



### Biological Control of Aphids

#### Introduction

Aphids can be serious and persistent pests in the greenhouse. They are difficult to control due to their high reproductive capability and short development time that quickly leads to their developing resistance to many different insecticides. The presence of aphids, their white shed skins and honeydew can reduce the aesthetic quality of a wide range of greenhouse crops. Aphids can also vector viruses such as cucumber mosaic virus (CMV) and many different potyviruses.

#### Biology and Life Cycle

Most types of aphids found in greenhouses do not mate. All of the aphids present are females that can give birth to live nymphs. There is no egg stage. An adult female may live for up to one month. During this time, she may give birth to 40 to 100 live nymphs. About one week is sufficient for the young aphids to reach maturity. Migratory winged aphids may appear when the colony becomes overcrowded or when the food supply is depleted. Outdoors, in the fall, winged aphids appear that mate and lay eggs, so that aphids overwinter in the egg stage.

#### Identification

Aphids are small (less than 1/8 of an inch long), soft-bodied, pear-shaped insects with long legs and antennae. In greenhouse ornamentals, some of the important species include the foxglove aphid (*Aulacorthum solani*), green peach aphid (*Myzus persicae*), the melon or cotton aphid (*Aphis gossypii*) and the potato aphid (*Macrosiphum euphorbiae*). See [Managing Aphids in the Greenhouse for more information](#).

#### Cultural Controls

Inspect incoming plants for aphids. Avoid high nitrogen fertilization that promotes lush growth that is favorable to aphids. Remove weeds and “pet plants” that can be sources of aphid infestations. See [Greenhouse Weed Control](#) for more information.

#### Biological Controls

Aphids are susceptible to many natural enemies, including aphid parasitoids, predators and entomopathogenic fungi. Unfortunately, managing foxglove aphids with natural enemies, especially on the widely grown calibrachoa, is more challenging.

#### Aphid Parasitoids

Parasitoids (parasitic wasps) develop in a single host and kill the host as they grow and mature. In general, parasitoids are more effective than predators in

reducing aphid populations. However, it may be difficult for some parasitoids to search effectively on crops with hairy or sticky leaves. Aphid parasitoids are host specific. If you are unsure of the species of aphids you may have or have multiple species, mixtures of different aphid parasitoids are commercially available. Parasitoids are shipped as either adults or “aphid mummies” from which the adults emerge.

*Aphidius* lays its eggs in aphids and the larvae develop within the aphid. The aphid is killed as the developing larvae feed upon it. The swollen exoskeleton of the aphid remains and is referred to as an “aphid mummy.” As the adults emerge from this mummy, you can see the small round exit hole.



Figure 1: Aphid mummies. Photos by L. Pundt

*Aphidius colemani* is a tiny (2 mm.) long wasp that is used against green peach aphids and melon aphids. The adult wasp lays one egg inside an aphid. This egg hatches into a larva that feeds inside the aphid. When mature, a new adult wasp will emerge from the tan aphid mummy. This active searcher is not as effective at temperatures above 86 °F.

*Aphidius ervi* attacks larger aphids such as the foxglove (*Aulacorthum solani*) and potato aphids (*Macrosiphum euphorbiae*). It resembles *A. colemani* but is about twice as large and darker in color.

*Aphidius matricariae* attacks green peach aphid (*Myzus persicae*) including the closely related tobacco aphid (*Myzus persicae* subsp. *nicotianae*).

*Aphelinus abdominalis* attacks foxglove (*Aulacorthum solani*) and potato aphids (*Macrosiphum euphorbiae*). Adults feed on the small aphid nymphs and parasitize the larger aphids. *Aphelinus* is better able to withstand higher temperatures than *Aphidius spp.* This species works more slowly for a longer period than the other parasitic wasps. Look for the elongated black mummies that are less swollen than *Aphidius* mummies.



Figure 2: Black mummy from which *Aphelinus* will emerge. Photo by L. Pundt

### **Tips for Use**

- Release preventively
- Remove yellow sticky cards.
- Temperatures should be between 65 and 77° F and relative humidity between 70 and 85%
- Release at the end of the day in shaded locations.
- Look for aphid mummies after about 2 to 3 weeks, depending upon greenhouse temperatures.
- Consult with your supplier on release rates.

