

# Control of Apple Maggot in Commercial Apple Orchards in BC

Effective protection of commercial orchards from apple maggot (*Rhagoletis pomonella*) infestations requires an understanding of the pest's life cycle, recognition of the pest and its damage, an awareness of its presence and abundance, and area-wide cooperation of all host tree owners to apply control products in a timely and proper fashion. This fact sheet provides information to help apple growers prevent apple maggot from infesting their orchards, and how to protect the fruit once the pest is detected in their orchards. Descriptions and links to the many web sites describing apple maggot, as well as all other apple pests, are available through the BC Ministry of Agriculture & Lands Infobasket – Tree Fruits at <http://infobasket.gov.bc.ca/portal/server.pt>

## Life Cycle of Apple Maggot

This description of the apple maggot life cycle is based on information from Washington State University<sup>1</sup> which should be very similar to that of apple maggot populations in the Lower mainland. As of 2006 the apple maggot had yet to be detected in the BC Southern Interior.

The pest overwinters as pupae under host trees. Primary hosts of apple maggot are apple (*Malus* spp.), crabapple (*Malus* spp.) and hawthorn (*Crataegus* spp.). However, recent research<sup>2</sup> from Washington State found apple maggot also attacks Asian (*Pyrus serotina*) and common pear (*Pyrus communis*), bitter cherry (*Prunus emarginata*), garden plum (*Prunus domestica*) and spreading cotoneaster (*Cotoneaster divaricatus*). Sour (*Prunus cerasus*) and sweet cherry (*Prunus avium*) were not found to be hosts in Washington State<sup>2</sup>, but were in Wisconsin<sup>3</sup> and Utah<sup>4</sup>. Adult flies begin to emerge in late June – early July and continue to emerge until early October. A small percentage of flies may not emerge for 2-3 years. Adults require 7 to 10 days to feed (aphid honeydew, bird droppings, other plant/insect exudates) and become sexually mature in order to mate and lay eggs. Females are attracted to ripening fruit to lay eggs and will move between hosts as the fruit ripens. This also applies to apple varieties that ripen at different times. Each female can lay a total of up to 500 eggs over its life time of 2- 4 weeks. Eggs are laid singly just under the skin and hatch in 3 – 7 days. The larvae (maggots) burrow through the fruit before maturing in 13 to 50 days, depending on temperature. Mature larvae leave the fruit, usually after it has dropped to the ground, and burrow into the soil to overwinter. Any larvae in unharvested fruit in the fall are not likely to survive the winter.

## Recognizing Apple Maggot Damage and Larvae

Small dimples and depressions will appear where females insert their eggs under the skin of the fruit (Fig. 1). Apples infested early in the season will appear bumpy as they mature. Larval feeding damage appears as distinctive brown tunnels meandering through the flesh of the fruit (Fig. 2). Heavily infested fruit can become mushy and prematurely drop.



Fig. 1 External evidence of infested fruit.

Photo credits: Agriculture & Agri-Food Canada, Research Branch, Ottawa

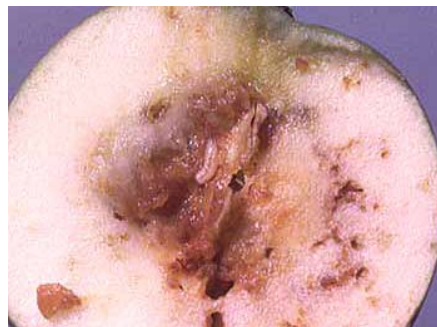


Fig. 2 Larva and internal feeding damage.

The injury can be confused with that of codling moth (*Cydia pomonella*) and the lesser appleworm (*Grapholitha prunivora*). Codling moth larvae create one or two tunnels through the flesh to the core where they feed on the seeds and inner fruit tissue which often becomes moldy. There is usually only one larva per fruit. The smaller lesser appleworm larvae generally enter the fruit through the calyx end where they create shallow tunnels in the fruit as they feed.

