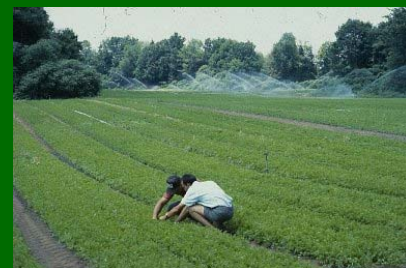




# HORT MATTERS



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## Snowy white orchards in July? Battling woolly apple aphids

*Kathryn Carter, Apple IPM Specialist*

Over the past few weeks woolly apple aphid (WAA) (*Eriosoma lanigerum* Hausmann) populations have been increasing dramatically in Ontario apple orchards. Woolly apple aphids are first seen on pruning cuts and on wounded limbs. Their populations can increase quickly and the insects spread to water sprouts and succulent tissue. Over the past few years we have seen an increase in the incidence and severity of woolly apple aphids in apple orchards.

The WAA nymph passes through four instars, changing in size from 0.6 mm long to 1.3 mm long. The nymphs are dark reddish-brown with a bluish-white waxy covering that becomes more extensive in the later instars (Fig 1). This waxy coating help to protect the aphid from predators and pesticide sprays.



Figure 1 Woolly apple aphid colony on apple terminal

WAA is a sucking pest that feeds on the tree, weakening it and forming galls on twigs or roots. These aphids also produce honeydew, which causes black sooty mold to form on fruit and leaves. The wax and the honeydew are bothersome to pickers when it brushes off the tree and onto clothing.

Reproduction by WAA may be either sexual or asexual, depending on the host plant. WAA overwinters as an egg on elm (produced via sexual reproduction) or as an immature nymph (apple). The eggs are laid in cracks of elm tree bark in the fall and the eggs hatch in the spring. Overwintering nymphs hibernate underground on apple roots if elm trees are not nearby. On elm, first and second generation nymphs are wingless and they begin feeding on buds during May and June. The third generation of WAA is winged and migrates to apple, hawthorn or mountain ash. The aphids establish new colonies there, and repeated generations are produced during the summer.

Most WAA born on apples are produced without mating. Female aphids give birth to large numbers of nymphs. First instar nymphs are very active crawlers and in the spring disperse to initiate aerial colonies. They can also be moved by wind from tree to tree within an orchard. When an established colony becomes crowded winged adult females are produced.

In the fall, some nymphs develop into wingless males that mate with wingless females. Each mated female then lays a single egg in the bark of elm trees. Sexual reproduction is believed to occur only when elm grows near other hosts; sexual forms of woolly apple aphid and eggs are rarely produced on apple trees. Due to the disappearance of American elm trees (Dutch elm disease), WAA now lives on apple trees throughout the year.

From petal fall through the summer orchard should be monitored for WAA colonies on sprouts, new growth and pruning cuts. There is no threshold for WAA, however controls should be applied if colonies are present in the fruiting area. It is often difficult to manage WAA due to their thick waxy coating. The best options for control are Diazinon, Thiodan, and Zolone. Be sure to use high water volumes (at least 70 US gal/ha or preferably more). Some export programs may have restrictions on the frequency or use of these products, so be sure to check with your packer before using these products.

Some pesticides (pyrethroids and carbamates) encourage outbreaks of WAA, so they should be used sparingly. Although some reports have indicated that the increase in WAA populations may be a result of reducing the use of broad spectrum insecticides in orchards. In Australia, researchers found that in a conventional spray program using Guthion for codling moth, the level of woolly aphid infestation increased with each successive season and biological control was not established (Nicholas *et al.*, 2005). However when Guthion was not used in orchards, natural enemies migrated in and provided control of woolly aphids within one season. Researchers found that the European earwig (*Forficula auricularia* L.) was the primarily responsible for WAA control, and in combination with the parasitoid *Aphelinus mali* (Haldeman) reduced woolly aphid infestations below the action threshold set by commercial growers. When earwigs were excluded, commercially acceptable control of woolly aphid was not achieved, even if other natural enemies (parasitoids, lady beetles, lacewings, hoverflies) were present. The relative importance of earwigs in Ontario apple orchards has not been evaluated.

### Reference

Nicholas, A., R. Spooner-Hart, R. Vickers. Abundance and natural control of the woolly aphid *Eriosoma lanigerum* in an Australian apple orchard IPM program. *BioControl* 50: 271-291.

