



Whiteflies in the Greenhouse

Whiteflies are sucking insects that feed on plant sap. The adults are small, powdery insects with four white wings. Both the adults and immature stages are found on the underside of the leaves. If heavy populations develop, plants become weakened with less vigor. However, the presence of low numbers of whiteflies can reduce the marketability of many crops.



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Identification

Several species may be found in greenhouses including: the greenhouse whitefly (*Trialeurodes vaporariorum*), the silverleaf whitefly (*Bemisia argentifolii*) and the banded-winged whitefly (*Trialeurodes abutilonia*). Of these species, the recently introduced silverleaf whitefly is most difficult to control due to its higher reproductive rate and resistance to insecticides.

Proper identification is important in order to choose the most effective management option. Specific pupal and adult characteristics can be used to identify the different species.

The powdery white (0.06-inch-long) greenhouse whitefly adults have wings that tend to lie flat over their body. The yellowish, silverleaf whitefly adults are slightly smaller than the greenhouse whitefly adults. Silverleaf whitefly adults also tend to hold their wings at a 45-degree angle close to their body. Adults of the greenhouse and banded winged whitefly look very similar. They can be distinguished by the two grayish bands that form a zigzag pattern across each front wing of the banded-winged whitefly adult.

A more reliable method to identify the different species is to examine the immature pupal stage. The greenhouse whitefly pupae are white with straight, elevated sides. You can also see a fringe of wax filaments around the edge of the pupal case. The banded-winged whitefly pupae are very similar to the greenhouse whitefly. However, the banded-winged whitefly pupae have a dark band down the center of their pupal case. Silverleaf whitefly pupae are yellowish with a more rounded edge. In general, silverleaf whitefly pupae have fewer waxy filaments than the greenhouse whitefly pupae.

Feeding Damage

While low populations may not cause serious plant injury, the presence of only one or two whiteflies at the time of sale may be objectionable to customers. At higher population levels, whiteflies can cause the plant's foliage to become yellowed and mottled. Whiteflies are sucking insects. The resulting honeydew, a sweet sugary sap, can be excreted onto the plant's foliage. This can cause sooty mold to develop and interfere with photosynthesis.

Biology and Life Cycle

Whiteflies develop from egg to adult in approximately one month depending upon temperature. Their life cycle progresses from the first, second, third and fourth nymph stages to the pupal stage (end of the 4th instar) to adults. Adult whiteflies may live for one to two months.

Females lay their eggs on the underside of upper leaves. The eggs hatch into first instar nymphs that move a short distance and then settle down to feed. The nymph stages (2nd, 3rd and 4th) are stationary and do not move. During the late fourth instar, you may see the red eyes of the developing adult. After the adults emerge from the pupal case, you can see a T-shaped emergence hole.

Whitefly Development at 70°F

| Developmental Stage | Greenhouse Whitefly | Silverleaf Whitefly |
|-----------------------------------|---------------------|---------------------|
| Egg | 9 Days | 12 Days |
| 1st Instar | 4 Days | 6 Days |
| 2nd/3rd Instar | 7 Days | 10 Days |
| Pupal (4th Instar) | 11 Days | 10 Days |
| Adult | 5-40 Days | 5-30 Days |
| Egg laying period of adult female | 6 days | 22 Days |
| Egg to Adult | 32 Days | 39 Days |

Prevention

Start the cropping cycle with a clean greenhouse. A fallow period of 7 to 10 days, when all plants and weeds are eliminated, will help to minimize potential insect problems. If this is not feasible, eliminate all weeds and pet plants, and closely monitor any whitefly-favored hosts. These may include: astilbe, chenille plant, columbine, chrysanthemum, dicentra, flowering maple, gerbera daisy, glory bower, hibiscus, lavender, lantana, malva, monarda, mints, Martha Washington geranium, primula, salvia, scaveola, tomato, rosemary (and many other herbs), verbena and zinnia.

Inspect incoming plants and cuttings for both adult and immature whiteflies. Silverleaf whiteflies are frequently found in greenhouses during poinsettia production. However, both greenhouse and silverleaf whiteflies can occur on poinsettias at the same time.

