

A step by step introduction to an innovative and all natural method for dealing with greenhouse pests

BY JANET WALLACE

Aphids in the greenhouse. It's a common enough problem but Lisa Brown has little tolerance for the pest. At Farmer Brown's Greenhouse, outside of Moncton, N.B., she sells ornamental bedding plants. Her customers expect the plants to be unblemished and do not want to bring pests home along with their flowers.

Brown tried using insecticidal soap to control aphids. The non-toxic soap only works when it comes into contact with the aphids so it has a short-term effect and limited efficacy when used on a large-scale. "Insecticidal soap just gives you clean aphids," she says.

Next, she brought in beneficial organisms to deal with aphids. Specifically, she used the parasitic wasp *Aphidius colemani* to control Green Peach aphids on her bedding plants.

The biological control was highly effective but also expensive. Once released in the greenhouse, the wasps successfully eliminated almost all the aphids. Great news for Brown and her customers, but bad for the wasps. They no longer had food and couldn't reproduce, so their numbers dwindled. Eventually the aphids would come back and she would need to order more beneficials. Brown estimates that frequent releases of beneficials during her short growing season (roughly three months) cost her at least \$700 a year.

Another major obstacle with buying beneficials is the need to ship the organisms to the greenhouse. Shipping live organisms is expensive and takes time. In the interval between submitting an order for parasitic wasps (from another province) and releasing them in her greenhouse, a small population of pests could develop into an infestation.

Brown found another option; she started to raise her own stock of the parasitic wasp *Aphidius colemani* using banker plants. The banker plant system involves making live food for the wasps available at all times, but kept in reserve (i.e., 'banked' aphids) so the wasps will not eat them all. This way, she has a supply of beneficial organisms on hand throughout the growing season. She saves money, becomes more self-sufficient and can keep aphids under control throughout the season.

Banki



ng on bugs

Parasitized aphids (mummies).



Lisa Brown checks yellow sticky traps daily to get a sense of the number of aphids and other insects flying in the greenhouse. The traps are used simply for monitoring pest populations, not for pest control.

She started her own banker plant system through the help of Biobest products and Halifax Seed, their supplier in Atlantic Canada.

“I’m amazed at how supportive Biobest and Halifax Seed are in helping people create their own systems,” she says. “Most companies would take my \$700 and look for more but they encourage us in creating our own banker plants knowing it may cut their financial returns. I think they actually look at the big picture.”

The banker plant system is a food web involving the following components.

1. Pest aphids: Their populations, ideally, will be controlled by the parasitic wasp but it is unlikely they will be completely eliminated.
2. Crops: The plants, usually vegetables, herbs or ornamental flowering plants that are affected by the pests.
3. Beneficial organisms: Parasitoid wasps or other beneficials that attack aphids. The parasitoids include *Apbelinus abdominalis*, *Aphidius colemani*, *Aphidius matricariae* and *Aphidius ervi*.
4. Non-pest aphids: Aphids that provide food for the wasps when there are few pests around. These are usually aphids that feed on monocots (i.e., grain, corn, grasses). The bird cherry oat aphid (*Rhopalosiphum padi*) is commercially available.
5. Banker plants: A monocot plant that provides food for the non-pest aphid. Pots of barley, oats or wheat are often used.

There are two groups of banker plants; one or both are covered to prevent wasps from entering or leaving the plants.

5 (a) Aphid nursery. Banker plants with aphids but without wasps; these sustain populations of aphids.

5 (b) Parasitoid nursery. Banker plants with both aphids and wasps; these are used to maintain breeding populations of wasps. When aphid control is needed, some of these plants will be placed throughout the greenhouse so the wasps can disperse. The wasps find aphids by tracking the alarm signals released by stressed plants.

Some growers keep a stock of both types of banker plants covered at all times. They continually start new plants, move pots from the aphid nursery into the parasitoid nursery and move pots from the parasitoid nursery into the greenhouse.

Using banker plants is “dead easy,” says David Blanchard of Pleasant Hill Farm in Nova Scotia. “If you can raise chickens or pigs, you can raise bugs. They’re just small livestock.”

