Whiteflies are tiny, sap-sucking insects that may become abundant in vegetable and ornamental plantings, especially during warm weather. They excrete sticky honeydew and cause yellowing or death of leaves. Outbreaks often occur when the natural biological control is disrupted. Management is difficult once populations are high.

IDENTIFICATION AND LIFE CYCLE

Despite their name, whiteflies are not true flies (in the insect order Diptera) but are in the order Hemiptera, related to aphids, scales and mealybugs. They derive their name from the mealy white wax covering the adult’s wings and body. Adults are tiny insects with yellowish bodies and four whitish wings. Although adults of some species have distinctive wing markings, many species are most readily distinguished in the last nymphal (immature) stage, which is wingless and lacks visible legs. Depending on species, whitefly nymphs vary in color from almost transparent yellow or whitish to black with a white fringe (Table 1).

Whiteflies develop rapidly in warm weather, and populations can build up quickly in situations where natural enemies are ineffective and when weather and host plants favor outbreaks. Large colonies often develop on the undersides of leaves. The most common pest species—such as greenhouse whitefly (Trialeurodes vaporariorum) and sweetpotato whitefly (Bemisia tabaci)—have a wide host range that includes many weeds and crops (Figures 1 and 2). These species breed all year round in warmer parts of California, moving from one host to another as plants are harvested or dry up.

Another species of whitefly with a broad host range is the giant whitefly, Aleurodicus dugesii, which invaded Southern California in the early 1990s. It is now found in coastal areas and interior valleys in much of the state on a number of tropical and semitropical ornamental species. For more information on this species, see Pest Notes: Giant Whitefly listed under References. Other species of whiteflies, especially those on woody species, often have a more limited host range. Table 1 lists common whiteflies in California gardens and landscapes.

Whiteflies normally lay their tiny oblong eggs on the undersides of leaves. The eggs hatch, and the young whiteflies gradually increase in size through four nymphal stages called instars (Figure 3). The first nymphal stage (crawler) is barely visible even with a hand lens. The crawlers move around for several hours before settling to begin feeding. Later nymphal stages are immobile, oval, and flattened, with greatly reduced legs and antennae, like small scale insects. The winged adult emerges from the last nymphal stage (sometimes called a pupa, although whiteflies don’t have a true complete metamorphosis). All stages feed by sucking plant juices from leaves and excreting excess liquid as drops of honeydew as they feed.
Table 1. Major Economic Hosts of Some Common Whiteflies.

<table>
<thead>
<tr>
<th>Whitefly</th>
<th>Host plants</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash whitefly (Siphoninus phillyreae)</td>
<td>many broadleaved trees and shrubs including ash, citrus, Bradford pear and other flowering fruit trees, pomegranate, redbud, toyon.</td>
<td>Fourth-instar nymphs have a very thick band of wax down the back and a fringe of tiny tubes, each with a liquid droplet at the end. Adults are white. Ash whitefly is now under good biological control in CA, so it is rarely seen in high numbers.</td>
</tr>
<tr>
<td>Bandedwinged whitefly (Trialeurodes abutilonea)</td>
<td>very broad including cotton, cucurbits, other vegetables.</td>
<td>Fourth-instar nymphs have short, waxy filaments around their edges. Adults have brownish bands across the wings, and their body is gray.</td>
</tr>
<tr>
<td>Citrus whitefly (Dialeurodes citri)</td>
<td>citrus, gardenia, ash, ficus, pomegranate.</td>
<td>Fourth-instar nymphs have no fringe around their edges but have a distinctive Y-shape on their backs. Adults are white.</td>
</tr>
<tr>
<td>Crown whitefly (Aleuroplatus coronata)</td>
<td>oak, chestnut.</td>
<td>Nymphs are black with large amounts of white wax arranged in a crownlike pattern. Adults are white.</td>
</tr>
<tr>
<td>Giant whitefly (Aleurodicus dugesii)</td>
<td>avocado, begonia, hibiscus, giant bird of paradise, orchid tree, banana, mulberry, vegetables, and many ornamentals.</td>
<td>Adults are up to 0.19 inch long. They leave spirals of wax on leaves. Nymphs have long filaments of wax that can be up to 2 inches long and give leaves a bearded appearance. For more information, see Pest Notes: Giant Whitefly, listed in References.</td>
</tr>
<tr>
<td>Greenhouse whitefly (Trialeurodes vaporariorum)</td>
<td>very broad including most vegetables and herbaceous ornamentals. Also may occur on avocado, fuchsia, gardenia, lantana and redbud.</td>
<td>Fourth-instar nymphs have very long waxy filaments and a marginal fringe. Adults have white wings and a yellow surface or substrate.</td>
</tr>
<tr>
<td>Iris whitefly (Aleyrodes spiraeoides)</td>
<td>iris, gladiolus, many vegetables, cotton and other herbaceous plants.</td>
<td>Fourth-instar nymphs have no fringe or waxy filaments but are located near distinctive circles of wax where egg laying took place. Adults have a dot on each wing and are quite waxy.</td>
</tr>
<tr>
<td>Mulberry whitefly (Tetraleurodes mori)</td>
<td>avocado, citrus, mulberry, other trees.</td>
<td>Nymphs have blackish, oval bodies with white, waxy fringe. Adults have reddish to gray wing markings.</td>
</tr>
<tr>
<td>Sweetpotato whitefly (Bemisia tabaci)</td>
<td>very broad including many herbaceous and some woody plants including cole crops, cotton, cucurbits, tomatoes, peppers, crape myrtle, lantana, roses, and hibiscus.</td>
<td>Fourth-instar nymphs have no waxy filaments or marginal fringe. Adults have white wings and yellow body; they hold their wings slightly tilted to surface or substrate.</td>
</tr>
<tr>
<td>Woolly whitefly (Aleurothrixus floccosus)</td>
<td>citrus, eugenia.</td>
<td>Nymphs are covered with fluffy, waxy filaments. Adults are white.</td>
</tr>
</tbody>
</table>
DAMAGE
Whiteflies use their piercing, needle-like mouthparts to suck sap from phloem, the food-conducting tissues in plant stems and leaves. Large populations can cause leaves to turn yellow, appear dry, or fall off plants. Like aphids, whiteflies excrete a sugary liquid called honeydew, so leaves may be sticky or covered with black sooty mold that grows on honeydew (See Pest Notes: Sooty Mold, listed under References). The honeydew attracts ants, which interfere with the activities of natural enemies that may control whiteflies and other pests.