Band-winged whiteflies feed on several weeds such as ragweed, velvetleaf and beggar-ticks and may then enter the greenhouse. However, high populations rarely develop and control is usually not needed.

Monitoring

A weekly, regular monitoring program is needed for the early detection of whiteflies and to evaluate the effectiveness of your management strategy. Use yellow sticky cards, random foliar plant inspections and pest-infested indicator plants to monitor whitefly populations.

Yellow sticky cards can be placed in the greenhouse at the rate of approximately one per 1000 sq. ft. Place additional cards near doors and vents. Keep track of population trends to determine if populations are increasing or decreasing. Randomly inspect plants in production areas and near whitefly emigration areas. Weekly inspections will help you determine which life stage (egg, crawler, pupae or adult) is present. Often, only one to two life stages may be present. By knowing the predominant life stage you can time pesticide applications to occur when they are most effective. For example, you may want to target wet sprays against the adult and immature nymphs. Eggs and pupae are tolerant to many insecticides.

When a pest-infested plant is detected, it can be tagged to be used as an indicator plant. You can then track the development of the whiteflies.

Treatment Options

Several natural enemies including predators, parasitoids and insect pathogens are commercially available. Much research has been conducted on whitefly biological control programs.

Predators

Delphastus pusillus is a predatory lady bird beetle that can feed on all stages of whiteflies. Both immature and adult beetles are predacious. Delphastus are most effective against high populations and may be used to supplement other whitefly biological controls.

Parasitoids

Encarsia formosa, is a small, parasitic wasp that attacks both greenhouse and silverleaf whiteflies. *Encarsia* is, however, more effective against the greenhouse whitefly. It is sold as parasitized greenhouse whitefly pupa that are glued onto small cards. These cards can be placed face down near the center of the plant. The release rate will depend upon the type of plant, and the size and density of the planting. *Encarsia* needs to be released as soon as the first whiteflies are detected.

The adult wasp lays its eggs in the 3rd or 4th instar whitefly nymph. Parasitized greenhouse whiteflies turn black and parasitized silverleaf whiteflies turn brown. However, researchers have demonstrated that host feeding on body fluids has more effect than parasitism in reducing whitefly populations.

Encarsia is very sensitive to pesticide residues on plants or in the greenhouse. Planning is needed so that insecticides with a long residual effect are not used in the greenhouse before the wasps are released. Insecticidal soaps, horticultural oils, and many insect growth regulators are more compatible with their release than other insecticides. Favorable environmental conditions for the release of *Encarsia* include a temperature of 80° F and between 50 to 80% relative humidity.

Eretmocerus sp. is a small, lemon-yellow wasp. It is more effective than *Encarsia* against the silverleaf whitefly. Because adults are highly attracted to yellow sticky cards, you should consider using fewer than the normal number of yellow sticky cards.

Insect Pathogens

Beauveria bassiana is a common, soilborne fungus that occurs worldwide. Two strains of this fungus, Naturalis O and Botanigard, are commercially available. Fungal spores infect the insect through the cuticle. The insect dies as a fungal toxin weakens its immune system. Thorough spray coverage is needed to insure that the fungal spores target the insect and begin the infection process. Do not apply with fungicides or in a spray tank with fungicide residues. For more information on specific materials to apply, see the latest edition of the New England Floriculture Crop Pest Management and Growth Regulation Guide: A Management Guide for Insects, Diseases, Weeds and Growth Regulators.

Despite good cultural practices, pests and diseases at times may appear. Chemical control should be used only after all other methods have failed. For pesticide information please call UConn Home and Garden Education Center weekdays, in Connecticut call toll free 877-486-6271. Out of state call 860-486-6271.

References:

Cranshaw, Whitney. 2004. Princeton University Press. Garden Insects of North America.

Ellis, Barbara w. and Marshall Bradley, Fern. 1996. Rodale. The Organic Gardener's Handbook of Natural Insect and Disease Control. 2003-2004 New England Pest Management Guide.

Ohio State University Extension Fact Sheet #HYG-2041-88

NS Dept. of Agriculture and Fisheries Fact Sheet, Apple Maggot Control in the Home Garden, 1995.

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