
CLEARWING MOTHS

Integrated Pest Management for Home Gardeners and Landscape Professionals

The larvae of several species of clearwing moths (family Sesiidae) are important wood-boring pests in landscapes. Hosts include alder, ash, birch, fir, oak, pine, poplar, sycamore, willow, and stone fruit trees such as apricot, cherry, peach, and plum.

IDENTIFICATION

Dying limbs, rough or gnarled bark, trunk and branch swellings (Figure 1), sap exudation, and sawdustlike frass (excrement), are good indications that wood-boring insects have infested a tree. Clearwing moth larvae bore beneath tree bark (Figure 2) and push frass, sometimes mixed with gummy tree exudate, from their tunnels. Small piles or a scattered dusting of frass mark the location of tunnel openings and clearwing pupal cases may be visible (Figure 3).

Clearwing larvae are 1 to 1 1/2 inches long at maturity and have a dark brown head and a whitish to pink body that darkens before pupating. After clearwing larvae mature and pupate and moths emerge, their empty, thin-walled, brownish pupal cases may protrude from bark or drop to the ground near the base of the tree. Clearwing pupal cases closely resemble those of the American plum borer and another wood-boring moth, *Prionoxystus robiniae* (Cossidae), discussed in *Pest Notes: Carpenterworm*. However, carpenterworm pupal cases are typically greater than 1 1/2 inches long while those of clearwing and plum borer larvae are about 3/4 inch long. Also, adults of these other moths have a very different appearance and are not attracted to traps used for monitoring clearwing moths. See Management section below.



Figure 1. Bark swelling and frass on a poplar tree branch infested with western poplar clearwing, *Paranthrene robiniae*.

Clearwing moth adults (Figures 4–6) have long, narrow front wings and shorter, wider hind wings. The hind wings, and in some species the front wings, are mostly clear. These moths fly during the day or at twilight, and their yellow and black coloring resembles that of paper wasps or yellowjackets. Adults display wasplike behavior by intermittently running while rapidly fluttering their wings. They differ in color depending on species and sex. They are often yellow, orange, or red on black or dark blue.

Larvae that closely resemble those of clearwing moths include another moth, the American plum borer, *Euzophera semifuneralis* (family Pyralidae), which bores in wood of fruit and nut trees (primarily at the junction of main scaffolds), mountain ash, olive, and sycamore. Other wood-boring pests in landscapes include beetles, such as the bark beetles (Scolytinae; see *Pest Notes:*



Figure 2. Sycamore borer larva.



Figure 3. Pupal case and larval frass of the sycamore borer.

Bark Beetles listed in References), long-horned beetles, or roundheaded wood borers (Cerambycidae), and flatheaded wood borers, or metallic wood borers (Buprestidae).

PEST NOTES

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LIFE CYCLE

Clearwing moths develop through four life stages: egg, larva, pupa, and adult (see Figure 7). Adults do not directly damage plants and live only about one week. Soon after emerging from the pupal case, female moths emit a pheromone that attracts males. After mating, the female deposits her tiny reddish to pale pink eggs in cracks, crevices, and rough or wounded areas on bark. Eggs hatch in about one to four weeks. The newly emerged larvae bore into the bark, cambium, or heartwood of the host tree. Mature larvae pupate beneath bark, except for the peachtree borer, which pupates in soil. The species listed in this section have one generation per year, except for the western poplar clearwing, which requires one to two years to complete one generation. After the adults emerge, their offspring re-infest susceptible trees; the same individual insects are not permanent inhabitants.

At least six species of clearwing moths—American hornet moth, ash borer, peachtree borer, redbelted clearwing, sycamore borer, and western poplar clearwing—are pests of broad-leaf trees and shrubs in California. Other common species in California include the sequoia pitch moth, *Synanthedon sequoiae*, and Douglas-fir pitch moth, *Synanthedon novaroensis*, which attack pine, spruce, and Douglas-fir. These conifer-infesting clearwings are discussed in *Pest Notes: Pitch Moths* listed in References.

American Hornet Moth

The American hornet moth, *Sesia tibialis*, closely resembles the western poplar clearwing, and it infests many of the same plants. Hosts include aspen, cottonwood, poplar, and willow. It ranges from New England to the Pacific coast states. The American hornet moth is mostly blackish blue with some brown, orange, or yellow.

