



## Protecting Backyard Apple Trees from Apple Maggot

Michael R. Bush, Michael Klaus, Arthur Antonelli, and Catherine Daniels

### Apple Maggot Invades the Pacific Northwest

Since first detected in 1979 in Portland, Oregon, the apple maggot has spread and infested apples in many parts of the Pacific Northwest. Homeowners may want to rethink growing apples and other fruit trees. Many spray products labeled for homeowner use on fruit trees have been canceled. While apple maggot can render the fruit on your apple tree inedible, pockets of unsprayed “backyard” trees pose a serious threat to the commercial apple industry in the Northwest.

Commercial growers face added costs for insecticides to protect their fruit from apple maggot. They also risk restrictions from overseas markets that strictly enforce pest quarantines. To date, the apple maggot has not established itself in the major apple production areas of central Washington. Regulatory agencies are working to maintain these areas as apple-maggot-free zones. Homeowner cooperation and assistance in controlling this pest are critical to protecting the Northwest tree fruit industry.

The apple maggot, *Rhagoletis pomonella*, is an insect native to eastern North America. Apple maggot fed on hawthorn fruit until European colonists introduced the domestic apple to North America. Now apple maggot has spread throughout most of North America

as a key apple pest. While hawthorn and apple trees are the primary hosts, apple maggot has been reported in crab apples, plums, apricots, pears, cherries, and wild rose hips.

### Life Cycle and Damage to Apples

Apple maggot adults are known as fruit flies (fig. 1). Female flies lay their eggs singly in apples and other fruits. This egg-laying activity begins in July and continues through early October. When laying each egg, the female makes a tiny puncture in the fruit and inserts the egg just below the skin. This initial fruit damage is easily overlooked, but eventually leads to fruit dimpling (fig. 2).



Fig. 1. Apple maggot adults.



*Fig. 2. Damage from apple maggot egg-laying activity.*



*Fig. 3. Apple maggot larvae.*



*Fig. 4. Fruit damage created by tunneling apple maggots.*

Apple maggot eggs hatch in 3 to 7 days as small (less than  $\frac{1}{16}$  inch), cylindrical, cream-colored larvae known as maggots. Maggots lack legs and visible head capsules, but have dark mouth hooks that protrude from tapered heads (fig. 3). As apple maggots tunnel through the apple flesh, they leave characteristic winding brown trails (fig. 4) that are best seen when the fruit is cut open (fig. 5). The first indication that a backyard apple tree is infested with apple maggot occurs when the homeowner discovers these brown trails in fruit at harvest. The maggots measure  $\frac{1}{4}$  inch long when fully mature. Fruit damaged by apple maggot becomes soft, rotten, and often drops from the tree.

The apple maggot has one generation per year. Mature larvae exit the fruit, drop to the ground and overwinter as pupae in the soil under the infested tree. In early summer, apple maggot flies emerge from the soil and forage in the host tree canopy. There they feed on honeydew, bird droppings, and other sticky, sugary substances. An apple maggot fly measures  $\frac{1}{4}$  inch long. It has a black body, dark red eyes, black and creamy-white striped abdomen and a white spot on the thorax between the pair of transparent wings (fig. 1). The black banding pattern on the wings is a key character to distinguish apple maggot from other fruit flies. The one exception is a snowberry maggot that feeds on snowberry bushes, but not on apples. Experts rely on microscopic examination to distinguish the apple maggot fly from the adult fly of the snowberry maggot.

## **Apple Maggot Quarantine Program**

The apple maggot fly has expanded its range to areas in Washington State, California, Idaho, Oregon, Utah, and Colorado. Apple maggot is established in 17 western Washington counties and in Kittitas, Klickitat, Skamania, and Spokane counties in central and eastern Washington. To prevent apple maggots from spreading to other counties, local authorities rely on early detection and immediate eradication programs. Washington State Department of Agriculture (WSDA) and local Horticultural Pest and Disease Boards monitor apple maggots throughout Washington State.

Authorities suspect that the apple maggot is transported and spread as maggots or eggs within infested fruit. To prevent further spread, quarantine areas are established around counties that have known apple maggot infestations. Highway signs posted along



*Fig. 5. Cross-section of an apple infested with apple maggot.*

some Washington routes read: “Apple Maggot Quarantine Area/ Do not transport homegrown tree fruit” (fig. 6). These signs are part of an educational effort to discourage homeowners and consumers from transporting backyard apples and fruits that may be infested with apple maggot. It is illegal for anyone to carry backyard or noncommercial tree fruit north into western Canada, south into Oregon or across the Cascade Mountains into the apple-maggot-free areas of eastern and central Washington. For more information on these quarantine programs, contact the WSDA at 1-509-225-2609.



*Fig 6. Apple maggot quarantine sign along highway.*

### **Proper Pest Identification**

Since apple maggot is not established in all counties in Washington State, this insect may not be a problem in your county. Contact your local WSU Extension office to find out if you need to protect your backyard tree from apple maggot. Or, you may wait until you first detect damage characteristic of apple maggot in your backyard apples before initiating a control program. If the apple maggot fly has not been confirmed in your county, and if you have not seen apple maggot damage to your backyard apples, please take captured fruit flies or infested fruit to your local county Extension office for proper identification.

