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# CODLING MOTH

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*Integrated Pest Management for Home Gardeners*

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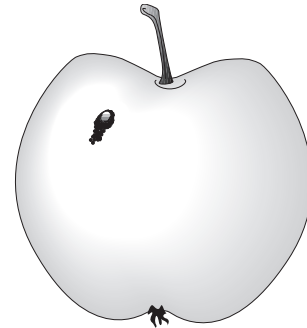
Codling moth, *Cydia (Laspeyresia) pomonella*, is a serious insect pest of apples, pears, and walnuts; it is a less important pest on plums and other stone fruits.

## IDENTIFICATION

Codling moth adults are small with a wing span of 1/2 to 3/4 inch, about the size of a house fly. Their gray mottled appearance blends well with bark, making them difficult to detect. If you are trapping the adults, codling moths can be distinguished from other moths associated with fruit trees by their dark brown wing tips that have shiny, coppery markings.

Eggs are laid singly on fruit, nuts, or nearby leaves. In pears, eggs may also be laid at the base of leaf clusters. The eggs are about the size of a pin-head, disc-shaped, and transparent white when first laid. As they mature, eggs become opaque white and develop a red ring. Just before hatching, the black head of the larva becomes visible. Eggs are hard to spot—your chances of finding them are best on apple and pear trees. It is very difficult to find them on walnut trees.

Caterpillars are not very distinctive; they are white to pink with a mottled brown head and shield at the top of

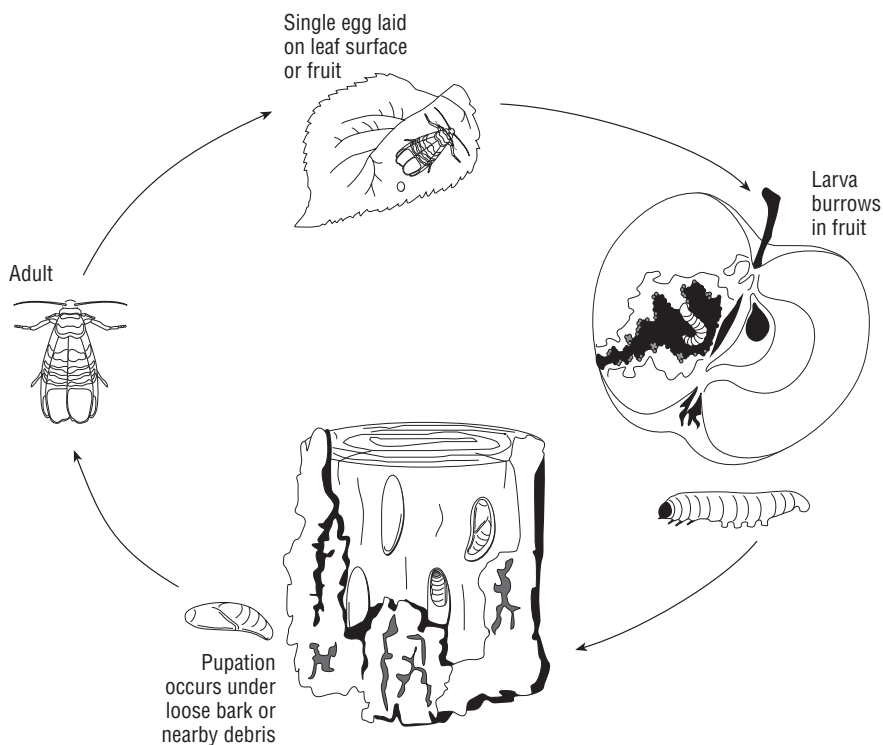


**Figure 2. Entry hole of codling moth larva is often marked by a small pile of frass (a mixture of feces and food fragments).**

the first segment behind the head. However, few other caterpillars are found inside walnut, pear, or apple fruit. Navel orangeworms may also be found in walnuts, but they have crescent-shaped markings on the second segment behind the head; in addition, unlike codling moth, the navel orangeworm leaves lots of webbing in the nut and is most common in late summer.

