CT IPM
Integrated Pest Management Program
Department of Plant Science and Landscape Architecture
UConn Extension

Starting a Biological Control Program for Greenhouse Insect and Mite Pests

Introduction

Biological control is the using of living organisms (natural enemies) such as insects, mites, fungi, or bacteria to manage pests. Natural enemies are living organisms that are most effectively used when pest populations are low. Use biological control agents **preventatively,** early in the cropping cycle, when plants are small, and when pest numbers are very low. This is a completely different mindset compared to conventional pest control, where one often waits until seeing damage and then treating with insecticides or miticides.

Some of the **advantages** of using biological control agents include:

- less worker exposure to toxic pesticide residues.
- less chance of plant damage from sprays.
- improved plant quality.
- no re-entry intervals (REI) to follow.
- part of "sustainability" marketing.
- preserving the effective life of pesticides used by removing the selection pressure for development of resistance.

Biological control programs use living organisms – so extra care and effort is needed to make these programs work. Commitment, patience (natural enemies do not work as quickly as pesticides), and a desire to learn about the life history and environmental requirements of pest and its natural enemy are all needed. The commitment of owner management with a dedicated staff is very important. Sometimes, it may be best to first start in a smaller greenhouse with edible crops or in propagation houses.

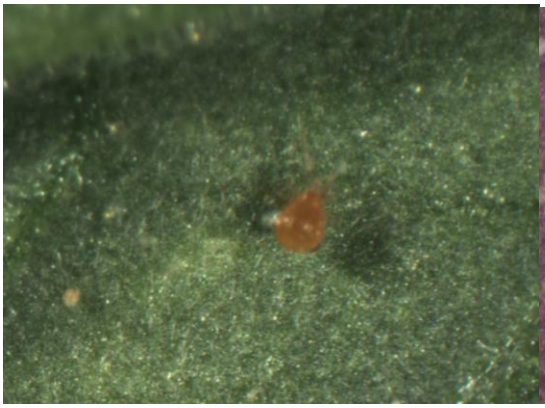
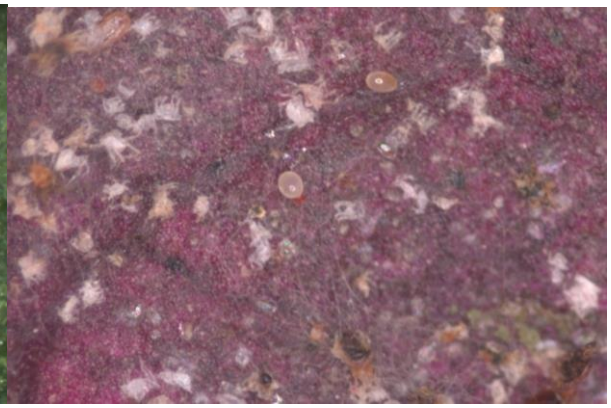
Types of Natural Enemies

Commercially available natural enemies commercially include **parasitic wasps or flies, predators, pathogens and entomopathogenic i.e. (insect-killing) nematodes.**

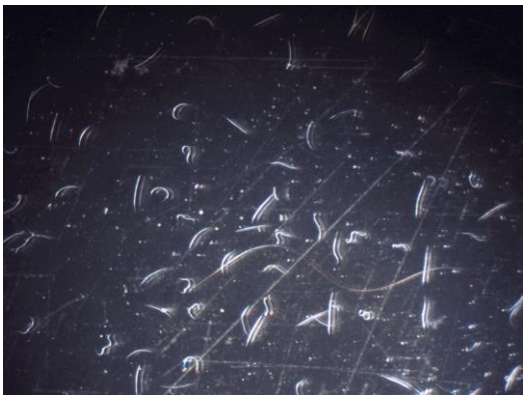
Parasitic wasps lay their eggs inside the host and kill the host as the newly hatched larvae begin to feed. They are very host specific compared to more generalist predators. Parasitic wasps require one host to complete their development as they kill the host in this process. Correct identification of the host prey is needed to determine the specific parasitic wasp to use. Different species of parasitic wasps are available for use against **aphids, whiteflies, leafminers, scale insects** and **mealybugs.** These mini-parasitic wasps do not have a stinger so are **not** harmful to humans.