At a greenhouse conference organized by the Atlantic Canadian Organic Regional Network (ACORN), Blanchard described how he uses banker plants. Blanchard is an organic market gardener in Nova Scotia who uses his greenhouse for season extension and to grow warm-loving crops in the summer. Like Lisa Brown, Blanchard uses banker plants and beneficials to control aphids, but the system can also control thrips, whiteflies and spider mites successfully.

You can’t wait until you have a pest problem before starting a banker system, says Blanchard. You need to start the plants weeks before you plan to start the greenhouse crops. Take into account shipping time before that. You need to plan ahead.



Although the aphids that cause damage to plants are wingless, the pests mature into winged adults that can travel between plants and get caught on yellow sticky traps.

Step 1

Begin by identifying the pests you need to control. Signs of aphids include curled leaves and cast off skins that look like white powder on the leaves.

In terms of aphids, winter or early spring greens are most likely to be affected by the green peach aphid. Cucumbers are often affected by the cotton (aka melon) or green peach aphids, and tomatoes, peppers and eggplant by the potato, green peach or foxglove aphids.

To identify aphid species, see www.aphidnet.org. Another option is to go Biobest's website <http://www.biobest.be/plagenalg/3/> and simply click on 'aphids' and scroll down to your crop. The website describes which beneficials are most suitable for the aphids most likely affecting that crop.

Parasitic wasps are commonly used in banker systems. These are tiny black wasps with long antennae and very pronounced 'waists.' Most are less than an inch long and do not sting humans. The females lay eggs in the eggs, larvae, cocoons or bodies of other insects. After wasp larvae hatch, they devour their host.

Most of the commercially available parasitic wasps used to control aphids lay their eggs in older nymphs or adult aphids. As the wasps mature, their aphid hosts become swollen and change colour. At this point, the parasitized aphid is called a 'mummy.' Mummies containing *Aphidius* spp. are bronze in colour, whereas *Aphelinus* produces black mummies. Eventually one adult wasp will emerge from each mummy.

Some wasps, such as *Aphelinus abdominalis*, attack several types of aphids and lives longer than *Aphidius* spp. Unfortunately, this species is a more expensive biocontrol and lays fewer eggs per day. Other wasps are more specialized. *Aphidius colemani* parasitizes the green peach aphid and melon aphid. *Aphidius matricariae* controls the green peach aphid and, to a lesser degree, the melon aphid, whereas *Aphidius ervi* controls the potato and foxglove aphids. If your crops are affected by more than one species or you can't identify the species, you can buy a mix of two or more aphid species.

Step 2

Start your banker plants by planting grain in pots. To shield these from wasps, cover the pots with hairnets or grow them in a screened tent or box. Place the plants in a well-lit, warm place such as a heated greenhouse, a growing chamber or in your house under grow lights.

If you want to skip this stage you can buy rockwool cubes planted with banker plants and infested with non-pest aphids.

Step 3

Some growers introduce the non-pest aphids to the banker plants when the grain is 4-5 inches tall. However, Blanchard starts the grain just three to four days before he expects the aphids to arrive. He orders "starter banker plants," barley colonized by the non-pest aphid (bird cherry oat

aphid). When the aphids and barley arrive in the mail, he “picks several leaves with a lot of aphids and lays them in the pots of germinating grain.”

Step 4

After three to four weeks, the aphids should be well established and it's time to order the wasps. Once you receive the shipment, keep the container in a warm place until the wasps emerge from their pupae. Then add the wasps to one banker plant. The parasitoids perform best at a temperature of 20C.

Step 5

After seven to 10 days, you should start to see ‘mummies,’ the swollen aphids that contain developing wasps. At this point, move some of the pots into the greenhouse. The wasps will emerge, mate and lay eggs in pest aphids. The population of beneficial wasps should soon explode and control the pest problem. However, if the pests are eliminated, the wasps will also die off.

Blanchard recommends succession planting of banker plants. He suggests that each week growers should bring plants with different life stages of wasps into the greenhouse. That way new wasps will emerge throughout the week.

Note that banker plants and pesticides aren't a good mix.

“If you can raise chickens or pigs, you can raise bugs. They're just small livestock.”

Pesticide used to control aphids can kill the non-pest aphids. Some of the common pesticides used for aphids will also kill the parasitic wasps (as well as bees and other wild beneficial organisms.)

