CLEARWING MOTHS

Integrated Pest Management for Home Gardeners and Landscape Professionals

The larvae of several species of clearwing moths in the insect 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. Larvae that closely resemble those of clearwing moths include the American plum borer (*Euzophera semifuneralis,* family Pyralidae), a serious boring pest of hosts that include fruit and nut trees, mountain ash, olive, and sycamore. Other common wood-boring pests in landscapes include bark beetles (family Scolytidae) (for more information, see *Pest Notes: Bark Beetles,* listed in Suggested Reading), longhorned borers (Cerambycidae), and roundheaded borers (Buprestidae).

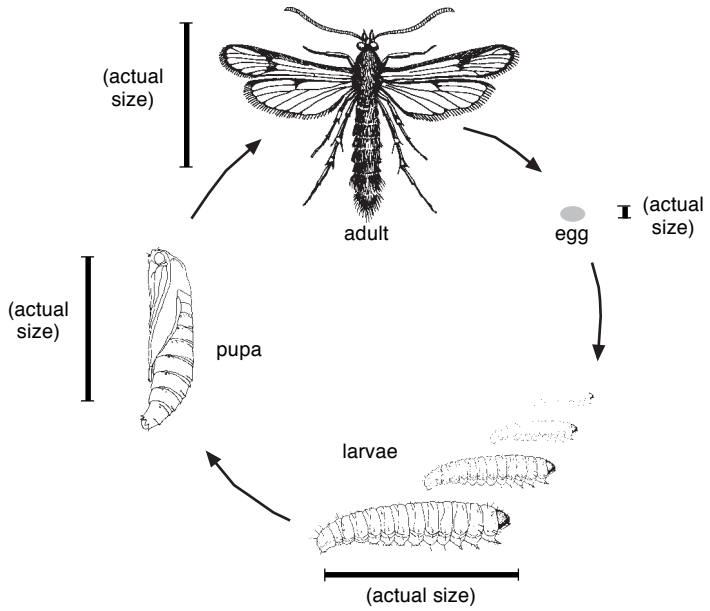

Figure 1. Clearwing moth stages and life cycle.

IDENTIFICATION

Dying limbs, rough or gnarled bark, and sawdustlike frass (insect excrement) are good indications that trees are infested with wood-boring insects. When clearwing moth larvae bore beneath tree bark, they push frass from their tunnels; the frass is sometimes mixed with gummy tree exudate. Small piles or a scattered dusting of frass mark the location of tunnel openings. The larvae are 1 to 1½ inches long at maturity and have a dark brown head and a whitish to pink body that darkens before pupating. After larvae mature and pupate and moths emerge, empty brownish pupal cases may be observed protruding from bark or on the ground near the base of the tree.

Clearwing moth adults 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.

LIFE CYCLE

Clearwing moths develop through four life stages: egg, larva, pupa, and adult (Fig. 1). Adults do not directly damage plants and live only about 1 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 1 to 4 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 discussed here have one generation per year except for the western poplar clearwing, which requires 1 to 2 years to complete one generation.

At least six species of clearwing moths are frequent pests of broadleaf trees and shrubs in California and are covered in this publication. Other com-

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mon species 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: Sequoia Pitch Moth,* listed in Suggested Reading.

American Hornet Moth. The American hornet moth, *Sesia tibialis*, closely resembles the western poplar clearwing discussed below, 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. 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, ash borer occurs primarily in the Central Valley, where it attacks the tree trunks and limbs, mostly within about 5 or 10 feet of the ground. Infestations occur most often at sites on the tree where bark has been injured by pruning, improper staking, or previous generations of ash borer.

Peachtree Borer. The peachtree borer, *Synanthedon exitiosa*, attacks all stone fruit trees, including apricot, cherry, peach, and plum. Adults are mostly bluish black. Males have narrow yellow bands on their abdomen; females have a single orange band. 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 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. 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, usually in stressed trees. The adult's forewings are an opaque pale orange to brownish; the hind wings are clear. The thorax is black with a yellow hind border and the abdomen is yellow with three broad black bands. The entire body of the desert form of this insect is pale yellow. The pale, dark-headed larvae have two hornlike spines on their backs.