## LIFE CYCLE

Codling moth overwinters as a full-grown larva within a thick, silken cocoon that can be found under loose scales of bark and in soil or debris around the base of the tree (Fig. 1). The larvae pupate inside their cocoons in early spring, usually sometime in February or March. Shortly thereafter they emerge as moths. Moths are most active from a few hours before to a few hours after twilight. Mating occurs when sunset temperatures exceed 62°F. Each female deposits 30 to 70 eggs singly on fruit, nuts, or nearby leaves. After the eggs hatch, young larvae seek out and bore into fruit or developing nuts (Fig. 2). After completing development



**Figure 1. Life cycle of the codling moth**

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## PEST NOTES

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they leave the fruit and drop from the trees to search out sites in which to pupate. Depending on the area of California and whether it is a warm or cool summer, there can be two or three, and sometimes four, generations a year.

### DAMAGE

On apples and pears, larvae penetrate fruit and bore into the core, leaving brown-colored holes in the fruit that are filled with frass (larval droppings). In plums, and occasionally other stone fruits, codling moth bores into the fruit all the way to the pit. Codling moth larvae feed within walnuts on the kernel. Nuts damaged early in the season drop off trees soon after damage occurs. Nuts damaged later in the season remain on trees, but their kernels are inedible.

### MANAGEMENT

Codling moth can be very difficult to manage, especially if its population has been allowed to build up over a season or two. It is much easier to keep moth numbers low from the start than to suppress a well established population. In trees with low to moderate levels, codling moth can often be kept to tolerable levels by using several nonchemical management methods; however, it is important to begin to implement these measures early in the season. Where populations are high and many infested trees are nearby, insecticide applications may be necessary to bring populations down to very low levels. However, insecticides are very difficult to time accurately, and the only highly effective material available is toxic to natural enemies and honey bees. In many backyard situations, the best course of action may be to combine a variety of the nonchemical methods discussed below and accept the presence of some wormy fruit.

### Nonchemical Control

There are several methods for reducing population numbers that do not require the use of insecticides. These methods include sanitation, bagging the fruit, mass trapping, and trunk banding. Pruning trees to a height

where the canopy is easy to reach will simplify management of this pest.

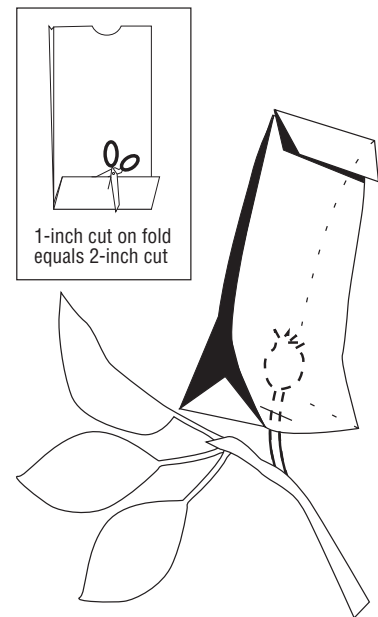
If a backyard tree or orchard has a very high moth population, it may take several seasons of diligently practicing the following control methods to reduce codling moth damage to about 10 to 20% per year. Orchards or backyard trees within a half-mile radius in which no control program is in place can serve as a continual source of codling moths, thus making it even more difficult to limit damage from this pest.

**Sanitation.** Various sanitation practices may be helpful in limiting codling moth numbers in isolated backyard trees. If your trees are not isolated from other codling moth host trees and your neighbors do not also follow these sanitation practices, this method alone will only control a small percentage of the population.

A portion of the codling moth population will overwinter as pupae in protected areas on tree trunks and in rubbish around the base of a tree. Remove rubbish and loose bark in winter. Every week or two beginning about 6 to 8 weeks after bloom, check fruit on trees for signs of damage and remove and destroy any infested ones. This can be a very effective method in the overall reduction of codling moth numbers. Also, clean up dropped fruit and nuts as soon as possible after they fall. This may help reduce populations of the next generation, because dropped fruit and nuts may still have larvae in them. Cleaning up is especially important in May and June.

**Bagging Fruit.** By enclosing fruit that are on the tree in bags so that they are not accessible to codling moth larvae, you can achieve excellent control of this pest (Fig. 3). Bagging can be done on fruit over the entire tree, or on as many fruit as desired.

To bag the fruit, thin fruit to one per cluster. The best time to do this is when the fruit is from 1/2 to 1 inch in diameter. Use No. 2 paper bags (standard lunch bag size) that measure



**Figure 3. Bagging the fruit to protect it from codling moth larvae**

7-1/4 inches by 4 inches. Cut a 2-inch slit in the bottom of the bag and slip this opening over the fruit to form a seal around the stem. Staple the open end shut.