### **Aphid Banker Plants**

One way to reduce the costs of biological control is to rear or grow your own natural enemies. This helps to reduce your shipping costs with releases of fresh, newly emerged biological control agents. Some biological control suppliers are selling “Aphid Banker Plants” consisting of wheat or barley plants with bird cherry oat aphids (*Rhopalosiphum padi*); (these aphid species feed upon cereal grains, and are only used in the banker plant system. The bird cherry oat aphid is a small, brownish to olive-green aphid. Bird cherry oat aphids feed upon monocots and grasses and should not be used in greenhouses with Easter lilies, Alstroemeria, ornamental grasses, orchids, irises, spring bulbs such as tulips and daffodils, palms, onions and grasses. Some growers have noticed that the bird cherry oat aphids have moved upon Cordyline, Cyprus, and Dracaena as well.

Aphid banker plants need to be well watered and distributed throughout the greenhouse with new replacements starting every two weeks. Banker plants for *A. colemanii* and *A. ervi* are generally not compatible. See references at the end for more information on how to use aphid banker plants.



Figure 3: Starter Aphid Banker Plant with bird cherry oat aphids. Photos by L. Pundt

### **Aphid Predators**

Predators consume many prey during their lifetime. Repeated releases of aphid predators are often needed in order to keep pace with the aphids' high reproductive rate in the greenhouse. Their effectiveness depends upon their predation rate, ability to locate prey and increase in number.

### **Predatory Midges**

The predatory midge, *Aphidoletes aphidimyza*, can feed on more than 60 different species of aphids. This gall midge is nocturnal, and prefers dark and humid areas closest to the lower plant canopy. They require a period of darkness for mating and egg laying. Only the larvae stage is predacious. Adults feed primarily upon pollen and honeydew. The bright orange larva kills aphids by biting their knee joints, injecting a paralyzing toxin and then sucking out their body fluids.

*Aphidoletes aphidimyza* is typically sold as pupae mixed with a carrier in trays, bottles or blister packs. Adults that emerge from the pupae lay their eggs near aphid colonies. Larvae move to the ground to pupate and use organic debris to make their pupal cocoons. Plastic or concrete floors that are free of debris will not provide sufficient pupation sites. Sawdust, peat or holes in the weed mat barrier on the ground are needed. Some growers also place their aphid banker plants in trays of moist sand to provide pupation sites.

Adults are short-lived and tend to be active at night, so are rarely seen. This midge is most effective in the summer and will go into diapause (period of resting) between September and March. This is because the larvae need at least 15.5 hours of light to prevent the pupae from diapausing. The adults will lay eggs and larvae will feed upon aphids, but there is no second generation of

midges produced. Low light intensities are sufficient to prevent diapause. This predatory midge works well against green peach aphids, but not against foxglove aphids because the foxglove aphids are too low in the plant canopy.

### Tips for Use

- Place in greenhouse away from direct sunlight
- Release in the early morning or evening near aphid colonies
- Temperatures should be between 60 and 80° F, relative humidity between 50 to 85%
- Look for fed upon aphids that will appear shriveled, and turn brown or black
- Can be used with *Aphidius* parasitoids

### Green Lacewings

The green lacewing (*Chrysopa rufilabris* and *C. carnea*) adults are active at night and feed on nectar, pollen and honeydew. The predatory larvae (also known as "aphid lions") feed upon aphids, mites, whiteflies, mealybugs, scales and thrips. Because larvae will feed upon each other, they must be released as far apart as possible to discourage cannibalism. Green lacewings may be less effective on plants with hairy leaves.

Green lacewings are commercially available as eggs on cards, or as larvae shipped with a food source in an inert material in a small container or as larvae shipped in separate cells. Larvae may survive better than eggs and are quicker acting. A reduction in aphid population should occur after approximately two weeks.

Green lacewings also available as adults shipped in a small cardboard container. Look on the underside of leaves for the eggs laid on extended stalks.



