



Biological Control of Whiteflies

The primary whitefly species in greenhouses include the greenhouse whitefly (*Trialeurodes vaporariorum*) and sweet potato whitefly B-biotype (MEAM1) (*Bemisia tabaci*), which was formally called the silverleaf whitefly (*Bemisia argentifolii*). A new biotype of *B. tabaci*, the Q-biotype, (now known as MED) was reported in the U.S. in 2006, which is known to be resistant to many commonly used insecticides.

Biology and Life Cycle

The life cycles of both whitefly species are similar, consisting of eggs, nymphs, pupae, and adults. Development from egg to adult takes 14 to 40 days, depending upon temperature, host plant and whitefly species. Greenhouse whitefly adults are more active at temperatures around 75°F whereas sweet potato whitefly adults prefer warmer temperatures above 80°F.

The best way to determine if you have greenhouse whiteflies or sweet potato whiteflies is to examine the pupal stage found on the leaf undersides. See [Managing Whiteflies in the Greenhouse](#) on the UConn Greenhouse IPM website for photos and tips. Proper identification is important, especially when using host specific parasitic wasps for biological control. But, you cannot tell whether you have the B or Q biotypes of sweet potato whitefly by visual inspection, samples need to be sent to a laboratory for molecular analysis.

Scouting

A regular monitoring program is needed for early detection of whiteflies and to ensure the success of your biological control program. Use yellow sticky cards to monitor for adult whiteflies.

Inspect incoming plant material for the presence of whiteflies. Monitor plants weekly by checking the leaf undersides to detect eggs, nymphs, pupae, and adults. See [Tips on Scouting Poinsettia Insect and Mite Pests](#) on the UConn Greenhouse IPM Website for helpful photos.

Biological Controls

Biological controls are more likely to be successful if combined with proper cultural controls. Avoid over fertilizing crops, especially with nitrogen, as this increase their attractiveness to adult whiteflies. Remove “pet plants” and weeds that may be a source of whiteflies.

Host specific parasitic wasps, predatory mites, predatory beetles and entomopathogenic fungi can all be used in your biological control program.

Types of Host Specific Parasitic Wasps

Encarsia formosa

Encarsia is especially effective against the greenhouse whitefly on long term crops, such as greenhouse grown tomatoes. *Encarsia* adults are very small wasps with a black head and thorax and a yellow abdomen. Females prefer to lay their eggs in the 3rd and 4th instar whitefly larvae. They can also host feed on smaller whitefly larvae. Parasitized whiteflies turn black. Look for a small hole as the adults emerge. *Encarsia formosa* is most effective at 70 to 80°F and 50 to 80% relative humidity. Adults do not fly when ambient air temperatures are below 65°F and survival is reduced at temperatures >86°F. *Encarsia* are primarily shipped inside black parasitized whitefly pupae which are glued to small cards. They are also available as loose pupae in bottles.



Figure 1: Close-up of adult *Encarsia* (left) and *Encarsia formosa* pupae glued to a piece of cardboard that is attached to the plant. (right). Photos by L. Pundt

Tips for Using *Encarsia formosa*

- Remove yellow sticky cards before and after releasing *E. formosa* to avoid capturing adults on the cards. Replace sticky cards 3 to 4 days following release.
- Hang the cards in shaded areas in the lower canopy of plants to avoid desiccation from direct sunlight.
- Adults emerge from the pupae and fly upward. Introduce cards weekly starting when whiteflies are first detected.
- In general, for most crops, continue making releases until 80% to 90% of the whitefly population has been parasitized.
- When scouting, look for the distinct, black greenhouse whitefly pupae that are parasitized.

Encarsia is very sensitive to pesticide residues on plants or dried pesticide residues on greenhouse plastic. Avoid use of insecticides with a long residual effect in the greenhouse before the wasps are released. Consult online side

effects databases maintained by biological control suppliers such as [Koppert](#), [Biobest](#), [Bioline AgriSciences](#), or [Bioworks](#) for more information.

Eretmocerus eremicus

This parasitoid has been commercially available since the 1990s for control of *Bemisia tabaci* on poinsettia. It tolerates warmer temperatures (77 to 84° F) as it is native to southern desert areas of California and Arizona. *Eretmocerus* are very small parasitic wasps that are pale yellow with clubbed antennae. Besides directly parasitizing whitefly nymphs, *E. eremicus* adult females kill nymphs by host feeding. *Eretmocerus eremicus* attacks both sweet potato whitefly and greenhouse whitefly.

