

12. Biological Control of Aphids in Greenhouse Vegetable Production

(HortReport, March 2001)

Effective and timely control of aphid populations in greenhouse vegetable production is important due to their ability to develop into large populations quickly. There are many different aphid species in PA greenhouses including green peach aphid, potato aphid, and melon aphid. The aphid that is usually found to infest vegetable crops, especially tomatoes (Solanaceae crops) is potato aphid (*Macrosiphum euphorbiae*). In addition to the ability to transmit viruses, aphids cause direct damage by feeding on plant sap to acquire the proteins and sugars needed for their reproduction. Aphids secrete excess sugars in the form of sticky “honeydew”. Honeydew supports the growth of black sooty mold that affects plant photosynthesis, possibly reducing plant yields. Removing sooty mold from fruit increases handling time and can possibly render fruit unmarketable.

Life cycle

In greenhouse production, aphids are very prolific. Instead of reproducing by eggs, female aphids (stem mothers) give birth to live offspring (3-10/day) that start to feed immediately. Within a week, this offspring will be ready to reproduce. Aphids can have two forms: winged or wingless. As colonies enlarge, aphids develop wings to migrate to less populated areas in the crop.

The most outstanding characteristic for identifying aphids is by the two cornicles (“tail pipes”) on the rear of their abdomen. Color is variable among species and is not accurate for identification. As aphids increase in size, they shed their exoskeletons (cast skins). These white cast skins, often mistaken for adult whiteflies, can be found on leaves or stuck in honeydew excretions.

Monitoring

Plant monitoring should begin at the seedling stage and continue through the duration of the crop cycle. Start plant inspection on lower leaves and continue up the plant to the growing tips. As aphids feed on growing tips, the leaves curl, sometimes looking like virus symptoms.

Yellow sticky cards are useful in detecting winged aphids. Hang sticky cards 4-6 inches from growing

tips. IPM Labs (ipmlabs@baldcom.net) sells a chart with drawings of important insects found on sticky cards. Unfortunately, winged adults on sticky cards may indicate that there are clumped populations already established in the crop and they are migrating to less populated areas. The presence of ants in the greenhouse may indicate aphid development, since the ants feed on the excreted honeydew and thus protect the aphids. When introducing natural enemies, place them in an area protected from ants and control ants with baits or traps.

Biological Control

Several long-lasting and effective biological controls are commercially available for aphid control. Each natural enemy has an effective introduction strategy that will be discussed further in upcoming issues of this column.

Predators for aphid control

Ladybeetles (*Hippodamia convergens*):

Ladybeetles are sold as adults in pints, quarts and gallons. A general predator, ladybeetles are effective for cleaning up hot spots. They also feed on scales, thrips, and other soft-bodied insects.

Lacewings (*Chrysoperla rufilabris*): Lacewings are sold as eggs or larvae. The larvae are voracious predators known as “aphid lions”. They will also feed on mealybugs, scales, spider mites and thrips.

Predatory Midge (*Aphidoletes aphidimyza*): This midge is sold as adults to be released in the greenhouse. The adult midge lays eggs near aphid colonies and the orange larva feeds on aphids.

Parasites for aphid control

Caution: Parasites for aphid control are very species specific. Identify the aphid species infesting your crop before ordering from your supplier.

***Aphidius colemani*:** Used to control green peach aphid and melon aphids. This tiny parasitic wasp lays an egg in the aphid. The egg hatches into a larva, which spins a cocoon, producing a new wasp. The wasp exits the aphid body, leaving behind a brown shell called an aphid mummy.

***Aphidius ervi*:** Used to control potato aphids. This parasite has a similar appearance and life cycle as *Aphidius colemani*, but is about twice its size.



Fig. 1 Potato Aphid



Fig. 2 Honeydew and sooty mold development on tomato leaves.

***Aphelinus abdominalis*:** Used to control larger aphid species such as potato aphid and glasshouse potato aphid. This wasp is about 3 mm long. The main advantage to using this parasite is that the female adult will parasitize for several weeks and it will also feed on the aphids.

Other effective controls for aphids: include screening vents, removing weeds in the greenhouse and outside the greenhouse, inspecting incoming plant material, disposing of plant debris, and avoid growing ornamentals in vegetable production area.



Fig. 3 Honeydew and sooty mold can also damage tomato fruit.

