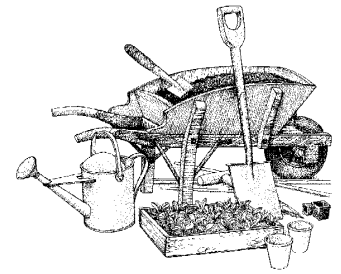


For the Gardener

Center for Agroecology & Sustainable Food Systems
University of California, Santa Cruz



Controlling Codling Moth in Backyard Orchards

Home orchardists who don't want to use synthetic chemical controls can still limit codling moth damage by consistently practicing several non-chemical control methods. An ongoing, consistent suppression effort is the key to backyard codling moth control. This is a pest that can build up over a season or two and become difficult to control – it's much easier to keep moth numbers low from the start than to try and suppress a well-established population. Therefore, it's especially critical to implement a suppression program early in the season.

Several tactics that don't require synthetic chemical pesticides can be combined to control a codling moth population. Here are some ideas for limiting codling moth damage in small orchards or individual trees –

✓ Step 1: Practice Good Cultural Management

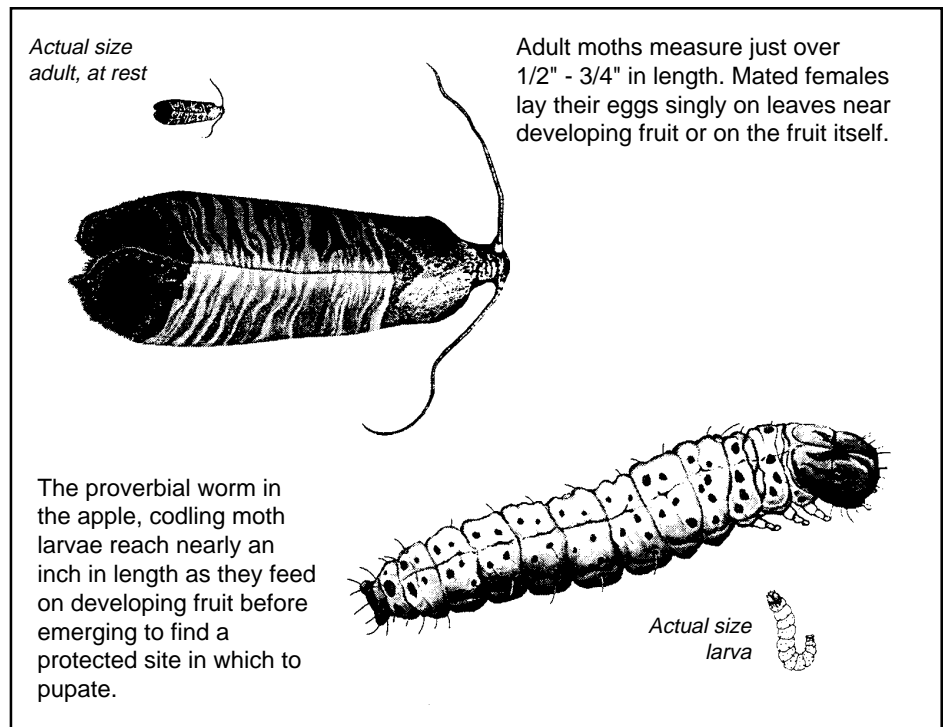
Home orchardists can practice "preventive medicine" by learning to prune, train, and manage their trees properly. It's easier to see and thin fruit on a well-pruned tree, and good cultural management, including a good fertility and watering regime, will contribute to overall tree vigor. Backyard or small-scale growers should consider planting trees on semidwarf rootstocks to control tree height and make management easier.

It's also important to get to know your orchard well. Growers should become familiar with the seasonal cycles, and learn to recognize signs of stress or damage so that problems can be promptly remedied.

✓ Step 2: Monitor the Orchard to Determine Mating Periods and Population Pressure

By mid to late March, or soon after bud break, backyard growers should hang a codling moth trap in the orchard and begin to monitor it weekly. These "sticky wing" traps contain a codling moth pheromone lure which dispenses a synthetic copy of the sex scent females use to attract males. Traps are available from farm and garden supply stores and mail order companies. Follow the label directions for positioning the trap and make sure to replace the pheromone lure as indicated.