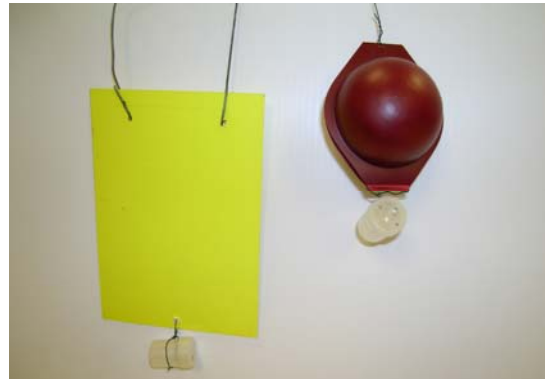
Both codling moth and lesser appleworm larvae have distinctive brown to dark brown heads and six legs; apple maggots have no head capsule or legs, and have a wedge-shaped body with two small black hooks extending from the pointed 'head' end when feeding.

## Monitoring Apple Maggot

Monitoring adult apple maggots (Fig. 3) involves setting out ammonium carbonate-baited yellow sticky panels or sticky plastic red spheres in host trees before mid-June\*. Ammonium carbonate (AC) is available from most pharmacies. Place about 5 mL (1 tsp) of the AC bait in a small container (film canister, pill vial), and puncture the lid to allow ammonium vapour to escape. Suspend the AC container from the trap and replace every 7 to 10 days (or when vapour-release ceases).



*Fig. 3 Adult apple maggot*  
Photo credit: Agriculture & Agri-Food Canada,  
Research Branch, Ottawa



*Fig. 4 Apple maggot traps baited with ammonium carbonate.*

The red plastic spheres (Fig. 4) are specific for apple maggot whereas the yellow panels will attract flies with wing patterns that resemble apple maggot (Fig. 5). Snowberry maggot wing pattern is identical to that of apple maggot, so red spheres are recommended where snowberry shrubs are present. Red spheres are more attractive to sexually mature flies seeking ripening fruit whereas yellow panels are attractive to immature flies seeking leaves in search of food.

For commercial orchards, place the traps at intervals of 45 m along the orchard margins. Traps can be set inside the orchard to confirm if infestations are present which will affect the design of a control program. Set the traps in the outer 1/3 of the tree canopy, and remove all foliage within 30 – 45 cm to increase trap exposure. Place the traps 2-3 rows inside any border adjacent to dusty roads. Earlier detection of apple maggot presence surrounding non-infested orchards can be done by placing traps in host trees within 0.5 km of the orchard. Infested host trees within 0.5 km of an orchard place the orchard at high risk of becoming infested.

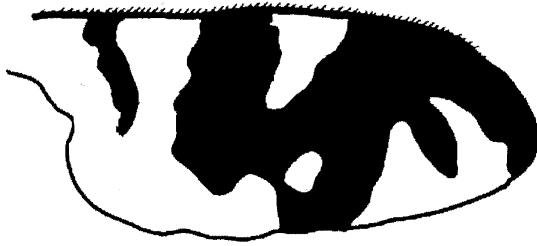
Check the traps every 2-3 days and carefully remove any suspicious specimens and place on a piece of cardboard or stiff paper. Refresh the sticky coating once it begins to lose its stickiness.



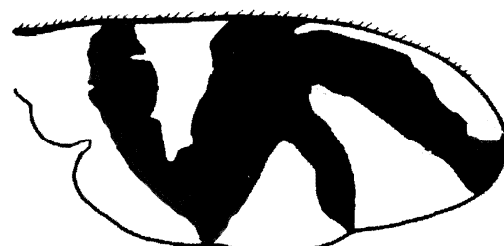
Walnut husk fly wing



Western cherry fruit fly wing



Black cherry fruit fly wing



Apple maggot wing

*Fig. 5 Wing patterns of other flies related to apple maggot*

Growers in the Lower Mainland and Vancouver Island (currently only infested regions in BC) can submit specimens to the BCMAL Plant Diagnostic Lab in Abbotsford (<http://www.al.gov.bc.ca/cropprot/lab.htm>) and for a nominal fee have the identification confirmed. Growers in the non-infested BC Interior can also submit specimens to the Plant Diagnostic Lab free of charge or to the BCMAL office in Kelowna, or to any Canadian Food Inspection Agency office.