Feeding by the immature sweetpotato whitefly, *Bemisia tabaci*, can cause plant distortion, discoloration, or silvering of leaves, and may cause serious losses in some vegetable crops. Some whiteflies transmit viruses to certain vegetable crops. Whiteflies are not normally a problem in fruit trees although their populations can build up in citrus, pomegranate and avocado.

Several whitefly species occur on ornamental trees and shrubs (see Table 1), but most are uncommon because of natural controls such as parasites and predators. Most whiteflies on trees have limited host ranges. Low levels of whiteflies are not usually damaging. Adults by themselves will not cause significant damage unless they are transmitting a plant pathogen. Generally, plant losses do not occur unless there is a significant population of whitefly nymphs.

MANAGEMENT
Management of heavy whitefly infestations is difficult. The best strategy is to prevent problems from developing in your garden or landscape. In many situations, natural enemies will provide adequate control of whiteflies; outbreaks often occur when natural enemies are disrupted by insecticide applications, dusty conditions, or interference by ants. Avoid or remove plants that repeatedly host high populations of whiteflies.

In gardens, whitefly populations in the early stages of population development can be held down by a vigilant program of removing infested leaves or hosing down with water sprays. Reflective mulches can repel whiteflies from vegetable gardens, and yellow sticky traps can be used to monitor or, at high levels, reduce whitefly numbers. If you choose to use insecticides, insecticidal soaps or oils such as neem oil may reduce but not eliminate populations. Systemic insecticides may be more effective but can have negative impacts on beneficial insects and pollinators.

Figure 3. Greenhouse whitefly life cycle.

Figure 4. Encarsia inaron parasite laying an egg in an ash whitefly nymph. This introduced parasite has brought this formerly serious pest down to almost undetectable levels.

Biological Control
Whiteflies have many natural enemies, and outbreaks frequently occur when these natural enemies have been disturbed or destroyed by pesticides, dust build up, or other factors.

General predators include lacewings, bigeyed bugs, and minute pirate bugs. Several small lady beetles including *Clitostethus arciatus* (on ash whitefly) and scale predators, such as *Scymnus* or *Chilocorus* species, and the Asian multicolored lady beetle, *Harmonia axyridis*, feed on whiteflies.

Whiteflies have a number of naturally occurring parasites that can be very important in controlling some species (Figure 4). *Encarsia* spp. parasites are commercially available for release in greenhouse situations; however, they are not generally recommended for outdoor use because they are not well adapted for survival in temperate zones.