Figures 1 & 2: Adult *Encarsia formosa* on sticky card (on left) and greenhouse tomato leaf with black parasitized greenhouse whitefly pupae due to *Encarsia formosa*. Photos by L. Pundt

Predators are more generalist feeders and are less host specific than parasitic wasps. There are many different species of predatory mites that prey upon spider mites and thrips.

Figures 3 & 4: *Phytoseiulus persimilis* (on left) that feeds upon two-spotted spider mites (on left) and barrel shaped eggs of *P. persimilis* on left. Photos by L. Pundt (left) and D. Ellis (right).



Entomopathogenic (insect-killing) nematodes are microscopic roundworms that enter the insect's body through openings in the exoskeleton. The nematodes multiply inside the host insect and release a bacterium that is toxic to the host. *Steinernema feltiae* is used against fungus gnat larvae and thrips pupae in the growing media. *Steinernema carpocapsae* is used to suppress shore fly larvae.

Figure 5: Dead nematodes will be straight and healthy nematodes will have a slight J curl. Check nematodes before and after application. Photo by L. Pundt

Pathogens include insect-killing fungi such as *Beauveria bassiana* and *Isaria fumsoroseus* that use enzymes to dissolve the insect's cuticle using the insect as a food source.

Getting Started in Biological Control

1) Gather resources

It takes time and commitment to learn the biology and life cycles of the insect and mite pests and their natural enemies. Become familiar with the optimum environmental requirements (temperature and relative humidity) needed by the different natural enemies. If your greenhouse environment does not provide the appropriate temperatures and humidity levels, it may be difficult for the natural enemies to survive. For example, *Encarsia formosa* (a parasitic wasp used against greenhouse whiteflies), adults rarely fly at temperatures below 64°F. At temperatures above 86°F, their adult life span is reduced. If you are dealing with warmer summer temperatures, *Eretmocerus* sp. may be a better choice. The mealybug destroyer (*Cryptolamus montrouzieri*) prefers warmer temperatures – between 72 to 77°F. Is this compatible with the temperature requirements of the crops being grown? The predatory mite, *Phytoseiulus persmilis*, does best at a humidity range above 60%. Put together a list of resources and personal contacts (biological control suppliers, other growers, extension educators etc.) that can help you.

2) Review past pest problems

Review your past pest problems. Know the pest species you are dealing with. This is especially important if you are considering releasing host specific parasitic wasps for aphids, whiteflies, or mealybugs. For example, if you have foxglove aphid, but release Aphidius colemani because you think you have green peach aphids, these releases will not be effective. Instead, purchase a mix of different species that work against both the foxglove and green peach aphids.

3) Review pesticide use

Many insecticide residues, especially pyrethrins or organophosphates can adversely affect natural enemies for up to three to four months after their application. Review your pesticide use for the past 3 to 4 months before starting a biological control program.

Both direct contact and pesticide residues on containers, benches, and greenhouse plastic may be directly toxic to natural enemies or effect how well they survive and reproduce. Some of the newer, more selective insecticides and miticides (including some insect growth regulators) are compatible with some, but not all, natural enemies.

For more information on pesticide compatibility with BCA's, consult with your supplier, and with online side effect databases maintained by Koppert, Biobest and Bioline Agrosciences. Using pesticides compatible with biological control agents helps ensure the success of your biological control program.

Because of the "zero tolerance" of pests for ornamentals, cuttings may be treated with long residual pesticides that are not compatible with biological controls. When receiving incoming plant material, always ask your plant supplier for a list of pesticides applied to those plants.

Research is continuing the compatibility of pest control materials with natural enemies so be sure to contact your university-based Extension or research entomologist, biological control supplier, or technical representative of the manufacturer of the chemical for more information.

4) Have a Regular Scouting Program in Place

Before beginning a biological control program, develop a regular, consistent scouting program. This helps you anticipate when the various pest populations are of concern, so you can plan to release the natural enemies in sufficient time. You will also know where potential hot spots of pest activity are and can evaluate the effectiveness of the natural enemies (just as you evaluate the effectiveness of any method of control). Keeping good records is important.