DAMAGE

Clearwing moth larval feeding can cause tree bark to become gnarled or rough. Borer feeding can damage the plant's food- and water-conducting tissues. With some clearwing species such as those that attack sycamore and pine, feeding is tolerated by trees and apparently causes no serious harm. Feeding by other species can weaken or kill branches. Branches weakened by larval tunneling 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. Sometimes larvae can be killed by puncturing or crushing them. Heavy infestations of clearwing moths may warrant treatment with beneficial nematodes to kill larvae, broad-spectrum insecticides to kill adults, or both.

Traps containing clearwing moth sex attractant (pheromone) are used primarily for monitoring. However, continual dispersion of clearwing moth pheromone throughout the mating season to reduce the ability of the adult moth to mate (a process called "mating disruption") has been found effective in reducing peachtree borer populations and injury in orchards in the eastern United States. Mating disruption is relatively expensive and labor intensive, and apparently has not been investigated in landscapes.

Monitoring

Because other wood-boring insects produce damage resembling that of clearwing moths, correctly identify the cause before taking control action. If insecticide applications are planned, 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, in tree crotches, and around the base of trees. Because old pupal cases can persist for months, remove these when found and monitor frequently with care to ensure that any pupal cases observed are new. This trunk inspection method does not work with peachtree borer because larvae drop from tunnels and pupate in soil around tree bases.

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 (see Pheromone Trap Suppliers at the end of this publication), hang a trap containing the pheromone about shoulder high on each of two or more trees spaced at least several hundred feet apart. Follow the manufacturer's recommendations for maintaining the trap, such as the frequency with which pheromones should be replaced. Commercial traps typically attract more than one species of clearwing. Identify trapped moths and be certain they are species that attack your trees before you decide to take control action.

Because moths can be attracted from great distances, traps need not be located in infested trees, but may be placed where they are more convenient to monitor. Check the traps once a week for moths. To help you identify 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 Suggested Reading) and the version of this Pest Note available online at www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7477.html. You may also take the trap containing your moths to your county Cooperative Extension office for identification. Save the identified moths for comparison when additional moths are captured.

Clearwing moths may be captured in traps almost any time during the growing season. However, each species typically flies in numbers during only a few weeks or months each year. Ash borer and redbelted clearwing adults in California fly from April through July. 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 first and fly primarily around dusk. Females are ready to mate and lay eggs almost immediately after they emerge.

Biological Control

Clearwing moths are killed by various parasites and predators, including small *Apanteles* spp. braconid wasps. For example, *Apanteles paranthrenidis* often parasitizes poplar clearwing larvae. Larvae parasitized by *Apanteles* spp. have many small, oblong, white cocoons adhering to their bodies. 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, for example by not spraying trees that tolerate borers (sycamores) 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* 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. They kill only the insects they contact in protected plant parts. Effective timing of nematode application (whenever borer larvae are feeding) may be easier to determine than monitoring for adults to time trunk sprays. However, the quality of nematodes can be difficult to determine, they can be difficult to apply effectively, and they can be inconvenient to obtain.

Nematodes usually must be mail ordered. They are perishable, so store them as directed (usually under cool, dark conditions) and do not store nematodes for long periods. Purchase them from a reputable producer or supplier of fresh nematodes. Some sources are listed at the end of this publication. For a more complete, up-to-date list, consult *Suppliers of Beneficial Organisms in North America*, available from the California Department of Pesticide Regulation, 830 K Street, Sacramento, CA 95814-3510, phone (916) 324-4100, or online at http://www. cdpr.ca.gov/dprnews.htm. Suppliers and more details on nematode use are available at http://www2.oardc.ohio-state.edu/nematodes.

Apply nematodes with a squeeze bottle applicator or 20-ounce oilcan at a concentration of 1,000,000 or more nematodes per ounce of distilled water. First clear the tunnel entrance of frass and then insert the applicator nozzle as far as possible into each gallery. Inject the suspension until the gallery is filled or liquid runs out another hole; then plug 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 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 nematodes are killed by light and heat, 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 1 week before dying. A second application 1 or 2 weeks after the first one 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 1 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 the gallery opening is no longer covered with paint, the larva has not died. Re-treat the gallery.

