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Natural ENEMIES to the Rescue

Beneficial insects, such as mealybug destroyers, Asian lady beetles and green lacewings, help to implement augmentative biological control.

Natural enemies are good bugs that eat plant-damaging pest insects and often thrive in nurseries. Yet due to production practices — applications of insecticides, high levels of fertility or large planting blocks that are monocultures — pesky insects and mites sometimes gain the upper hand, and their populations explode. One of the underlying principles of integrated pest management is trying to maximize the use of beneficial organisms. Natural enemies provide biological control. The goal of biological control is to reduce pest populations to tolerable levels — low enough to keep plants marketable and free of noticeable damage. Sometimes, shortly after pest populations begin to build, natural enemies, such as predators or parasitoids, appear and decimate pest populations. Ecologically "healthy" landscapes and nurseries have this capacity.

In some cases, not enough natural enemies are present in a production area to keep pests at bay, and control methods must be implemented. A traditional approach to controlling insects and mites is to apply pesticides. An alternative approach that has shown promise is to purchase and release natural enemies into the production area. This approach to biological control is called augmentation. The following vignettes describe some of our observations and experiments to understand how biological controls work naturally, and how the activities of natural enemies can be augmented for plants in protected culture.

by Michael Raupp and Paula Shrewsbury

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Mealybug destroyers are lady beetles that really live up to their name when released on mealybug-infested plants.

Mealybugs. The citrus mealybug *(Planococcus citri) is* one of the most common and damaging insect pests in greenhouses and outdoor nurseries throughout the South and West. It has a wide host range, feeding on plants in more than 25 families. Mealybugs have sucking mouthparts that feed on phloem, which reduces plant vigor, causes yellowing and distortion of foliage, and leaf drop. Citrus mealybugs produce huge amounts of honeydew. They have several overlapping generations a year.

We wanted to know if irrigation and nutrient- management practices affected mealybug populations. In addition, we were interested to know if irrigation and fertilization affected the ability of a predatory ladybug, the mealybug destroyer *(Cryptolaemus montrouzieri),* to reduce populations of citrus mealybugs. *C. montrouzieri is* readily available from suppliers of biological-control agents.

We grew *Heuchera micrantha* var. *diversifolia* 'Palace Purple' under standard production practices with three rates of nitrogen fertilization: low (25 parts per million a week (ppm/wk]), medium (75 ppm/wk) and high (150 ppm/wk). Within each fertilizer treatment, plants either were water-stressed or not water-stressed. In the absence of predators, citrus mealybug populations increased dramatically on water-stressed plants that received either high or low levels of fertilizer. Where mealybug destroyers were excluded from 'Palace Purple' plants and no biological control occurred, the density of mealybugs increased dramatically from 106 per leaf to 1,869 per leaf after three weeks. On plants where mealybug destroyers were allowed to attack and kill citrus mealybugs, there was a 100-fold reduction of mealybugs on plant leaves to less than 15 per leaf after 35 days.

This study indicates that high or low rates of fertilization and water stress should be avoided, as these conditions contribute to outbreaks of citrus mealybug. If mealybugs do outbreak, augmentative releases of the mealybug destroyer can be very effective in reducing their populations.

Asian lady beetles. A second ladybug that shows up commonly in outdoor nurseries throughout the country is the mul-

Adult multicolored Asian lady beetles can eat more than 100 aphids each day.

A single larva of the multicolored Asian lady beetle may eat more than a thousand aphids during its development.

If you find small, spindle-shaped, lemon yellow eggs on your plants, consider leaving them alone, as they are likely eggs of lady beetles.

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ticolored Asian lady beetle *(Harmonia axyridis)*. This ladybug was imported in the 1970s and 1980s and released in the southern US to control aphids on nut- bearing trees. Since then, it has spread from coast to coast and now consumes billions of aphids every year in landscapes and nurseries. To recognize this beneficial insect, keep an eye open for little, yellow, spindle-shaped eggs. When the larvae hatch, they are small and alligator-like. In their youth, a single *H. axyridis* larva may devour more than 1,000 aphids before turning into a pupa. From the pupa emerges the adult ladybug — an aphid-killing machine. Each adult may eat 90 to 270 aphids per day. In the autumn, *H. axyridis* enter homes by the millions and can be a nuisance.

How effective are *H. axyridis* at removing aphids from plants? A few years ago, I discovered a large planting of barberry *(Berberis)* dripping with barberry aphids *(Liosomaphis berberidis)*. I treated four of the bayberries with a systemic insecticide,

Green lacewings are voracious killers of soft-bodied prey, such as mealybugs, lace bugs and mites.

Helpful Web sites

Web sites on biology, ecology and biological control of insect pests and beneficial insects on woody plants:

- www.raupplab.umd.edu/bugweek — Bug of the week
- www.nysaes.cornell.edu/ent/biocontrol — Biological Control: A Guide to Natural Enemies in North America
- http://cipm.ncsu.edu/ent/biocontrol — North Carolina State University Biological Control Information Center
- http://plantdiagnostics.umd.edu/# — Home and Garden Information Center, Plant Diagnostic Web Site
- www.oardc.ohio-state.edu/nematodes — Insect Parasitic Nematodes
- www.attra.org/attra-pub/PDF/farmscaping.pdf — "Farmscaping to Enhance Biological Control," by Rex Dufour, regarding flowering plants to attract beneficial insects
- www.koppert.nl/e0110.html — Koppert Biological Systems, regarding effects of pesticides on beneficial insects
- http://biocontrol.ifas.ufl.edu/natural_enemies/Mizell_ornamental_pesticide_side_effects.htm — "Pesticides Registered for the Nursery and Landscape and Their Impact on Beneficials and Nontarget Organisms," by Russell Mizell

and four others were left as untreated controls. The plants treated with the insecticide were free of aphids after nine days. Surprisingly, the untreated plants were virtually free of aphids just eight days later. What happened? About the time the insecticide was applied, I noticed fleets of multicolored Asian lady beetles moving onto the shrubs. Several days later, the plants were crawling with hundreds of these hungry predators. These lady beetles took a few more days to work, but in the end, biological control was equally effective as the insecticide at reducing aphid populations.