When the overwintering generation of codling moths begins to emerge (as indicated by trap catches) and evening temperatures reach 62°F or higher, moths will begin to mate and lay eggs. If you plan to use sprays or release beneficial wasps, it's important to time applica-



tions and releases to coincide with egg laying or egg hatching (see *Additional Control Measures*, below).

Check and clean the trap once a week throughout the season. Make a note of the date when the first codling moth is captured and how many codling moths are caught each week. A simple graph of the pattern of weekly moth captures should be kept from bud break until harvest. This pattern of flight activity is very important for timing control measures. At the end of the season, the total number of moths caught will give you a relative measure of the moth population pressure in your trees. Keep track of this number from year to year to help measure the control program's impact.

If a trap in a backyard tree or small orchard catches fewer than 50 moths over the course of the season, the orchard's moth population is relatively low; 50 - 100 indicates moderate pressure; and more than 100 means a high population requiring aggressive control measures. Don't be lulled by low trap counts in years when the weather is cool. Cold spring weather will suppress a population by limiting the time available for mating. However, low trap counts in a cool year don't necessarily indicate subsequent control of moths. A year-to-year trap monitoring and suppression effort must be maintained to be effective.

✓ Step 3: Thin Aggressively and Destroy Windfalls

By the post-bloom period, when the young fruit are between the size of a large marble and the size of a walnut (mid May in the Central Coast region), thin each fruit cluster to one or two apples per cluster site. Thinning will improve tree vigor and help prevent alternate bearing (a heavy crop one year, followed by a light crop the next). An apple tree should only carry from 10% to 20% of the fruit it sets, depending on number of flowers, variety, and growing conditions.

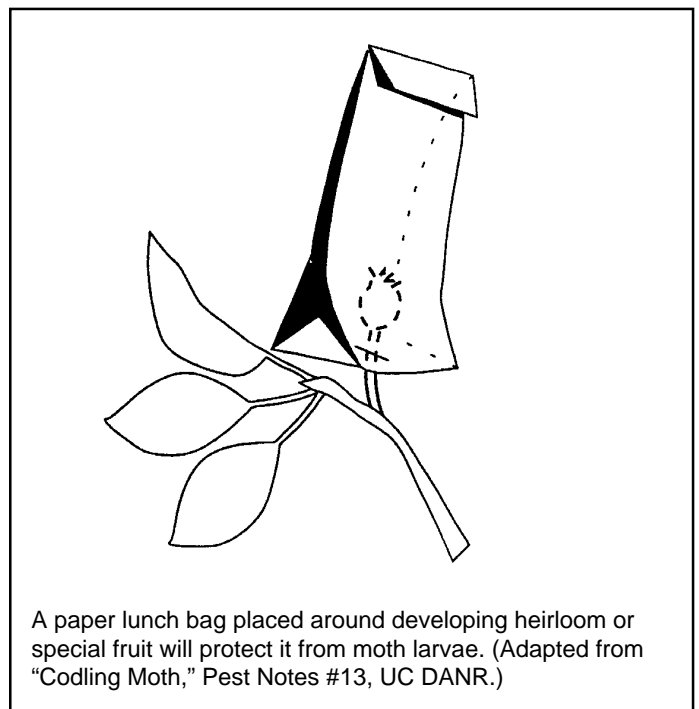
Remove any fruit that have been visibly damaged by codling moth larvae at this time. Entry points – the point where the codling moth larvae entered the fruit – will be small holes at this stage, but there will be some brownish frass (larval excrement and fruit material) at the site that should make the entry visible in May.

Fruit that is removed or has dropped should be destroyed. Bury it 6 to 12 inches deep, or place it in a black plastic bag in the sun for at least four weeks before composting. This will prevent any codling moth larvae within the fruit from maturing. When an apple has fallen off the tree, the codling moth larva usually exits within a few days. Any fruit left lying on the ground may contain larvae that can emerge and find a spot to pupate. Windfall fruit should be collected and destroyed every week throughout the season.

✓ Step 4: Look for Damage and Thin Again

In June, when the apples have reached golf-ball size, go back and remove any visibly damaged fruit. This "return thinning" will rid the tree of fruit containing mature codling moth larvae. Again, damaged fruit from the tree, as well as windfalls, should be buried or placed in a plastic bag in the sun.