In the Pacific Northwest, only two key pests tunnel into apple fruit: the codling moth and the apple maggot. Properly identifying these two pests will help you protect your fruit. The larvae of codling moth are pinkish or cream-colored “worms,” which have distinct black or dark brown heads and six claw-like legs (fig. 7), while apple “maggots” are white, headless and legless (fig. 3). Codling moth larvae tunnel straight to the core of an apple (fig. 7), often leaving granular brown excrement around the entry holes (fig. 8).



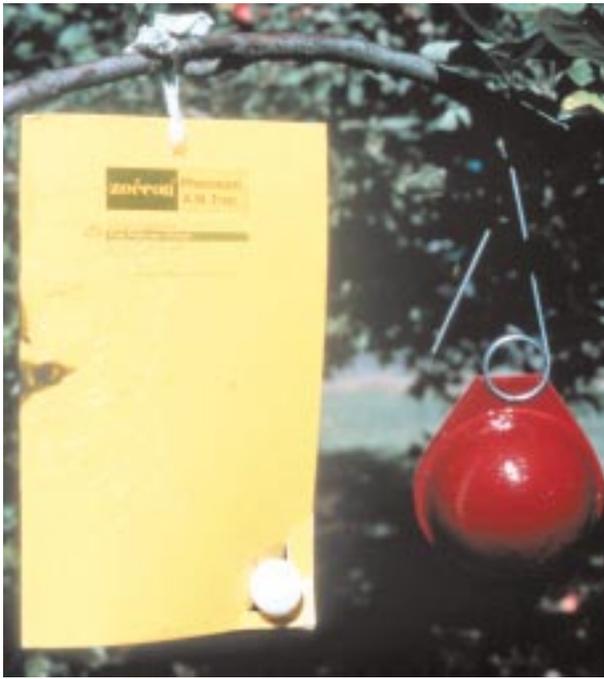
*Fig. 7. Codling moth larva tunnels to apple core.*



*Fig. 8. Codling moth larvae leave granular brown excrement around entry hole.*

### **Monitoring Apple Maggot Flies**

Soil temperatures, soil types, rainfall, geographic location, and topography affect when apple maggot flies emerge from their over-



*Fig. 9. A yellow rectangular sticky trap with an ammonia lure or a red spherical sticky trap work best for trapping apple maggot flies.*



*Fig. 10. Apple maggot and other flies captured on a yellow sticky trap.*

wintering sites in the soil and fly into apple trees. Typically, growers and home-owners monitor for apple maggot flies to time their insecticide spray program. Most spray programs start within one week after the first apple maggot fly is captured.

One practical and effective way to monitor apple maggot flies is to hang yellow, rectangular sticky traps in your tree (fig. 9). The yellow color attracts flies over short distances,

and the flies become trapped by the sticky substance. Other types of sticky traps include red spherical traps that resemble apples. Improve trapping efficacy by using ammonia extracts or fruit essences as fly lures. In late June, hang these traps on the apple tree at eye level in the tree foliage. Tightly secure the traps to keep them from excessive swinging in the wind. Trim back foliage and any fruit within 12 inches of the trap to increase trap efficacy. Check the traps daily for adult flies. Since these traps attract many flies, be sure to familiarize yourself with the distinct wing pattern, body size and color of the apple maggot fly (fig. 10). These traps will eventually lose their tackiness. Replace them every 3 to 4 weeks. Depending on brand used, change the lure at regular intervals also.

### **Timing Critical for Effective Management**

The traditional approach to protecting apples from apple maggot has been spraying backyard trees with organophosphate insecticides. Since apple maggot spends most of its life cycle protected within the fruit or buried in the soil, the insecticides must be timed to coincide with adult fly activity. Apple maggot flies are active from late June to October. Apply the first insecticide spray within 7 days of trapping the first adult on yellow sticky cards. Repeat applications every 7 to 14 days until preharvest, or more frequently if it rains. It is not necessary to reapply an insecticide if no more apple maggot flies are captured on traps after 3 to 4 weeks. Observe the preharvest interval (time interval between last spray application and fruit harvest) on the insecticide label. This interval will prevent unacceptable pesticide residues on your harvested fruit.

Public concerns about misuse and over-use of pesticides have led to the removal of most organophosphate insecticides available to homeowners from the market. Diazinon was a widely recommended product for homeowners to control apple maggot, but all diazinon labels were removed from retail

markets at the end of 2004. Other organophosphate insecticides, such as the malathion products, may still be available to homeowners. Insecticides containing carbaryl or esfenvalerate may also be available, but these products will require weekly applications to protect your fruit from adult flies. Check with your WSU Extension office for a list of products currently available for homeowners to use for apple maggot control.

