the curl, where their young, called nymphs, feed and develop on the soft tissue. The nymphs' feeding causes the leaves to fall off, so the vine has fewer leaves to capture sunlight for the energy it needs.

Tests showed that mite-infested ferns had one-fourth the growth of plants sprayed with a miticide. Says Goolsby, "We're running the study for 2 years so we can examine the long-term effects of the mite on the fern."

A petite beetle, brown and only about one-quarter inch long, might also become an important member of the fern-fighting team. Wright found the insect, *Endelus bakerianus*, during an expedition to Thailand.

The beetle is a leafminer, meaning that while in its caterpillar or larval stage, it tunnels into the leaves to feed on them.

"We're just now starting host-specificity testing," says Goolsby. With luck, this little beetle might end up playing a big role in protecting the Everglades.—By **Marcia Wood**, ARS, and **Jesús García**, formerly with ARS.

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

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