

## Whiteflies

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**Identification** Whiteflies are small, white, fly-like insects in their adult stage. The nymphal stages are tiny, flattened, oval scales that have no obvious legs, do not crawl (except immediately after egg hatch for a day or so), and with no obvious head, thorax, or abdomen, do not look like a "typical" insect. Because of their appearance and their location on the undersurfaces of leaves, the nymphal stages may go unnoticed.

The silverleaf whitefly (SLWF), *Bemisia argentifolii* (=strain B of the sweetpotato whitefly, *Bemisia tabaci*), the greenhouse whitefly (GHWF), *Trialeurodes vaporariorum*, and the bandedwinged whitefly (BWFF), *Trialeurodes abutilonea*, are the most common whitefly pests. Among these three, SLWF is usually the biggest problem, followed by GHWF. SLWF and GHWF often infest the same crop. The BWFF is relatively rare; it is sometimes found on yellow sticky traps, though rarely on the crop.

Distinguishing the species of a whitefly can be difficult. The best stage to use for identification is the pupal stage, which is found on the underside of leaves. The pupal case, which is left behind after an adult emerges, can also be used to identify the species of whitefly. Toward the end of the pupal stage, the red eyespots of the developing adult can be seen through the pupal case. These red eyespots help distinguish the pupal stage from the other nymphal stages.

The pupa of the GHWF is oval, and it has elevated sides that are very straight and perpendicular to the leaf surface. This gives it a disk-like, or "cake-shaped" appearance. In contrast, the pupa of the SLWF appears from the side to be more rounded, dome-shaped, or even pointed. Seen from above, the GHWF has a tiny "fringe" of wax filaments around the top "rim" of the pupa. The SLWF pupa has no such filament fringe. Both species may have several pairs of longer wax filaments rising from the top of the pupa. Usually the filaments are larger and more noticeable on the GHWF, but this may vary. A 10x hand lens will be needed to examine pupae closely enough to see these characters and differentiate accurately between the species.



The adult GHWF is somewhat larger than the SLWF. Both adults are white, as their name suggests, although the body of SLWF is slightly more yellow in color. However, color alone is not a reliable basis for identification. The most noticeable difference is the angle of their wings to their body. The wings of the GHWF adult lie fairly flat over its abdomen, almost parallel with the leaf surface. The wings of the adult SLWF, on the other hand, are held tent-like against its abdomen at approximately a 45-degree angle to the leaf surface.



Unfortunately, the primary means of examining adults — insects stuck to a yellow sticky trap — almost inevitably obscures such fine distinctions of appearance. Again, it is best to use the pupal stage for species identification.

The BWFF is named for the 2 irregular smoky grey lines that zigzag across its front wings. Other than these bands, the adult looks very similar to the GHWF. The pupal stage can also be used to distinguish the BWFF from the other species, although these nymphs are rarely found on poinsettia. An obvious dark grey band that is fairly wide runs down the length of the pupa.

**Damage** Whiteflies are pests mainly because consumers don't want plants on which whiteflies are noticeable. They infest numerous greenhouse crops, including poinsettia, fuchsia, mums, gerbera, geranium, hibiscus, rose, tomato, many herbs, and many foliage crops. They feed by inserting stylet-like mouthparts through plant tissue into the phloem and removing plant sap. In high populations, their "honeydew" secretion can make leaves sticky and shiny, and lead to the growth of ugly grey sooty mold. Silverleaf whitefly can transmit geminiviruses on outdoor vegetables, and can transmit tomato yellow leaf curl virus in greenhouse tomato transplants.