13. Biological Control of Aphids with *Aphelinus abdominalis* (HortReport, May 2001)

The aphid that is usually found to infest vegetable crops, especially tomatoes (Solanaceae crops) is potato aphid (*Macrosiphum euphorbia*). Aphid nymphs and adults feed on plant sap, stopping plant growth. Signs of aphid feeding are curled leaves, yellow spots and the presence of sticky honeydew excreted by the aphid. A black sooty mold will develop on the honeydew, affecting photosynthesis and possibly reducing plant yields. Aphids may also transmit viruses. Other aphid species such as green peach or melon aphid are also pests, especially if tomatoes are grown with ornamental crops.

On page 16 is information on *Aphidius ervi*, a parasitic wasp that attacks larger species of aphids. Another parasite that can be used alone to control potato aphid or in combination with *Aphidius ervi* is *Aphelinus abdominalis*. In addition to tomatoes, *Aphelinus* can be applied on crops such as sweet pepper, tomato, eggplant, bean, roses and chrysanthemums. Remember – aphid parasites are host species specific. For effective control, identify the aphid species attacking your crop before ordering a biocontrol!

Aphelinus abdominalis can be introduced as a preventive method when the crop is installed, or begin introductions as soon as aphids appear. *Aphelinus* has a long-lasting but slower activity compared to *Aphidius ervi* which goes to work immediately, however, *Aphelinus* adults may persist for up to eight weeks after they are introduced. Start crop monitoring for pest and disease development at the seedling stage and continue weekly until the end of the crop cycle. Detect and treat hot spots on a timely basis to prevent rapid colonization of aphids. Always initiate biocontrols when pest populations are low. Biological control is not a rescue treatment.

Life cycle of *Aphelinus abdominalis*

This wasp is very tiny, about 3mm long, has short legs and short antennae. The female wasp has a black thorax and a yellow abdomen. When the female wasp finds an aphid she injects it with her ovipositor depositing an egg. *Aphelinus* can parasitize any aphid stage including winged

aphids. The parasite larva develops inside the aphid body and transforms it into a black mummy. The new wasp will emerge through a hole chewed in the aphid exoskeleton. *A. abdominalis* will also feed on aphids that she does not parasitize.

Application

- Reduce or eliminate the use of toxic or residual pesticides before introducing *Aphelinus* or any other natural enemy. (Consult biocontrol supplier for information on pesticide residues)
- Release *A. abdominalis* on a preventive basis or introduce at a higher rate (curative) when aphids are first found.
- When aphids are first observed introduce *Aphelinus* at a curative rate for 3 introductions at 1 week interval.
- Monitor weekly for the development of black, mummified aphids. When 80% of the aphids are parasitized a parasite/prey balance has been achieved and no further introductions are needed. Augment with further introductions as required since aphid migration from outside may occur in warmer months.
- When pruning leaves, check for parasitized aphids (black mummies). If mummies are present keep these leaves in the greenhouse until new parasites hatch.
- Discuss release rates with your biocontrol advisor.
- When aphid populations are heavy, the production of honeydew can interfere with the searching ability of the parasite. Heavy aphid populations can be reduced with soft, compatible compounds or by using ladybeetles.
- Tap wasps onto leaves (or near hot spots) of the infested plants in the morning or evening, not in direct sunlight. This wasp is not very mobile so placing it close to infestations will increase the effectiveness.
- Protect parasites from ants. Ants feed on honeydew and thus protect the aphid colonies from natural enemies. Install traps for ants.

- Activity of parasites is reduced at high temperatures (above 86° F).
- *A. abdominalis* can be stored up to two days at 47-50° F in the dark, however it is best to distribute parasites immediately.
- *Aphelinus abdominalis* is usually shipped as adults or mummies.

***Aphelinus abdominalis* products**

Trade names for *Aphelinus* products are:

Biobest: **Aphelinus-system**, Phone: 303-661-9546, <http://www.biobest.be> or <http://www.bugsandbees.com>



Figure 4. *Aphelinus* adult (wasp) parasitizing green peach aphid.

Kopperts: **Aphilin**, Phone: 734-641-3763, <http://www.koppert.nl>

Syngenta: **Aphiline ab**, Phone: 805-986-8265, Fax: 805-986-8267, email: info@syngentabioline.com

This parasite can be obtained through most biological control distributors.

Benefits

- Long lasting form of aphid control.
- Black parasitized aphids are easy to recognize
- Parasitize and feed on aphids.



Figure 5. Aphid body appears black when a new parasitoid has formed. A new wasp emerges through a hole chewed in the dorsum.