Ash Borer

Larvae of the ash borer, *Podosesia syringae*, also known as the lilac or lilac-ash borer, mine the wood of ash, lilac, olive, and privet. This clearwing moth occurs throughout the United States but varies

in appearance and behavior depending on location. In the West, the male ash borer has long brownish legs and a black body with narrow yellow bands. In California, the ash borer occurs primarily in the Central Valley, where it attacks tree trunks and limbs, mostly within about 5 to 10 feet from the ground. Infestations occur most often when the bark has sustained injuries due to pruning, improper staking, or previous generations of ash borer. This insect is not the same as the emerald ash borer, *Agrilus planipennis*, a beetle which has caused extensive damage in the upper midwest and eastern United States.

Peachtree Borer

The peachtree borer, *Synanthedon exitiosa*, sometimes called greater peachtree borer, attacks all stone fruit trees, including apricot, cherry, peach, and plum. It is also found on almonds grafted to peach or plum rootstock. In California it occurs mainly in coastal areas and in the northern San Joaquin Valley. It occurs throughout the United States and is a different species than the lesser peachtree borer (*S. pictipes*), which occurs only in the eastern United States. Adult peachtree borers are mostly bluish black. Males have narrow yellow bands on their abdomen; females have a single orange band (Figure 4). Virtually all larval tunneling occurs within a few inches of the ground near the base of the main trunk, after which larvae emerge and pupate in soil.

Redbelted Clearwing

The redbelted clearwing, *Synanthedon culiciformis*, is common around Sacramento. It infests red and white ash and also occurs in alder and birch. The adult is mostly brownish black with an orangish-red band on the anterior of the abdomen. Its biology and management are similar to those of the ash borer.

Sycamore Borer

The sycamore borer, *Synanthedon resplendens*, occurs in the southwestern



Figure 4. Adult peachtree borers from the eastern United States (male, top left and female, top right) and an adult male from the western United States (bottom).



Figure 5. Sycamore borer adult male (left) and female (right).



Figure 6. Western poplar clearwing adult male (left) and female (right).

United States. It is prevalent in sycamore and also infests oak and ceanothus. The male is mostly yellow with a brownish-black head and black bands on its body. Its legs are yellow, except for black along the margins on the portions nearest to the body. The mostly clear wings have orangish to yellow margins (Figure 5). Sycamores tolerate extensive boring by this insect, and generally no control is recommended.

Western Poplar Clearwing

The western poplar clearwing, *Paranthrene robiniae*, also called the locust-clearwing, is found throughout warm, low-elevation areas in the West. In Southern California and the Central Valley it is a pest of birch, poplar, and willow in nurseries and landscapes, especially when trees are stressed. There is large variability in susceptibility among poplar varieties, and willows tolerate infestation, apparently without serious harm.

The adult's forewings range from an opaque pale orange to a brownish color; the hind wings are clear. The thorax is black with a yellow hind border, and the abdomen is yellow with three broad black bands (Figure 6). The entire body of the desert form of this insect is pale yellow. The pale, dark-headed larvae have two hornlike spines on their back. The adult resembles a yellowjacket wasp, but has a thick waist and feathery antennae of a moth, unlike the narrow threadlike waist and filamentous antennae of a wasp.

DAMAGE

Clearwing moth larval feeding can damage the plant's food- and water-conducting tissues and cause tree bark to become gnarled or rough (Figure 1). With some clearwing species, such as those that attack pine, sycamore, and willow, these host trees tolerate the feeding, which apparently causes no serious harm. Feeding by other species, however, can weaken or kill branches. Branches that larval tunneling has weakened may break and fall, especially during windy weather. Sometimes entire trees may die. Other types of wood-boring insects produce similar damage.