## Management with Kaolin Clay

One product homeowners may consider using for control of apple maggots is a kaolin clay (Surround At Home®). This clay product is not a true pesticide and is not toxic to apple maggot or other insects. These products form a barrier film that irritates insects and disguises the host. Insect pests avoid the kaolin-treated trees and fly to other potential host trees. Kaolin clay works best when the visible film barrier is established over the entire tree before fly activity begins. Begin applying kaolin clay by late June and reapply every 7 to 14 days, or more frequently if it rains, to maintain a good visible film on the apples (fig. 11). You can monitor apple maggots with sticky cards and begin applying kaolin at first fly catch. Apply Surround At Home® at a rate of 1/2 pound (about 3 cups) per gallon of water and spray onto tree until the product begins to drip from the leaves. Use enough product



**Fig. 11.** A visible kaolin clay film must cover apple to be an effective insect deterrent.

at this concentration to cover the entire tree. While applying kaolin, agitate the mixture in the sprayer often and use caution to prevent drift to nearby plants and areas. Kaolin clay can be applied up to the day the fruit is harvested. Wash the white residue off the fruit with a power sprayer or use a brush under running water.

Kaolin clay products will suppress a broad range of insects that feed on apple leaves and apple fruit, including codling moth and leafrollers. Homeowners may consider applying kaolin clay as early as petal fall and continue on a 7- to 14-day schedule to protect apples from other insect pests. **Caution:** *kaolin clay does not kill insects; they can fly to adjacent fruit trees.*

## Other Management Strategies

The easiest management strategy to control apple maggot would be to avoid planting or growing apple trees in your backyard. Since apple trees are commercially grown throughout the Pacific Northwest, apples are readily available to consumers. In Washington State, homeowners have a legal responsibility to manage insect pests that may reside on their backyard fruit trees. Homeowners not willing to protect their fruit trees from apple maggots and other pests should remove all fruit trees from their residential property.

At low fly populations, the same sticky traps used to monitor apple maggot flies may be used to trap out invading flies. Place one trap in each small apple tree (less than 8 feet tall), two to four traps on medium-sized trees or six to eight traps on standard-sized apple trees (20 to 25 feet tall). You will need to scrape any flies or insects from the trap weekly. Replace these traps or recoat them using the sticky insect adhesive every 3 to 4 weeks. At high fly populations or when fruit in the tree is already infested with maggots, these sticky traps alone will not ensure adequate protection of your crop from the apple maggot.

Backyard sanitation is one of the most effective management strategies homeowners can adopt. Homeowners should remove or

treat any alternate hosts for apple maggot including crab apples, ornamental hawthorns or other fruit trees. Although apple maggots are not strong fliers, any wild or untreated hosts within  $\frac{1}{4}$  to  $\frac{1}{2}$  mile can serve as a source for apple maggots in your backyard. Regularly inspect fruit while it is on the tree, removing and destroying any insect-infested fruit. Do not dispose of these infested fruit onto the ground. Apple maggot will continue to develop inside the dislodged fruit and then

pupate in the soil. Pick up and destroy fallen apples at weekly intervals from early August to harvest.

To make backyard sanitation easier, homeowners should plant apple trees grafted onto dwarfing rootstocks such as M9 or M26. Dwarfing rootstocks will produce smaller trees (less than 12 feet tall). Smaller trees are easier to spray, easier to search to inspect the fruit, and easier to harvest at the end of the season. Smaller trees require minimal ladder use.

### **Authors:**

**Michael R. Bush**, Ph.D., Washington State University Extension educator, WSU Yakima; **Michael W. Klaus**, M.S., Pest Biologist II (Entomology), WSDA Yakima; **Arthur Antonelli**, Ph.D., WSU Extension entomologist, WSU Puyallup; and **Catherine Daniels**, Ph.D., WSU pesticide coordinator, WSU Tri-Cities.

### **Photo courtesies:**

Figures 1 & 4,—*Integrated Pest Management for Apples & Pears*, by B. L. P. Ohlendorf, Univ. CA Statewide IPM Project, Davis, CA, 1999;

Figures 2, 5, 7, 8, & 9—*Orchard Pest Management: A Resource Book for the Pacific Northwest*, Edited by E. H. Beers et al., published by the Good Fruit Grower, Yakima, WA, 1993;

Figure 3—Anon., WSU Extension;

Figures 6 & 10—Michael Klaus, WSDA;

Figure 11—John Mosko, Englehard Corp.





College of Agricultural, Human, and Natural Resource Sciences

**Use pesticides with care.** Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Copyright 2002 Washington State University

WSU Extension bulletins contain material written and produced for public distribution. You may reprint written material, provided you do not use it to endorse a commercial product. Alternate formats of our educational materials are available upon request for persons with disabilities. Please contact the Information Department, College of Agricultural, Human, and Natural Resource Sciences, Washington State University for more information.

Publications are available online <http://pubs.wsu.edu> or from the WSU Bulletin office, 1-800-723-1763.

Issued by Washington State University Extension and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, national or ethnic origin; physical, mental or sensory disability; marital status, sexual orientation, and status as a Vietnam-era or disabled veteran. Evidence of noncompliance may be reported through your local Extension office. Trade names have been used to simplify information; no endorsement is intended. Replaces EB1320 and EB1603. Revised March 2005. C. Subject codes 352, 235. EB1928