At this point in the season (usually after the last threat of spring rain has passed), any heirloom or very special fruit can be bagged to protect it from codling moth damage. To bag fruit, use a standard brown paper lunch bag. Cut a slit in the floor of the expanded bag big enough to slide the apple through, slip the bag over the fruit and make sure it seals around the stem (the open end of the bag should face the end of the branch, not the tree trunk), then tie the opening shut with a piece of string or staple it closed. Open the bag and check the fruit occasionally to make sure no damage has occurred. Bags should be opened or removed approximately two weeks before harvest to allow the fruit to ripen and color.



✓ Step 5: Collar Your Trees

At the same time as the early June thinning, cardboard or burlap bands or collars can be installed around the tree trunks and main scaffold branches. These "pupal collars" attract mature codling moth larvae that are looking for a place to spin their cocoons. They should be checked weekly from June 1 through July 15,

then checked again in August - September. The collars are more effective on smooth-barked varieties, since rough-barked trees offer the moth larvae many alternative sites to pupate.

To install the collar, wrap a 3- or 4-inch-wide piece of corrugated cardboard or a burlap sack around the trunk 12 - 18 inches off the ground, and around scaffold branches. Secure the wrap with plastic flagging tape, string, or wire that can be removed and retied. Make sure the hollow "flutes" of the corrugated cardboard face the tree and are oriented parallel to the length of the trunk.

To check for larvae or pupae, remove the trap and look for the brownish cocoons. Moth cocoons should not be confused with the white webs or egg cases of spiders. Spider egg cases should be left in the collars. The cocoons or the large, pink codling moth larvae can be destroyed by cutting out the cardboard strips and squashing or burning them, or dropping the cocoons or larvae in soapy water.

The peak larval migration periods of June and August-September are the most important times to monitor the collars. In June, the bands catch the first generation's pupae, which will definitely damage apples if allowed to mature and lay eggs as adults in July. In September, bands are usually catching the mature larvae that would overwinter and emerge the following spring. In Watsonville area, these late-flying adults will seek to lay eggs near the very latest-maturing apple varieties in about half the years.

✓ Step 6: Clean Up After Harvest

Throughout the growing season, continue to check and clean codling moth traps and remove damaged fruit from the trees, as well as destroy windfall. Following harvest, clean up and remove tree props, wooden bins, boxes, and other material that larvae might seek out as a place to pupate. This will help limit the overwintering population.

Additional Control Measures

Beneficial Wasps - A Natural Enemy

As soon as the moths start to fly (as indicated by trap catches) and it has consistently been 62°F at sunset, backyard growers may want to release *Trichogramma platneri*. This tiny wasp is a codling moth egg parasite - the female wasp lays her eggs inside codling moth eggs, which the developing wasps eventually destroy.

Trichogramma platneri can be purchased as small "egg-cards." A one-inch egg card will usually have 1,000-2,000 pupae ready to emerge as adults - a good dose for

an individual tree. *Trichogramma platneri* is available from several insectaries in the state. A local strain (from the Santa Cruz Mountains) can be purchased on a first-come, first-served basis from the Center's insectary at UC Santa Cruz (see *Resources*).

Trichogramma platneri has a role in the home orchard. Diverse backyard gardens, where apples are growing in amongst pollen- and nectar-heavy flowers and other plants, may be better places for wasps than larger, clean-cultivated orchards where there are fewer food sources to support them. If you use *T. platneri*, make several weekly releases when codling moth breeding begins, as indicated by trap catches and sunset temperatures (usually around the first of April on the Central Coast). Releases are usually made by placing the egg cards of fresh parasite pupae in a small cup in the apple tree's foliage, where they hatch out and disperse in search of prey.

Trap-Out

Some backyard orchardists successfully use sticky wing codling moth pheromone traps (described above) to capture all the male moths in their yard and thereby prevent breeding. This practice, known as mass trapping or "trapping out" the male population, requires a trap or two in every tree. It is only effective if moth pressure is relatively low, the orchard is limited to a few apple trees, and the trees are at least a mile away from possible sources of mated female moths, such as orchards with no suppression efforts or abandoned orchards. Trapping out should be combined with the other control methods described above.

Some backyard growers report success with a home-made moth trap consisting of a one-gallon plastic milk jug filled with the following: 1 cup cider vinegar, 1/3 cup dark molasses, 1/8 teaspoon ammonia, and enough water to make 1.5 quarts of liquid. Cut a silver-dollar sized hole just below the shoulder of the jug. Fill the jug and hang it using a wide strip of cloth to protect the tree branch (use up to three per tree for large trees).