MANAGEMENT

Mature woody plants usually tolerate and can recover from the attack of a few clearwing moth larvae. However, the presence of this pest often indicates that plants have been injured, stressed, or neglected. Providing trees with appropriate cultural care is the primary damage prevention strategy. Drought stress leads to attack by borers, although for poplars, willows, and

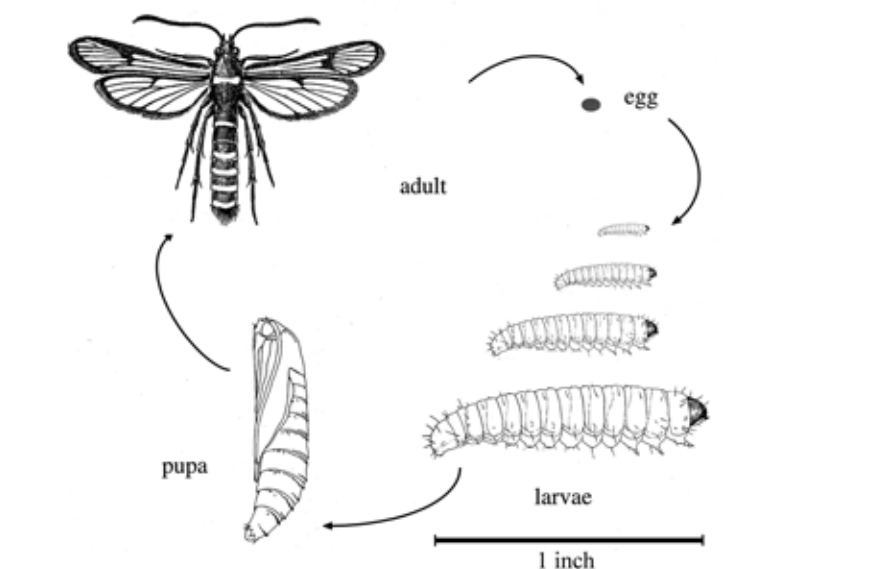


Figure 7. Clearwing moth life cycle.

birches inherent susceptibility can lead to clearwing infestations despite sufficient irrigation. In the Central Valley and other hot locations, key management methods are adequate irrigation and whitewashing the trunks of young or heavily pruned trees. To whitewash, apply white interior (not exterior) latex paint diluted with an equal amount of water to trunks to reduce light exposure and sunburn or sunscald damage.

Sometimes you can kill larvae by puncturing or crushing them. Heavy infestations of clearwing moths, on the other hand, may warrant treatment with beneficial nematodes to kill larvae, broad-spectrum insecticides to kill adults, or both.

Traps containing a clearwing moth sex attractant (pheromone) are used primarily for monitoring. However, these traps or special dispensers (e.g., those resembling twist ties) can be a management tool as well as a detection tool. Continual dispersion of clearwing moth pheromone throughout the mating season reduces the ability of the adult moth to mate. This mating disruption has controlled western poplar clearwing in poplar tree plantations in the state of Washington and has been somewhat effective in reducing

Synanthedon spp. (dogwood borer, lesser peachtree borer, and peachtree borer) populations and damage in commercial orchards in the eastern United States. Mating disruption is relatively expensive and labor intensive and there is no research on effectiveness of clearwing moth mating disruption in California landscapes. Because the method depends on treating a relatively large, contiguous area, mating disruption is probably not suitable for preventing clearwing borer infestation of one or a few scattered trees in a landscape.

Monitoring

Because other wood-boring insects produce damage resembling that of clearwing moths, the cause should be correctly identified before any control action is taken. If you are planning insecticide applications, use traps to monitor moth emergence, inspect bark for fresh pupal cases, or both.

Bark Inspection. Immediately before adult moths emerge, clearwing pupae often force about half of their length out of a tunnel and through the surface of damaged bark. Carefully inspect around damaged bark at least once each week, starting before adult emergence is expected. Look for fresh

clearwing moth pupal cases protruding from bark, from tree crotches, and around the base of trees. Because old pupal cases can persist for months, remove cases as you find them, then monitor frequently and with care to ensure that any you observe are new ones. With peachtree borer, extensive gumming is evident where infestation occurs but pupal cases generally are not observed because peachtree borer larvae drop from tunnels near the base of the tree and pupate in soil.

Traps. Traps baited with a pheromone (insect sex attractant) are available for certain clearwing moth species, including ash and peachtree borers. Male clearwing moths drawn to the pheromone dispenser become caught on the trap's sticky coating. If a pheromone is available for the clearwing borer species of concern (check the websites of insect trap suppliers), hang a trap containing the pheromone about shoulder high on each of two or more trees. Follow the manufacturer's recommendations for maintaining the trap, such as the frequency with which to replace pheromones. Because commercial traps typically attract more than one species of clearwing, identify trapped moths to be certain they are the species that attack your trees before you decide to take control action.