Figure 4: Releasing lacewing larvae, lacewing larvae (close-up), and lacewing eggs. Photos by L. Pundt

### Tips for Use

- Spread larvae over an area because they are cannibalistic

- Look for clean, new growth as a sign that aphids have been killed
- Ants and slugs will eat lacewing eggs on the cards so need to be controlled
- If it is too warm (above 95° F), they will leave the greenhouse

### Lady Beetles

Lady beetles feed on many different types of aphids and other soft-bodied insects. Both larvae and adults feed upon aphid nymphs and adults. Adult lady beetles feed upon pollen, fungi and nectar in the absence of prey. Eggs are laid near prey and the larvae may consume from 500 to 1000 aphids. Older, fourth instar larvae are more efficient at capturing prey than adults.

Convergent ladybird beetles (*Hippodamia convergens*) are wild collected from the mountainous areas of the west coast where ladybird beetles migrate and aggregate in large masses. This removes ladybeetles from their native habitat. Because they are field collected and not mass-produced, quality control guidelines for *H. convergens* have not yet been developed.

Adult beetles are highly dispersive and once released in greenhouses, most will leave. They are also poor at searching out pests, so need to be used where there are high populations of aphids. If wild harvested from natural winter aggregation sites, they may inadvertently carry natural enemies including endoparasitoids and pathogens that can potentially affect native ladybird beetles. Wild collected ladybird beetles may have been parasitized by a small wasp, (*Dinocampus coccinellae*) that develops as an internal parasite and microorganisms including *Nosema hippodamiae*.



Figure 5: Ladybird beetle adult, larvae and pupa. Photos by L. Pundt

### Tips for Use

- Adults can be refrigerated until released
- Release in the evening or early morning, near aphid colonies when the vents are closed

- Repeated applications may be needed
- Look for aphids that have been fed upon and for ladybird beetle adults, larvae or their bright yellow eggs
- Flowering, pollen-producing plants will attract the beetles

### **Naturally occurring predators**

Hover flies, also known as syrphid or flower flies are naturally occurring beneficial, predatory insects that may enter the greenhouse from outdoors. Adults begin emerging in April and May about the same time that aphid populations start to increase outdoors. They are called hover flies because of their ability of the adult to hover in mid-air, dart a short distance very quickly, and then hover again.

Adults are small ( $\frac{3}{8}$  to  $\frac{3}{4}$  of an inch long) and look like small bees or wasps. They are in the fly (Diptera) family with two wings, short antennae and large eyes. Hover flies lay their eggs (resembling a small grain of rice) near aphid colonies. Eggs hatch into small, legless larvae with a tapered head that feed upon aphids.



Figure 6: Hover fly adult on lobelia and Close-up of hover fly larvae. Photos by L. Pundt

### **Pathogens**

Several types of entomopathogenic (or insect-killing) fungi have been developed for use against greenhouse pests. The entomopathogenic fungus, *Beauveria bassiana*, is commercially available for use against aphids. However, because aphids have high reproductive rates and molt rapidly, repeat applications are typically required. *Beauveria bassiana* is most effective when aphid populations are low. *Beauveria* may not be compatible with the convergent ladybird beetle (*Hippodamia convergens*) depending on the concentration of spores applied. The entomopathogenic fungus, *Isaria (=Paecilomyces) fumosoroseus* is most effective when the relative humidity is 80% or higher for 8 to 10 hours.

### **Tips for Use**

- Thorough spray coverage is needed so that the fungal spores contact the targeted insect pest and begin the infection process
- Repeated applications (three to five) may be needed for effective control
- High relative humidity is needed

For information on compatibility of pesticides with natural enemies, consult the following databases or consult with your biological control supplier.

### **Pesticide Compatibility Databases:**

Refer to online databases or apps such as those maintained by:

- Koppert's online interactive database: <https://www.koppertus.com/side-effects-database/>
- Biobest: <https://www.biobestgroup.com/en/side-effect-manual>
- Bioline Agrosiences <https://www.biolineagrosiences.com/> (download Bioline app)

In summary, aphid parasitoids, aphid predators and entomopathogenic fungi can all be incorporated into a biological control program against aphids.

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