While this technique does not affect the maturity or quality of the fruit, it may have an impact on the color development of red varieties. On the plus side, bagging a fruit protects it from both codling moth and sunburn. In addition, thinning the fruit to one per cluster results in larger fruit at harvest.

**Use of Pheromone Traps.** Pheromone traps are traps baited with a synthetic sex attractant (pheromone) that mimics the chemical female moths use to lure males for mating. Two ways home gardeners can use pheromone traps are (1) to mass trap male moths in an effort to reduce the size of the mating population (see section below), and (2) to help determine the need for an insecticide treatment.

When pheromone traps are used to determine the need for treatment, use no more than one trap in a 5-acre

area. Check the traps at least twice a week to determine when adult moths are flying and mating. Chemical treatment in home orchards is probably not necessary if fewer than 15 moths per trap are caught in a 7-day period.

**Mass Trapping.** Mass trapping of codling moth males with pheromone traps may help reduce the population size of subsequent generations, but research on the effectiveness of this method in backyards has shown mixed results. The idea behind mass trapping is to attract all the male moths in the area into the sticky traps. Once trapped in the sticky trap, males are no longer available for mating and unmated females cannot produce viable eggs. For this method to be effective, however, you must catch all the males in the area before they can mate. Thus mass trapping works best where trees are isolated by at least a mile from other trees harboring codling moth (especially apple, pear, and walnut trees). Always use other control methods in combination with pheromone traps.

To carry out a mass trapping program, start in mid-March by placing traps (two to four traps in each large tree and one to two in each small tree) away from the trunk about 6 feet above the ground. Place traps in trees that are about 20 to 50 feet away from apple, pear, or walnut trees to help draw the male moths away from host trees and reduce their chance of mating before being caught. Check the traps every week or two and remove dead moths. Replace pheromone lures according to the manufacturer's recommendations, and change the sticky bottoms every 4 weeks, or sooner if they become dirty. Also, scratch or score the sticky surface to maintain its adhesive quality. Codling moth traps, caps, and sticky bottoms are available from many commercial sources.

Mass trapping can also be done with a homemade moth trap consisting of a 1-gallon plastic milk jug containing the following: 1 cup cider vinegar, 1/3 cup dark molasses, 1/8 teaspoon am-

monia, and enough water to make 1-1/2 quarts of liquid. Cut a 2-inch diameter hole just below the shoulder of the jug. While research is not available on the effectiveness of these traps, backyard growers have reported success with this method, which traps both male and female moths. Hang the jug in the tree using a wide strip of cloth to protect the tree branch. Use up to three traps per tree for large trees.

**Trunk Banding.** A traditional nonchemical method for controlling codling moth is to trap mature larvae in a trunk band of Tanglefoot, burlap bags, or corrugated cardboard as they climb up the trunk to pupate under loose bark. Trapped caterpillars or pupae must be killed before they can emerge as adult moths that can lay a second generation of eggs. For effective control, use trunk banding in combination with other control methods.

Corrugated cardboard is preferred for trunk banding. Use a 4-inch-wide strip of large-core corrugated cardboard (size Flute A 18-inch rolls) and wrap it around the trunk of the tree so that the corrugation tubes are vertical and the band is snug against the trunk. Staple bands to trees about 18 inches or more from the ground and reinforce the staple with duct tape; pick the smoothest part of the trunk. Tanglefoot can also be used, but you cannot be sure the sticky band will kill all the codling moths; also Tanglefoot tends to accumulate dust and debris and must be replaced frequently.

Place bands on trunks after bloom, just before the caterpillars drop from the trees to seek pupation sites; generally this occurs in early May in the Central Valley and by the end of May along the coast. The codling moth caterpillars will crawl up the tree and into the corrugations to pupate. Remove the cardboard bands before moths begin to appear (the end of May in the Central Valley and the last week of June in the coastal areas) and destroy them to kill all caterpillars and pupae. Be sure to crush and kill

any pupae remaining on the trunk after you remove the band. To help control the overwintering generation, put new trunk bands up in August and remove and destroy them between November and January.

Banding works best on smooth-barked varieties such as Red Delicious apple that don't provide good alternative pupation sites; scaly varieties like Newtown Pippin and most types of pears have so many crevices that many caterpillars will pupate before they get to the banded area. Even in the best situations, banding will only control a small percentage of the codling moths because many pupate elsewhere on the tree or on the ground.