14. Biological Control of Aphids with the Predatory Midge, *Aphidoletes aphidimyza* (HortReport, June 2001)

The last two articles of Bug vs. Bug, discussed *Aphidius ervi* and *Aphelinus abdominalis*, two parasites that can be used alone or together to control potato aphid. Potato aphid is the most common aphid species to infest greenhouse tomatoes. Other species found in greenhouse vegetables are green peach and melon aphid. It is important to identify the species infesting your crop before ordering a biocontrol. Aphid parasites are host specific and the appropriate parasite must be applied for timely aphid control. Aphid parasites are effective in searching for isolated aphids, winged aphids and aphid colonies. If you cannot identify the aphid species attacking your crop, consider using a general predator such as *Aphidoletes aphidimyza*.

The predatory midge, *Aphidoletes aphidimyza*, is a general aphid predator, attacking many different species of aphids. It can be used alone or in combination with a parasite for rapid knockdown of aphids. This predator is most effective on aphid hot spots (clumped populations). The main benefit to using *Aphidoletes* is its applicability on several crops (peppers, eggplants, cucumbers, etc.) on which any species of aphid occurs.

Life cycle of *Aphidoletes aphidimyza*

Aphidoletes is a predatory gall midge that attacks over 70 different aphid species. The adult midge is about 2.5 mm long, with long legs and a slender body. The adult midge is mainly active at night, lives for about 7-10 days, and commonly feeds on honeydew.

After dusk, the female midge deposits her eggs in aphid colonies. She is attracted to aphid colonies by the smell of honeydew. The eggs hatch into a tiny larva (.3-3 mm) that searches the leaf and upon finding an aphid injects a paralyzing toxin that also dissolves the body contents. The larva attaches its mouthparts to the aphid and feeds on the dissolved contents. Each larva needs to feed on about 5 aphids to complete its development, however it will kill more if available (up to 65 aphids). Initially the larva is transparent orange, but becomes orange, red, brown or gray, depending on the food source. In about 7-14 days, the

larva falls from the plant into the soil, using soil particles to make a cocoon. Within 7-10 days, a new adult gall midge will emerge from the cocoon.

Application

- Reduce or eliminate the use of toxic or residual pesticides before introducing *Aphidoletes* or any other natural enemy. This predator is very sensitive to pesticides.
- Release on a preventive basis or introduce at a higher rate (curative) when aphid colonies are first found. (Consult supplier for rates)
- Three to four successive introductions are needed to build a sustaining population of *Aphidoletes*. Augment with new introductions as needed throughout the season.
- When pruning, examine leaves for orange larvae. These leaves should be left in the greenhouse so that the larva can complete the life cycle. All employees should be trained in recognizing this life stage.
- When introducing into the greenhouse, protect predators from ants. Ants feed on honeydew and thus protect the aphid colonies from natural enemies. Install traps for ants.
- Monitor the effectiveness of this predator by looking for aphids that appear to be shriveled and eventually turn brown and/or black and decay. Use at least a 10x hand lens when inspecting.
- In soil cultures, larvae can pupate in the ground and successive generations will occur. This eliminates the need for continual introductions.
- If soil is covered by plastic, there are no appropriate sites for pupation and many will die. Successive generations do not occur and continued releases are required.
- *Aphidoletes aphidimyza* is usually shipped as pupae in a vermiculite carrier. Adults will emerge from pupa when placed in the warm greenhouse. Introduce in plant canopy away from direct sunlight, preferably in early morning or evening near aphid colonies.

Note: The larva enters hibernation (lower temperatures, shorter days), starting in late September unless you add supplemental light (one 60 watt bulb per 30 feet, or 100 watt bulb per 65 feet). If you are growing a fall crop, a better strategy would be the application of a parasite such as *Aphidius ervi* or *Aphelinus abdominalis*.

***Aphidoletes aphidimyza* products**

Product names from major suppliers of biocontrols:

Biobest: **Aphidoletes-system**, Phone: 303-661-9546, <http://www.biobest.be> or <http://www.bugsandbees.com>

Kopperts: **Aphidend**, Phone: 734-641-3763, <http://www.koppert.nl>

Syngenta: Aphido-line a, **Phone: 805-986-8265**,
Fax: 805-986-8267,
email: info@syngentabioline.com

This predator can be obtained through most biological control distributors.

Benefits

- Controls all aphid species.
- Can be applied in several crops.
- Excellent searching ability.
- Curative control of aphid colonies.
- Long lasting effect in soil culture or trough culture.



Figure 6. Larval stage (orange) of *Aphidoletes aphidimyza* feeds on aphids. Aphid on lower right has had its body fluids sucked out. Scout for these aphids to determine if the biocontrol is effective.