Yellow sticky cards will attract many parasitic wasps, so reduce the number of sticky cards used or wait a few days after your releases before putting the sticky cards in place.

5) Transition into biological controls

Start in a small, isolated area or separate greenhouse as a trial area to learn how to use natural enemies before releasing BCA's in your entire production area. Decide what crops make the most sense for you to use biological controls for you. It may be a retail growing area, propagation house or houses where vegetable and herb bedding plants are grown. As your experience and comfort level expands, you can expand your use of biological controls.

6) Use with proper cultural controls and sanitation practices

- Start clean and stay clean.
- A fallow period (with greenhouses completely empty of plant material) of at least 4 weeks may help reduce pest pressure for the spring growing season.
- Remove unsold "pet plants" especially from propagation houses.

- Keep the inside and outside of greenhouses weed-free.
- Discard heavily infested plants.
- Keep cull piles as far as possible from production greenhouses.
- Avoid over fertilizing crops, because the tender lush growth is more prone to aphids, whiteflies, and other sucking pests.

Biological controls are more likely to be successful if they are integrated with proper cultural controls.

7) Plan ahead

Biological control agents, especially parasites, are often specific to a pest or may be shipped in a stage that does not attack the targeted pest. Careful planning is needed before starting a biological control program.

Start planning **6 months to one year** in advance. Develop a spreadsheet of dates when cuttings and plugs arrive, your planting schedule and when greenhouses will be open for production to help pre-order biological controls.

8) Establish a Good Relationship with your suppliers

Establishing a good relationship with your suppliers is critical. They want you to succeed, so should be able to supply you with technical information and advice.

9) Ensure quality of natural enemies

Natural enemies are living organisms that must be handled and stored carefully to maximize survival and to sustain their viability. In general, shipments of natural enemies should be received within four days after placing an order. Predatory mites such as *Phytoseiulus persimilis* that are shipped without a food source should be received after an overnight delivery.

The package containing the natural enemies must be shipped in a sturdy container such as a polystyrene box that minimizes exposure to high and low temperatures. Request that the biological control supplier include ice packs and a data logger (if possible). Make sure the container is secured with good packing material during shipment.

Ask your biological control supplier(s) how to best evaluate incoming shipments. They will often send a description of what to look for when receiving the natural enemies. In addition, see Grower Guide: Quality Assurance of Biocontrol Products compiled by Dr. Rose Buitenhuis.

Check the temperature within the shipping box with an infrared thermometer. If you notice a moldy odor or condensation, that is of concern. Consult with your supplier for information on how to best store and what are the maximum storage times are for each natural enemy. Most natural enemies should be released immediately upon arrival, especially if they have been shipped without a food source.

10) Release Rates and Timing and Application Delivery Methods

Work with your supplier to determine the appropriate release rates and timing based upon pest activity (determined by regular monitoring), effectiveness of the biological controls and the crops grown. Are the rates for a preventative or curative treatment?

Figure 6: Applying beneficial predatory mites via a shaker tube, via mini sachets on a stick. Small amounts of aphid mummies or other natural enemies can be placed in the release boxes to keep natural enemies from falling to the ground. Photos by L. Pundt

11) Make use of compatible pesticides, if necessary.

Use compatible pesticides, if necessary. Multiple pest complexes affecting ornamental crops make it difficult to control all pests – so sometimes-compatible pesticides are needed. However, rarely is a pesticide compatible with all the natural enemies released. Adverse effects can be minimized by using spot treatments (as compared to broadcast, cover sprays) and the application method (drenching tends to be safer compared to spraying). Effects vary depending upon the type of pesticide used and the natural enemies so check the **Pesticide Side Effects Databases** and talk to your supplier.

12) Be patient

You need to be able to tolerate some pests for the natural enemies to work. A proactive approach is needed for natural enemies do not work as quickly as pesticides. However, insect and mite pests do not develop resistance to the natural enemies, so biological control is an important part of an overall resistance management program.

By Leanne Pundt, UConn Extension, November 2007. Latest revision 2024.

Resources

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Some helpful websites:

- Association of Natural Biological Producers
- Biological Control: A Guide to Natural Enemies in North America
- Buglady Consulting – Biological Control Services
- University of Vermont, Entomology Research Laboratory