Lisa Brown now raises *Aphidius colemani* using a banker plant system involving pots of barley infested with bird cherry oat aphids, a monocot pest. Monocots include grasses, grains and corn — not typical greenhouse crops. Brown grows some ornamental grasses in her greenhouses but finds that the monocot aphids do little, if any, damage to them.

In fact, in addition to her banker plants, she leaves ornamental grasses at the end of each greenhouse, “so the aphids and the wasps always have something to eat.” This also allows her to monitor the populations of the parasitoids by checking the ornamental plants for mummies (parasitized aphids).

“I can see the mummies,” she adds. “So I know the wasps are there. I can tell they're doing a really good job.”



Parasite or parasitoid?

Although *Aphelinus* spp. and *Aphidius* spp. are called parasitic wasps, they are technically parasitoids, not parasites. Whereas parasites tend to feed on their hosts and rarely kill them, parasitoids use the hosts to feed and incubate their young. In the same way an egg yolk provides energy to a chick, the aphid is the source of energy for a developing parasitoid. Also, parasites tend to be much smaller than their hosts (e.g., tapeworm in a human), whereas parasitoids are about the same size as their hosts. Common parasitoids include ichneumonid wasps and tachinid flies. *Aphidoletes aphidimyza* is neither a parasite nor parasitoid. This midge is a predator that hunts but never lives within its prey. (Picture a tiger stalking a gazelle.)



Aphidius colemani are shipped inside of aphids. Rather than shipping the parasitic wasps themselves, biological control companies send parasitized mummies -- aphids that have been parasitized by the wasp. The wasps will soon hatch from the mummies, and some might even hatch during shipping.



The banker plant system is contained within the styrofoam container on the greenhouse bench. The grass provides food for the monocot aphids, which in turn provide food (and an incubation site) for the parasitic wasps.

For more information

- Detailed instructions can be found at *Aphid Banker Plant System for Greenhouse IPM, Step by Step*: <https://extension.umass.edu/floriculture/sites/floriculture/files/pdf-doc-ppt/AphidBankerPlantSystem.pdf>
- *Biological Control in the Greenhouse*. David Blanchard. <http://acornorganic.org/media/resources/LessonlearnedRupert.pdf>
- *Using Banker Plants for Aphid Control in Greenhouses*. <https://www.extension.umd.edu/learn/using-banker-plants-aphid-control-greenhouses>
- *Common Greenhouse Pests – Aphids*. A guide for identifying four common species. <http://www.uvm.edu/~entlab/Greenhouse%20IPM/Pests&Beneficials/Aphids.pdf>
- *Aphids in Greenhouse Crops*. <http://www.omafra.gov.on.ca/english/crops/facts/06-081.htm>

Stealth is key.

Predatory midge wanted. Must be able to kill 10 to 100 aphids without causing a disturbance. Stealth is paramount.

Parasitic wasps are not the only forms of biocontrol used to control aphids. Predatory midges (small flies) are also used.

Strange as it may sound, stealth is a key advantage of using *Aphidoletes aphidimyza*. The adults of this fly feed on honeydew, the sticky substance produced by aphids. The larvae prey upon aphids. Each larva can kill 10-100 aphids and can do so quietly. “Because of its furtive behaviour, it triggers little defensive reaction by aphids,” says one researcher.

A parasitic wasp, apparently, can cause an uproar in an aphid colony when it swoops in and injects its eggs into an aphid. The aphid will often struggle and kick. While doing so, it releases alarm pheromones that trigger nearby aphids to disperse.

The problem from the farmer’s perspective is that the fleeing aphids don’t travel *en masse*. They run off in a number of different directions. So where there was once one colony, there is now one infected aphid and perhaps several new aphid colonies. Ideally, after the wasps emerge, they will be able to find all the new colonies and this will be a moot point.

If you want to sustain populations of *A. aphidimyza*, ensure you have bare soil in the greenhouse. The midges need access to soil in order to pupate.

For more information: Gillian Ferguson, Graeme Murphy & Les Shipp. 2011. *Aphids in Greenhouse Crops*. OMAFRA. <http://www.omafra.gov.on.ca/english/crops/facts/06-081.htm>