Cultural Control

Make sure trees receive appropriate irrigation. Provide good soil conditions. Protect roots, trunks, and limbs from injury. Keep weed trimmers and lawn mowers away from trunks; using a 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.

Clearwing moths are attracted to tree wounds. 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, prune only during fall through early winter to minimize the chance of attracting egg-laying moths.

Physical Control

Kill peachtree borers and possibly larvae of other clearwing species by carefully using a knife or stiff wire to probe the trunk during spring or fall where gummy frass exudes from bark. It is difficult to know whether the larva has actually been killed by being punctured or crushed. Reinspect trunks in a week and again probe tunnels if fresh gum exudate is observed, indicating a live larva is present. Minimize injuries to bark when probing tunnels. Do not create large wounds in cambial tissue.

Where 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 that any tunneling will be observed. In the Central Valley, bare soil around trunks increases heat and dryness. This reduces survival of borer eggs and larvae and can prevent peachtree borer from becoming a pest.

Chemical Control

If high-value trees are infested, insecticide can be applied to bark when egg-laying moths are active to 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 trees are heavily infested with borers, spraying may provide little or no benefit and the tree may need to be removed.

Only certain broad-spectrum, long-lasting insecticides are effective in preventing borer attacks. Effective products may not be currently available for home users, although they are available to licensed pest control applicators. The pyrethroid permethrin (Astro, Dragnet) is the best choice for preventing clearwing moth attack. Spray residue must persist for weeks to several months in order to kill adults before they lay eggs or kill hatching larvae before they bore into wood. Insecticide sprays have not been found to be effective against borer larvae beneath bark. Soil or trunk injections of systemic insecticides are not effective either. Trees may continue to decline unless insecticides are used in combination with improved tree care practices.

To be effective, a bark spray must be carefully timed. Determine when moths are emerging by frequently examining trunks and limbs, by inspecting pheromone-baited traps, or both, as discussed in the section on Monitoring, above. About 10 to 14 days after you first detect adults (catch pest moths in traps or observe fresh pupal cases), apply an insecticide to the main trunk, on top and underneath limbs where they join the main trunk, and on wounded bark of susceptible trees. There is no need to treat foliage, especially in the upper canopy. Apply sufficient spray to thoroughly wet the bark. For peachtree borer, allow spray to run down the lower trunk and thoroughly wet the soil within several inches of the tree base. (Do not allow pesticide to drip down on to hard surfaces beneath or adjacent to trees since this can lead to runoff and water contamination.) If moths continue to emerge or to be found in traps for longer than about 1 month after the application, spray again. The following year treat once or twice to further reduce the infestation.

PHEROMONE TRAP SUPPLIERS

BioQuip Products
2321 Gladwick St.
Rancho Dominguez, CA 90220
(310) 667-8800
www.bioquip.com

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(800) 382-8473
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Vestaburg, MI 48891
(989) 268-5693
www.greatlakesipm.com

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Locke, NY 13092-0300
(315) 497-2063
www.ipmlabs.com

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Delta, BC, Canada V4G 1E9
(800) 665-0076
www.pherotech.com

Scentry Biologicals
610 Central Ave.
Billings, MT 59102
(800) 735-5323
www.scentry.com

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(918) 758-3061
www.trece.com

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Columbia, MD 21046
(800) 847-5620
www.certisusa.com

Integrated Pest Management Services
P.O. Box 989
Fresno, CA 93714
(559) 456-0990

M&R Durango
P.O. Box 896
Bayfield, CO 81122
(800) 526-4075
sales@goodbug.com

Peaceful Valley Farm Supply
P.O. Box 2209
Grass Valley, CA 95945
(530) 272-4769
www.groworganic.com

SUGGESTED READING

Dreistadt, S. H., J. K. Clark, and M. L. Flint. 2004. *Pests of Landscape Trees and Shrubs*. 2nd ed. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3359.

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For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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