### **Chemical Control**

Proper timing of insecticide applications is critical if they are to be effective against codling moth: they must be applied just as eggs are hatching. Once the caterpillar has gone into the fruit or nut, it is protected from pesticides. The most effective way to time insecticide applications is based on the calculation of heat units, known as degree-days. In order to calculate degree-days, you need daily maximum and minimum temperatures and a pheromone trap. Details on timing treatments using the degree-day method are given in *Integrated Pest Management for Apples & Pears*, listed at the end of this publication.

Though timing sprays is best done with the use of degree-day calculations, if you are unable to calculate degree-days and do not live in an apple- and pear-growing county where this information is available from your Cooperative Extension office, you can monitor your trees to detect the beginning of egg hatch. Check a sample of fruit at least twice a week for entry holes or "stings" that indicate larvae have begun boring into fruit. Be sure to examine the fruit where it touches another fruit: this is the most likely place to find an entry hole. Spray as soon as you see the first sting. Unless insecticide applications are properly timed, however, the nonchemical

methods listed above will probably provide more reliable control.

If a chemical treatment is planned, most home orchards only require treatment of the first spring generation (Fig. 4). Where populations have been very heavy or tolerance for damage is very low, however, the second and perhaps third generations may also need to be treated.

Only a few insecticides are available to home gardeners for managing codling moth. The most effective material is the broad-spectrum insecticide carbaryl. It remains effective for about 28 days, but it is very disruptive to natural enemies and mites as well as honey bees.

The only other option for home gardeners are the summer oils, which work by suffocating the eggs. Oils have no residual activity but are less toxic than a broad-spectrum material. Because they have no residual, three to five applications of oil are usually required to treat the egg hatch period, which lasts about 28 days. Oils are not

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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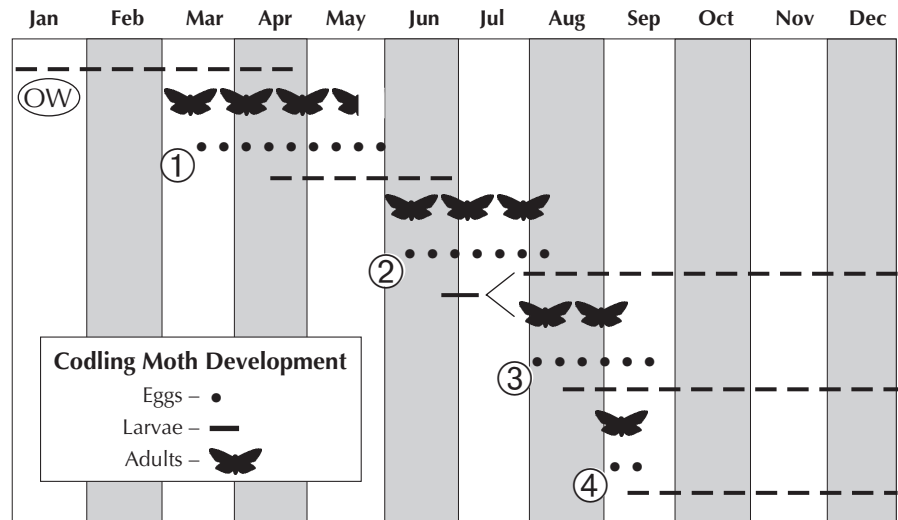
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**Figure 4. Generalized description of the codling moth's seasonal development. Moth flights and developmental times vary with temperature and location. Designated are (OW) overwintered population; (1) first generation; (2) second generation; and (3) third generation. A portion of the second generation larvae enter diapause and become part of the overwintering larval population, except in very warm locations where most of the second generation completes development and, in some years, a partial fourth (4) generation occurs.**

very effective at controlling codling moth, and they may injure leaves or fruit if applied within 30 days of a sulfur application.

Other materials such as *Bacillus thuringiensis*, cryolite, and pyrethrin/rotenone combinations have not been found to be effective at controlling codling moth.

#### COMPILED FROM:

Flint, M. L. 1998. *Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide*, 2nd ed. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publication 3332.

Ohlendorf, B. 1999. *Integrated Pest Management for Apples & Pears*, 2nd ed. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publication 3340.

Both of these publications are available for purchase online at <http://anrcatalog.ucdavis.edu>

#### WARNING ON THE USE OF CHEMICALS

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.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse the containers. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

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