**\* Trap suppliers:**

Yellow panels – Phero Tech International (<http://www.pherotech.com/>)

Red spheres – Great lakes IPM (<http://www.greatlakesipm.com/>)

## **Control Recommendations for Apple Maggot**

Chemical Control - Apply one of the products listed in Tables 1 and 2 within 7 days of first fly capture and repeat at intervals as recommended on the product labels (usually every 10-14 days). **It is important to keep the fruit protected as long as flies are captured.** If no flies are captured within 14 to 21 days after first fly capture, do not treat again until the next fly is captured. If flies are only captured in perimeter traps, the insecticide need only be applied to the outer 2 – 4 rows and 4 – 5 trees at each row end along the borders where the flies were captured.

Insecticides applied against second generation codling moth in late July and August will give protection against apple maggot for 10 – 14 days depending on the product. It is important to consider the pre-harvest intervals when selecting a control product because the application will be made as the fruit nears maturity, the favoured time for apple maggot attack. Read and carefully follow label instructions.

**Table 1. Control products recommended for control of apple maggot in orchards under conventional production**

Trade Name	Active ingredient	Application Rate per ha	Residual Control (days)	Pre-harvest Interval (days)
Calypso 480 SC	thiacloprid	440 mL	7 - 14	30
Diazinon	diazinon	5 L 50% EC 4.75 kg 50% WP	7	14
Imidan WP	phosmet	3.75 kg	10	1
Sevin XLR	carbaryl	6.25 L	6	11
Surround WP	kaolin clay	25-50 kg	7 - 14	0
Zolone Flo	phosalone	3.0 L	10-12	30

**Table 2. Control products recommended for control of apple maggot in orchards under certified organic production**

Trade Name	Active ingredient	Application Rate per ha	Residual Control (days)	Pre-harvest Interval (days)
Surround WP	kaolin clay	25-50 kg	7 - 14	0

Non-chemical Control – Remove any unmanaged, wild or unsprayed trees within 500 m of an orchard to eliminate outside sources of apple maggots. Inspect orchard regularly for signs of apple maggot infestation and fallen apples, especially along margins nearest backyard or wild host trees. Infested fruit should be destroyed or buried >30 cm before the larvae leave the fruit to hibernate in the soil.

Research in Quebec<sup>5</sup> has demonstrated that baited sticky red spheres or yellow panels with centre red sphere hung at 10- m intervals along the margins of non to low infested orchards will protect the orchard by intercepting females immigrating from nearby infested sources. This tactic is called perimeter trapping. Similar results have been demonstrated in New England using insecticide-treated spheres. However this control tactic has not been investigated thoroughly in western North America.

Do not store fruit bins under host trees to avoid risk of contaminating the bins with larvae or pupae and risk spreading the pest to non-infested areas. Empty bins should not be returned to non-infested areas unless pressure-washed to remove any larvae or pupae.

## References

1. Orchard Pest Management. 1993. EH Beers *et al.* eds. Good Fruit Grower, Yakima, WA
2. Yee, WL, and R Goughnour. 2006. New host records for the apple maggot, *Rhagoletis pomonella* (Diptera: Tephritidae) in Washington State. Pan-Pacific Entomologist 82(1): 54 – 60.
3. Shervis, L.J. et al. 1970. Infestation of sour cherries by apple maggot: confirmation of a previously uncertain host status. Journal of Economic Entomology 63: 294-295.
4. Jones, V.P. et al. 1989. Phenology of apple maggot (Diptera : Tephritidae) associated with cherry and hawthorn in Utah. Journal of Economic Entomology 82: 788-792.
5. Bostanian, NJ *et al.* 1999. Managing apple maggot, *Rhagoletis pomonella* (Diptera: Tephritidae), by perimeter trapping. Phytoprotection 80(1):21-33

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