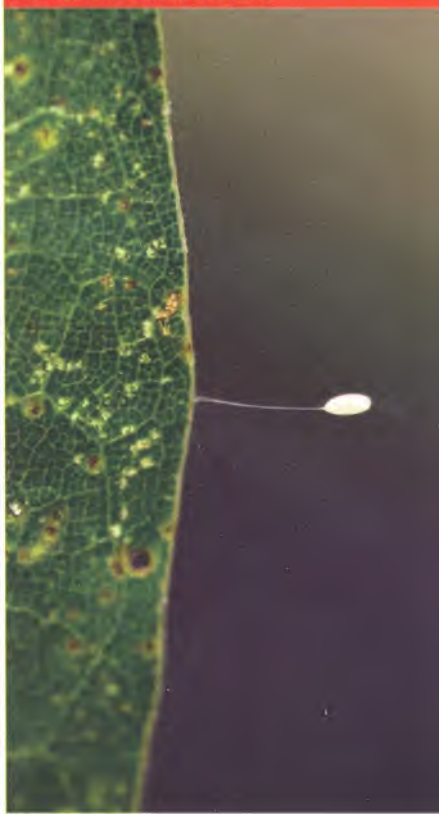
Green lacewings. Another predator that shows promise for use in nurseries as an augmentative biological- control agent is the green lacewing *(Chrysoperla sp.).* The larva of the green lacewing is a natural-born killer. It has two large, hollow jaws used to grab an aphid with a classic pincer movement. It has a hydraulic pump in its head, and as soon as it latches onto an aphid, it pumps digestive enzymes into the hapless victim. These enzymes begin to digest the internal tissues of the aphid while it is still alive. Then, the pump is reversed, and the green lacewing sucks the fluids from the victim. When the meal is nearly complete, I have seen green lacewings lift the carcass of the aphid into the air and twirl it about in a somewhat macabre celebration.

What can nursery professionals do to aid and abet the beneficial natural enemies in their nurseries? Make a deliberate attempt to preserve and protect them.

After completing development, the larva spins a cocoon on the surface of a leaf and pupates. From the pupa emerges a gorgeous insect with lacy wings and large, golden eyes. As a youth, the green lacewing is a meat-eater, but as an adult, these beauties eat nectar and pollen. The egg of a green lacewing looks like a small grain of rice atop a slender stalk. Anyone who works with plants on a regular basis will see the eggs of green lacewings during the months that aphids are active. Green lacewings are important predators of many other insects, such as lace bugs and small caterpillars, as well as spider mites.

We conducted a study in a wholesale nursery with green lacewings *(Chrysoperla carnea)* purchased from a commercial source as second- and third-instar larvae. These were shipped in cardboard, honeycomb, hexal units and released over azaleas infested with azalea lace bugs *(Stephanitis pyrioides)* at the rate of one predator to every three lace bugs. After six days, the number of lace bugs on plants without additional predators was 21 per branch, but plants that received lacewing larvae had on average only 0.5 lace bugs per branch. We also found that green lacewing larvae were most effective in killing immature stages of lace bugs. They will probably work best when small nymphs rather than adult lace bugs are present. These studies suggest that augmentative release of green lacewing larvae provides an alternative control tactic that can be integrated into lace bug pest-management programs in production nurseries.

Lacewing eggs look like small grains of rice on a slender stalk.



Implementing biocontrol strategies. What can nursery professionals do to aid and abet the beneficial natural enemies in their nurseries? Make a deliberate attempt to preserve and protect them. How do we do this? We can give them a habitat that promotes survival and increased populations. What do they need? They need just what you need: food, places to reside, favorable regimes of temperature and moisture, and habitats free of toxic chemicals. Diverse habitats that provide refuges and alternative food sources, such as many types of prey and sources of nectar and

Lacewings are formulated in cardboard containers and easily distributed over containerized plants.

The beautiful lacewing adult consumes nectar and pollen.

pollen, are very important. The immature stages of ladybugs and lacewings eat pests, like aphids, lace bugs and mites, but adult lacewings, lady beetles and many other natural enemies eat nectar and pollen. There maybe more natural enemies in your nursery if a constant array of flowering plants is present to provide food to attract and retain natural enemies.

The results in this article represent limited trials on relatively small scales. The release of lacewing larvae and mealybug destroyers was relatively inexpensive, and the multicolored Asian lady beetle arrived and worked for free. On larger scales, results of natural enemy releases have been variable and much remains to be learned about efficacy and cost effectiveness. However, when pests — such as aphids, mealybugs or lace bugs — get out of hand, consider purchasing natural enemies and giving them a try. Suppliers of biological-control agents can be found at the following Web sites: http://ohioline.osu.edu/ hyg-fact/2000/2 122.html and http: / /www .cdpr.ca.gov/docs/ipminov/ben_supp/ben _sup2.htm.

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