Using Traps. Because traps can attract moths from a distance, you don't need to place the traps in infested trees. Place traps in locations that will be convenient to monitor and within about 25 yards of host trees; check the traps once a week for moths. For further assistance identifying whether the moths are a species that attacks your plants, use the adult descriptions here and color photographs in *Pests of Landscape Trees and Shrubs* listed in References or take the trap containing your moths to the University of California (UC) Cooperative Extension or agricultural commissioner office in your county. It is a good idea to save the identified moths for comparison against additional moths captured.

Clearwing moths may be captured in traps almost any time during the growing season. However, each species typi-

cally flies in numbers during only a few weeks or months each year. Ash borer and redbelted clearwing adults fly from April through July in California. Peachtree borer, sycamore borer, and western poplar clearwing adults are active primarily from May through July. In Southern California, western poplar clearwing adults have been found in November and February through May. Male moths emerge from the pupal stage before females do and fly primarily around dusk. Females are ready to mate and lay eggs almost immediately after they emerge.

Cultural Control

Make sure trees receive appropriate and sufficient irrigation and that roots have an adequate volume of uncompacted soil that provides sufficient aeration (oxygen for roots). Protect roots, trunks, and limbs from injury. Keep weed trimmers and lawn mowers away from trunks; using mulch or a ground cover in a several-foot-wide area around the trunk will keep the area free of turf and other vegetation and eliminate the need for mowing. Stake young trees only if needed to protect or support the trunk or anchor the root ball during the first year or so after planting.

At least in the Central Valley and other hot locations, whitewash the trunks of young or heavily pruned host trees as discussed above. Because tree wounds attract clearwing moths, avoid pruning live branches unless necessary to develop tree structure or remove severely infested, dying, or hazardous limbs. Except for hazardous limbs that should be removed whenever they appear, decide when to prune based on that tree species' susceptibility to pruning-related problems. For example, prune only during fall through early winter to minimize the chance of attracting egg-laying clearwing moths and other wood borers. However, stone fruits that are especially susceptible to *Eutypa* canker and dieback, *Eutypa lata*, such as apricot and cherry, should be pruned during July or August. For the best time to prune to minimize pest problems, consult *Pests of Landscape Trees and Shrubs*, or contact the UC Coopera-

tive Extension or UC Master Gardener Program in your county.

Biological Control

Various naturally occurring parasites and predators, including the small *Apanteles* species braconid wasps, will kill clearwing moths. For example, *A. paranthrenidis* often parasitizes poplar clearwing larvae. Larvae that *Apanteles* species parasitize have many small, oblong, white cocoons adhering to their body. A minute blackish-brown wasp emerges from each cocoon after the larva dies. The importance of parasites and predators in reducing clearwing moth populations has not been documented, but avoid disrupting natural enemies whenever possible by, for example, not spraying trees, such as sycamores and willows, that tolerate borers, by not spraying foliage when treating bark for clearwings, and by using physical controls for peachtree borer and preventive cultural methods for all species.

Nematodes. Certain species of beneficial nematodes kill insects. *Steinernema carpocapsae* and *S. feltiae* commercially available nematodes are effective against at least some clearwing larvae, including peachtree borer, redbelted clearwing, sycamore borer, and western poplar clearwing. These nematodes are not hazardous to humans, pets, or plants. Instead, they kill only insects.

Nematodes can be inconvenient to obtain and usually must be mail ordered. It can be difficult to determine the quality of nematodes and they can be difficult to apply effectively. They are perishable, so store them as directed, usually under cool, dark conditions, and do not store nematodes for long periods of time. It is best to purchase fresh nematodes from a reputable producer or supplier.