Sprays

There are several types of sprays available for codling moth control, including materials approved for organic management. Sprays are not recommended for the backyard organic apple grower for a variety of reasons. Most chemical sprays harm beneficial insects as well as codling moth and should be avoided. Biologically derived disease agents (bacteria and viruses) are either not effective for the home orchardist or are difficult to mix and apply properly. Certain oil sprays can be applied effectively at egg laying to smother

codling moth eggs and larvae, but because these oils are very short acting they must be sprayed on three to five times during the hatch period. If the oils are applied within 30 days of sulfur, copper or zinc sprays, they can combine to cause toxicity and damage leaves and fruit.

Sprays designed to kill larvae are only effective if the applications are precisely timed to coincide with egg hatching. Once the larvae burrow into developing fruit, sprays will no longer reach them. Proper timing requires that you monitor daily maximum and minimum temperatures in order to calculate heat units, a measurement known as degree-days. You must also monitor a pheromone trap to determine when male moths begin to fly and mate. For more information on calculating degree days and using sprays for control, consult the UC IPM guide for apples and pears (see *Resources*).

Some commercial growers have begun to use pheromone dispensers to flood the orchard with the moth's sex scent in a program known as mating disruption. Although effective in many commercial orchards, these dispensers aren't designed for individual trees or small plantings. They require a large area of relatively uniform-sized trees to work well.

Varietal Choices

Growers putting in new trees can choose less-susceptible varieties to help limit codling moth damage. Jonagold, Gravenstein, Gala, Macintosh, and Red Delicious are among the early-maturing varieties that aren't as susceptible to late-season generations of moths and that perform well under various California conditions.

If a backyard tree or orchard has a very high moth population, it may take several seasons of the program described above to reduce codling moth damage. Trying to regain control of codling moth from conditions of past neglect or poor cultural practices is challenging. A number of years of aggressive biorational suppression measures are needed to achieve significant results. Growers can expect a 10% - 20% per year reduction in population at small orchard sites where codling moth has not been previously controlled.

Orchards between a quarter- and half-mile away in which no control program is in place can also add to a gardener's woes by serving as a continual source of

mated moths. Organic orchardists may need to encourage neighbors to practice better suppression efforts in their own yards in order to limit damage throughout the neighborhood.

RESOURCES

Rootstock Options

Martin, Orin. 1996. "Apple Trees for Every Garden." Available as a free handout from the Center for Agroecology & Sustainable Food Systems. Call 408/459-3240 or write to the address given below to request a copy.

Pheromone Trap & Trichogramma platneri Sources

Arbico Environmentals
PO Box 4247
Tucson, AZ 85738-1247
1-800-827-2847

Harmony Farm Supply & Nursery
PO Box 460
Graton, CA 95444
707/823-9125, 823-1734 (Fax)

Suppliers of Beneficial Organisms in North America
Catalogue available free from
California EPA

Department of Pesticide Regulation
Environmental Monitoring and Pesticide Branch
1020 N St., Room 161
Sacramento, CA 95814-5604
916/324-4100

UC Santa Cruz
Center for Agroecology & Sustainable Food Systems
Backyard orchardists in the Santa Cruz area can obtain *T. platneri* raised at the Center's insectary when supplies are available. Call 831/459-5069 or send a Fax to 831/459-2799 for more information.

Additional Information on Codling Moth Control

"Codling Moth." Pest Notes #13. University of California: Division of Agriculture and Natural Resources, June 1995. Available from UC Cooperative Extension offices.

Organic Apple Production Manual. Publication #3403. University of California: Division of Agriculture and Natural Resources, 2000. Call 1-800-994-8849 for ordering information, or online: <http://anrcatalog.ucdavis.edu>.

This material was written, produced, and distributed by staff of the Center for Agroecology and Sustainable Food Systems at the University of California, Santa Cruz. The Center manages the Alan Chadwick Garden and the UCSC Farm on the UCSC campus – both sites are open to the public daily from 8 am to 6 pm. For more information on the Center and its activities, call 831/459-3240 or write to the University of California, CASFS, 1156 High St., Santa Cruz, CA 95064. For information on tours of the Chadwick Garden and UCSC Farm, call 831/459-3248. You can visit our home page at <http://zzyx.ucsc.edu/casfs>