Eretmocerus eremicus is shipped as pupae that are either glued to paper cards or in blister packs or in bottles. When using blister packs, remember to open the flaps and do not place the blister back so they would be facing the sun. *Eretmocerus* is also available in a mix with *Encarsia*. Contact biological control suppliers for information on release rates.



Figure 2: *Eretmocerus* is available in a blister pack (left) and as pupae that are glued to paper cards (right). Photos by L. Pundt

Tips for using *Eretmocerus eremicus*

- Do not release in direct sunlight.
- Prior to release, remove yellow sticky cards, which attract and capture the emerging parasitoids.
- Replace yellow sticky cards four days after releases have been made.
- When scouting, look for parasitized whiteflies. Greenhouse whitefly pupae are black whereas sweet potato whitefly pupae are yellow brown.



Figure 3: Brown parasitized sweet potato whitefly (left) and black parasitized pupae of greenhouse whitefly. Photos by L. Pundt

To assess quality of the whitefly parasitic wasps, place cards or blister packs in a small, screened container placed in a shaded location at room temperature for two weeks. Place a small piece of yellow study card on the inside of the container lid to make it easier to count. Count the number of emerged adults. About 95% of the adults should have emerged.

Whitefly Predators Predatory Mites

Amblyseius swirskii, feeds on whitefly eggs and nymphs. This generalist predatory mite also feeds upon thrips, broad mites, spider mites and pollen. It is most effective at warmer temperatures (70°F) and a relative humidity of 70%. *A. swirskii* is available in breeding sachets, or in bulk that is released unto plant leaves. Growers often modify leaf blowers to broadcast these predatory mites when poinsettias are spaced pot to pot. In poinsettias, Dr. Vafaie from Texas A&M, found that combining *A. swirskii* with *Eretmocerus* was better at suppressing whiteflies compared to when either species was released alone. *Eretmocerus* prefers 2nd instar whitefly nymphs and *A. swirskii* prefers whitefly eggs and 1st instar nymphs.

Figure 4: *A. swirskii* is available in slow release sachets or released in bulk on leaves. Photos by L. Pundt



Predatory Beetles

Delphastus pusillus is a small (1.3- 1.4 mm) long, dark brown to black predatory beetle that attacks all stages of whiteflies but prefers eggs and nymphs. *Delphastus* adults and larvae are predacious. Optimum temperatures are between 75 and 80° F. Adults will not fly at temperatures below 55° F. *Delphastus* avoids feeding on parasitized whiteflies so is compatible with whitefly parasitic wasps. However, it does not perform well on greenhouse tomatoes.

Entomopathogenic (insect killing) fungi

Beauveria bassiana

When *Beauveria* fungal spores come into contact with and attach to the cuticle of susceptible insects, the fungal spores germinate and penetrate their body wall by force, producing enzymes that digest the cuticle.

Once the host insect is infected, the fungus rapidly grows inside of the insect, feeding on the nutrients present in the host's body and producing toxins. The infected whitefly larvae or pupa turn brown or pink as the insect's body is filled with the insect-killing fungus. White growth of the fungus from the insect's body is not necessarily seen under greenhouse conditions. Begin applications when whitefly populations are low. *Beauveria* is compatible with many, but not all beneficials. See [Bioworks](#) website for more information.



Figure 5: Infected greenhouse whitefly pupae turn brown or pink after infection with *Beauveria bassiana*. Photo by L. Pundt

Isaria fumosoroseus

This insect killing fungus is available under the trade name of Ancora. It attaches to whitefly eggs, nymphs, pupae, and adults. *Isaria* requires a relative humidity between 68 and 100% and temperatures between 72 and

86°F. Foliar applications of *Isaria* have been successfully combined with releases of *Encarsia formosa* in commercial greenhouse tomato production.

In summary, host specific parasitic wasps, predatory mites, and entomopathogenic fungi can all be used in your biological control program.

For information on biological control of whiteflies and other greenhouse pests on greenhouse tomatoes, see [Manage Greenhouse Tomato Pests with Natural Enemies](#).

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