**Biology** Females can lay 200+ eggs and live up to 1-1/2 mos. All life stages are found on lower surfaces of leaves. Tiny spindle-shaped eggs are often laid in semi-circles. Eggs hatch in about 10-12 days at 65°-75°F. Tiny crawlers walk a few millimeters from egg, insert mouthparts into leaf to feed and do not move again until they have completed the remaining three nymphal life stages and emerge as an adult. On poinsettia at 65°-75°F, total egg-to-adult development takes 32-39 days on average. Development time is considerably faster at warmer temperatures, perhaps 2-1/2 to 3 weeks. A female can begin to lay eggs from one to four days after emerging from the pupal stage. Mating is not necessary for egg production. Eggs are immune to most insecticides; 4th instar-pupae can also be difficult to kill with some products.

**Chemical Control** Many insecticides can provide good whitefly control. Marathon (granular or drench) continues to give excellent long-term control when used properly. Several new IGR insecticides also show excellent activity against nymphs. These IGR's provide important new insecticide options for pesticide rotation schemes. They are also very compatible with parasitic wasps for whitefly biological control, as discussed later. All whitefly insecticides must be used carefully, according to label directions, or resistance problems are likely to occur.

Eggs and the older nymphal stages are the most immune to many insecticides. When using foliar sprays, remember that thorough coverage is easier to achieve early in the crop before the canopy becomes dense. Plants should be spaced so as to maximize spray coverage. A spray wand or spray technique that directs the spray to the undersides of leaves will kill many more whiteflies per application. Nymphs occur on the undersides of leaves, and are generally covered more thoroughly with well-aimed hydraulic or electrostatic sprayers. Adults can be controlled with aerosols, smokes, various types of low or ultra low volume sprayers, or hydraulic sprayers. But adults should be killed before they are able to lay eggs - about 3 to 4 days under northeastern U.S. poinsettia production temperatures. So aerosol or ULV applications should be applied every 3 to 4 days as long as new adults are emerging.

**Biological control** Whitefly biological control could include the release of parasitoids and/or predators, and/or fungal pathogens. For biological controls to be successful, rely on releases of the natural enemies, and use selected insecticides as a back-up. Growers interested in biological control must learn about the natural enemies as well as the whiteflies, and have established a successful whitefly monitoring plan.

*Encarsia formosa* is the most commonly used natural enemy for GHWF on greenhouse tomatoes. But this parasitoid species is not as effective against SLWF on ornamentals. When compared with the commercial strain of *E. formosa*, another parasitoid, called *Eretmocerus eremicus*, provides better SLWF control on poinsettia. *E. eremicus* will also control GHWF on poinsettia. For successful SLWF management with parasitoids alone, *E. eremicus* should be released weekly at 3 female wasps/pot/week. But such a release regime is expensive. Our recent research has indicated that a less expensive approach may be to release *E. eremicus* at 1 female wasp/pot/week, coupled with an IGR (Distance, or soon-to-be-registered Applaud) applied once, just before bract coloration. Detailed information on the use of parasitic wasps for whitefly biological control on poinsettia can be found in: A Grower's Guide to Using Biological Control for Silverleaf Whitefly on Poinsettias in the Northeast United States, by M. Hoddle, R. Van Driesche, and J. Sanderson, UMass Floral Facts, UMass Extension, Stockbridge Hall, Univ. of Massachusetts, Amherst, MA 01003.

Some growers have reported successful use of parasitoids on the Christmas crop until late October, when smokes and aerosols were used for final clean up.

BotaniGard and Naturalis-L contain the insect fungal pathogen *Beauveria bassiana*. This pathogen should be used while whitefly levels are still low. Three to 5 weekly sprays should be applied, then carefully evaluate the degree of control to determine the need for additional sprays. Tank mixes with most conventional insecticides can be used to reduce pest levels, but do not mix with any fungicides, and be sure that the spray tank is clean of all fungicide residues. Do not use 48 hours before or after a fungicide application on the crop. Another fungal pathogen, PFR-97 (*Paecilomyces fumosoroseus*), is registered by Olympic and is expected to be available soon.

Combinations of natural enemies, such as *Beauveria bassiana* plus *E. eremicus*, or *E. eremicus* plus the tiny predatory beetle *Delphastus pusillus*, or other combinations, may also provide good whitefly biological control.

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