

While attending the OFA meetings in Ohio in July 2013, I had the opportunity to hear three greenhouse growers talk about how they are adopting biological control at their operations. It was rather refreshing since we have been trying to get greenhouse growers to adopt more biological control since the mid 1990s. The cost of chemicals has skyrocketed, pest resistance is becoming more troublesome, and the restrictions have made chemical applications less attractive to many growers. I am relaying the successes of these greenhouse operations and several in Maryland so more growers will begin to consider a biological approach to help control insects and diseases in greenhouses.

The three greenhouses that presented on use of biological control were Barlow Flower Farm of New York, Dickman Greenhouses of New Jersey and Longfellow Greenhouses of Maine. Each greenhouse made the commitment to use biological control to deal with insect and disease problems. Each operation used scouting as the mainstay of their program. Each flat of plug plants that arrive at their greenhouses is inspected for insects and diseases and rejected if there is a problem. Each greenhouse would then make up a solution of beneficial nematodes, *Steinernema feltiae*, 4 ounces of wettable powder of BotaniGard (*Beauveria bassiana*) in 15 gallons of water, and RootShield (*Trichoderma* for root disease control). A plug tray of plants was submerged in the solution. They can treat between 50-60 flats before they have used up 15 gallons of solution. In most cases, they come back 4-6 weeks after transplanting and apply RootShield a second time. The nematodes and BotaniGard were to deal with any thrips pupating in the soil. They also release rove beetles into the greenhouse to control fungus gnat and shore fly larvae.

We set up a biological control project in 2010 with Catocin Mountain Growers where we made three releases of rove beetles over an 8 week period. These releases reduced shoreflies and fungus gnat populations fairly well. Catocin Mountain Growers still uses these rove beetle releases in their plug production area which is kept very moist. In the three greenhouses in the OFA presentations the managers started Pepper 'Purple Flash' plants in February or March to serve as banker plants on which to release the predatory *Orius insidiosus* in late March to early April. The *Orius* arrive in lots of 100 adults per container (cost is around \$40 per 100) which they apply at the rate of 5 *Orius* (minute pirate bugs) on each of 20 plants. Since *Orius* is a little pricey, the idea is to get them to reproduce on banker plants so you can keep your order for more *Orius* limited. *Orius* will feed on the pollen of the peppers, and then lay eggs into the foliage. The nymphs feed on pollen until thrips are present. *Orius* adults migrate through the greenhouse looking for thrips on which to



Minute pirate bugs (*Orius* sp.): Adult and two stages of nymphs

Photo: John Davidson, Professor Emeritus, Entomology

feed. The great thing about *Orius* is that they will feed on 1st and 2nd instar nymphs and adult thrips. They use between 5-10 banker plants of the flash peppers per acre of growing area. All three operations felt this approach has given them good levels of control of thrips and felt the use of the *Orius* was worthwhile.

They also release the predatory mites *Amblyseius cucumeris*, in sachets of 50 mites each, applying at the rate one sachet on each hanging basket. For the flats of plants they obtain the mites in dispenser bottles and sprinkle grain with the predatory mites onto trays of plants at 5-10 mites per square meter. The predatory mites feed on the 1st instar stages of thrips. The combination of the predatory mites and *Orius* releases has been used successfully for two of the growers for the last 5 years. The third grower had been using this method for the last 3 years with success. One of the growers comes back with a soil drench application of beneficial nematodes to kill any thrips pupating in the soil and to kill fungus gnats.

For aphid control, each of the operations is using **banker plants**, growing oats or barley in a 6 – 8” pot. You can obtain a bag of oats or barley from a farm supply store. Two weeks after the oats are potted, the bird cherry oat aphid is introduced onto the oat plants. This aphid species feeds just on monocots such as grains and grasses and should not become a problem in the greenhouse on bedding plants. The bird cherry oat aphids are kept in a net covered cage so that it excludes predatory wasps. If the wasp gets to the bird cherry oat aphid too soon your population of aphids will be wiped out, and you will have to buy more bird cherry oat aphids from a biological supply house. The objective is to build up the bird cherry oat aphid population on the banker plants so there will be a good population as a food source for the release of predatory wasps on the plants.

One of the growers did not build a netted cage and instead used two layers of hair netting stretched over the pots to screen out the predatory wasps until the bird cherry oat aphid population was large enough. The banker plants are ready 2 – 3 weeks after the release of bird cherry oat aphids and have enough aphids present that they can be moved into the greenhouse growing area. The growers are using 5-10 plants per acre of growing area. A parasitic wasp, *Aphidius colemani*, is released onto each banker plant. The adult female wasp stings the bird cherry aphid and lays an egg inside the aphid's body. The wasp larvae kills the aphid and swells its body often changing the aphid a tan brown color. An adult wasp emerges from the dead aphid and will search the greenhouse for green peach aphids and melon aphids in which to lay eggs. The growers continue to produce additional oat or barley banker plants with bird cherry oat aphids and repeat the process of placing out the banker plants among their greenhouse crops so they have a source of aphids to increase their population on. If you develop a problem with potato aphid or foxglove aphids then you will have to release another predatory wasp called *Aphidius ervi*. At the University of Maryland Extension, we can help you identify the aphid species so you can decide which predatory wasp to purchase from a biological supply house.



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An aphid mummy is a sign that *Aphidius* is present in the crop

Aphidoletes aphidimyza is a general predator of aphids that can be used. It is a gall midge insect and the female will lay eggs near an aphid colony. The hatching larvae pierce the body of aphids and suck out the liquid contents of the aphid – sucking them dry. The midge is used against fast building populations of aphids. The manager at Longfellow Greenhouse in Maine used a plastic bucket that they cut a hole into the lid and they place the pupae of the *A. aphidimyza* inside it. The wasps are protected, and when they pupate can emerge through the hole in the lid. They

***Aphidoletes* midges are feeding on a small population of aphids**



move the bucket around the greenhouse to where they have rapidly building aphid populations. If fungus gnats build up in wet springs like 2013 then beneficial nematodes are applied as a drench, making sure to remove any screening if an injector is used.

Each of these greenhouse operations commented that their workers were happier since they stopped applying fungicides and insecticides regularly in the greenhouses and several have really become actively involved in the beneficial releases. So far, this approach has worked for these three diverse greenhouse operations in various parts of the ortheast. It might be time for you to consider working toward a biological control program.

We have conducted various biological control trials in Maryland greenhouses. If you are a Maryland grower and are thinking of trying biological control and want to work with me let me know at sgill@umd.edu.

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