Using Nematodes. Apply nematodes with a squeeze-bottle applicator or 20-ounce oil can at a concentration of 1 million or more nematodes per ounce of distilled water. First, clear the tunnel entrance of frass, then insert the applicator nozzle as far as possible into each gallery. Inject the suspension

until it fills the gallery or liquid runs out another hole before plugging the tunnel entrances with rope putty or grafting wax. Agitate the applicator frequently to keep nematodes suspended in the liquid. By adding 2% red or orange latex pigment, you can mark treated tunnels. Thoroughly drenching bark with a nematode spray is more convenient than injecting tunnels, but spraying may be less effective, because nematodes die on dry surfaces.

Make nematode applications during warm, but not hot, weather (at least 60°F) in spring or fall when borer larvae are actively feeding. Applications are most effective when larval openings are relatively large and moist. Because light and heat kill nematodes, make applications in the evening, especially in hot areas and sunny locations. Nematode-infected larvae can continue to feed and push frass from their tunnels for about one week before dying. A second application one or two weeks after the first can increase the likelihood that borer larvae will become infected. To monitor the effectiveness of squirting in nematodes and plugging tunnels, check that the opening of each gallery is still plugged one week after application. Replug any that have been opened, and spray the plugged openings with bright-colored paint. Wait another week, and check to see if these plugs are intact. If paint no longer covers the gallery opening, the larva hasn't died. Retreat the gallery.

Physical Control

During spring or fall, you can sometimes kill peachtree borers and larvae of other clearwing species by carefully using a knife or stiff wire to probe the trunk where gummy frass exudes from the bark. Because it is difficult to know whether puncturing or crushing has actually killed the larvae, reinspect trunks in a week, and probe tunnels again if you observe fresh gum exudate, which indicates a live larva is present. Minimize injuries to bark when probing tunnels and be sure not to create large wounds in cambial tissue.

Where the peachtree borer is a problem, remove suckers, and keep vegetation

and mulch away from the base of the tree. Bare soil around trunks increases the likelihood you will observe any tunneling. In the Central Valley, bare soil around trunks increases heat and dryness. This reduces the survival of borer eggs and larvae and can prevent the peachtree borer from becoming a pest.

Chemical Control

If the trees are of high value, making two or more insecticide applications to bark when egg-laying moths are active may reduce future infestations by some clearwing species, including the ash borer, peachtree borer, and western poplar clearwing. If extensive portions of the tree are already dead or if borers have heavily infested trees, spraying may provide little or no benefit, and the tree may need to be removed. Only certain broad-spectrum, residual insecticides (those that persist for weeks) thoroughly sprayed onto bark are potentially effective in preventing clearwing borer attacks. Their use generally requires hiring a licensed pest control applicator as the products available for home users are not effective. Spraying may not be practical on large trees in landscapes in part because of drift or runoff, which can cause pesticide movement offsite that might contaminate surface waters, and the difficulty in effectively timing applications.

A sufficiently concentrated pyrethroid, such as certain permethrin products (Astro, Dragnet), can be sprayed on bark to kill adults before they lay eggs and kill hatching larvae before they bore into wood. Direct the spray at the trunk or primary scaffold branches and avoid spraying leaves. Insecticide sprays have not been found to be effective against clearwing larvae beneath bark. Soil or trunk application of systemic insecticides also have not been found to control clearwing moths or their larvae.

It requires careful timing for a bark spray to potentially be effective, and the long emergence time of western poplar clearwing further complicates timing. Determine when moths are emerging by frequently examin-

ing trunks and limbs, by inspecting pheromone-baited traps, or both, as discussed in the section Monitoring, above. About 10 to 14 days after you first catch pest moths in traps or observe fresh pupal cases, apply a broad-spectrum, residual, contact insecticide to the main trunk, on top and underneath the base of large limbs where they join the main trunk, and on the wounded bark of susceptible trees. Apply sufficient spray to thoroughly wet the bark. For the peachtree borer, allow the spray to run down the lower trunk, and thoroughly wet the soil within several inches of the tree base. There is no need to treat any foliage. Take steps to avoid allowing pesticide to drip down onto hard surfaces or elsewhere that is likely to lead to runoff or washoff that can contaminate water.

If fresh pupal cases on bark or adults in traps continue to be found for longer than about one month after the application, a second spray may be warranted. The following year, spraying once or twice again may help to further reduce the infestation. Trees may continue to decline unless you use insecticides in combination with improved tree-care practices.

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Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original, labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

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