You can evaluate the degree of natural parasitization in your plants by checking empty whitefly pupal cases. Those that were parasitized will have round or oval exit holes and those from which a healthy adult whitefly emerged will have a T-shaped exit hole (Figure 5). Whitefly nymphs can sometimes be checked for parasitization before emergence by noting a darkening in their color (Figure 6).
Avoiding the use of insecticides that kill natural enemies is a very important aspect of whitefly management. Products containing carbaryl, pyrethroids, or imidacloprid (especially as a foliar application) can be particularly disruptive. Control of dust and ants, which protect whiteflies from their natural enemies, can also be important, especially in citrus or other trees.

Removal

Hand removal of leaves or plants heavily infested with the nonmobile nymphal and pupal stages may reduce populations to levels that natural enemies can contain. Remove and destroy whitefly-infested vegetable plants after harvest. Always inspect new plants for whiteflies and nymphs before introducing them in the greenhouse or garden.

If you have evergreen perennial plants that consistently host high populations of whiteflies in the winter season, then you may wish to remove these plants to lower overwintering populations. If you have high populations of whiteflies in a greenhouse, removing all host plants from the greenhouse for at least 2 weeks (and assuring that no whiteflies can enter from outside) may eliminate problems.

Water sprays (syringing) may also be useful in dislodging adults. Watering can also reduce the hot, dry dusty conditions that favor whiteflies and inhibit their natural enemies.

Reflective Mulches

Shiny metallic-coated construction paper or reflective plastic mulches can repel whiteflies, especially away from small plants. Alternatively, you can spray clear plastic mulch with silver paint. Reflective plastic mulches are available online and in some garden stores.

When putting a reflective mulch in your garden, first remove all weeds. Place the mulch on the plant beds and bury the edges with soil to hold them down. After the mulch is in place, cut 3- to 4-inch diameter holes and plant several seeds or single transplants in each one. You may be able to furrow irrigate or sprinkle your beds if you use coated construction paper or other porous mulch if it is sturdy enough to tolerate sprinkling. Plastic mulches will require drip irrigation.

In addition to repelling whiteflies, aphids, and leafhoppers, the mulch will enhance crop growth and control weeds. Reflective mulches have been shown to deter pests that transmit viruses in commercial vegetable crops, perhaps helping to reduce disease incidence and crop loss. When summer temperatures get high, remove mulches to prevent overheating plants.

Traps

In vegetable gardens, yellow sticky traps can be posted around the garden to trap adults (Figure 7). Such traps won’t eliminate damaging populations but may reduce them somewhat as a component of an integrated management program relying on multiple tactics. Whiteflies do not fly very far, so many traps may be needed. You may need as many as one trap for every two large plants, with the sticky yellow part of the trap level with the whitefly infestation. Place traps with the sticky side facing plants but out of direct sunlight.

Traps are most useful for monitoring and detecting whiteflies rather than controlling them. Commercial traps or sticky cards are available in stores and online. Additionally, you can make traps out of 1/4-inch plywood or masonite board, painted bright yellow, and mounted on pointed wooden stakes. Drive stakes into the soil close to the plants that are to be protected. Although commercially available sticky materials such as Tanglefoot are commonly used as coatings for the traps, you might want to try to make your own adhesive from one-part petroleum jelly or mineral oil and one-part household detergent. This material can be easily cleaned off boards with soap and water, whereas a commercial solvent must be used to remove the other adhesives. Periodic cleaning is essential to remove insects and debris from the boards and maintain the sticky surface.

Insecticide Sprays

Whiteflies can be difficult to control with insecticides. Most less toxic products such as insecticidal soaps, neem oil, or petroleum-based oils control only those whiteflies that are directly sprayed. Therefore, plants must be thoroughly covered with the spray solution, and repeat applications may be necessary. Be sure to cover undersides of all infested leaves; usually...
these are the lowest leaves and the most difficult to reach. Use soaps or oils when plants are not drought-stressed and when temperatures are under 90°F to prevent possible “burn” damage to plants. Early evening, when there is enough light to safely apply products but when the sun is not shining directly on plants, may be a good time to spray.

The soil-applied systemic insecticide imidacloprid can control whitefly nymphs. Imidacloprid can have negative impacts on natural enemies, honey bees and other pollinators in the garden, especially when applied as a foliar spray or as a soil application to plants that are flowering or soon to be flowering. It can also cause outbreaks of spider mites. Reserve its use for special situations where these problems can be avoided. Avoid using other pesticides (other than soaps and oils) to control whiteflies; not only do most of them kill natural enemies, whiteflies quickly build up resistance to them, and most are not very effective in garden situations.

REFERENCES