## Sanitation of fruit and vegetable storages

*Dr. Jennifer DeEll, Fresh Market Quality Program Lead*

Sanitation is critical for the control of bacteria and fungi in packinghouses and cold storages. Therefore, cleaning and disinfecting all parts of the warehouse and storage rooms is required each season. These include: 1) floors, walls, ceilings, doors, and structural beams; 2) refrigeration system components; 3) electrical wires and light fixtures; and 4) air and water pipes, ducts, channels, grates and drains.

The following summary is modified from the Agriculture and Agri-Food technical bulletin: *Hygiene Measures in Fruit and Vegetable Storage Warehouses*. 1999 E. V. Toussaint, A. Ouimet, O. Carisse, J. DeEll, and C. Vigneault. 4 pp. [http://res2.agr.ca/stjean/publication/bulletin/hygiene\\_e.pdf](http://res2.agr.ca/stjean/publication/bulletin/hygiene_e.pdf)

**Cleaning** - Debris on the floor can generally be removed by sweeping. However, vigorous brushing may be required for debris that is on the walls and ceiling. Any remaining dirt and organic matter should be removed with water and detergent. It is important to scour surfaces well enough to dislodge any ground-in dirt. High-pressure washing with a non-foaming industrial detergent is often the easiest method. For safety reasons, electrical systems and motors that are not waterproof should be covered. Cleaning is important because organic matter impedes and/or neutralizes the action of disinfectants. In addition, cleaning removes the substrates that can promote the growth of pathogens in the storage rooms. However, many pathogens will not be removed by simple cleaning and thus disinfectants are required.

**Disinfecting** – Information on the disinfectants approved for use in Canada is presented in Table 1. Special care should be taken if there is a high rate of contamination, as disinfectants destroy only pathogens on the surfaces. The conditions of application and contact time must be followed exactly in order for any disinfectant to be effective. It is also important to follow the recommended time between disinfectant use, airing of storage rooms, and entry of apples. To give storage rooms a good airing, the doors should be opened and outside air forced in. Storage rooms must be thoroughly ventilated for several days after the use of disinfectants and precautions should be taken to avoid anyone coming into contact with these products by mistake. Disinfectants are often irritating and thus to avoid discomfort and health problems, protective equipment and clothing should be worn when using them, e.g. safety glasses, breathing mask, and waterproof garments. Activated-carbon air filter prevent odors from developing in the storage rooms. It has been suggested that fungicide-based paint be applied to walls for additional protection (Phillips et al., 1979; Lidster et al., 1988). Ozone and UV radiation are not effective at disinfecting storage rooms. Leaving bins, pallets, and other equipment out in the sun and/or strong wind will partially disinfect them. Fumigants can be used to reach the small hidden corners that cannot be reached by conventional methods. However, this method is only effective when used with wet surfaces.

Table 1: Disinfectants approved in Canada for cleaning of fruit and vegetable warehouses (adapted from *Toussaint et al., 1999*)

Compound	Bactericide/ Fungicide activity	Inactivated by organic matter	Corrosive	Solution	Exposure time (minutes)	Advantages	Disadvantages
Hypochlorides (Javex)	Effective/ Effective	Yes	Yes (esp. metal)	10 L per 90 L H <sub>2</sub> O	10	Quick action, low cost	Odors, irritant, solution must be changed often, discolors some material, pH sensitive, rinsing is necessary
Quaternary ammonium (10% a.m.)	Very effective/ Effective	Slightly	No	8-24 mL per L H <sub>2</sub> O	10	Effective at low temp, can be combined with detergents	Cannot mix with other products, rinsing needed
Phenolic compounds (hospital disinfectant)	Very effective/ Very effective	Slightly	No	See label	10	Residual action	Non-volatile residues, rinsing is necessary
Formaldehyde 37% solution	Very effective/ Slightly effective	Yes	No	4 L per 100 L H <sub>2</sub> O	30	Broad spectrum action	Noxious to humans, toxic fumes, must air out room after use, unpleasant odor remains, irritant

*Rinsing* - The use of some disinfectants result in off-odors, which may result in unpleasant tasting fruit after storage. In addition, the long-acting effect of certain disinfectants can corrode materials within the storage structure and equipment. Therefore, proper rinsing is essential when disinfectants are used. Rinsing involves thoroughly spraying all surfaces treated with disinfectants, starting with high areas so that the residues run down to the floor. Any stagnant water must be removed and it is essential to use water of drinking quality so that the storage will not be re-contaminated.

*Drying* - The goal of drying is to eliminate humidity, which provides ideal conditions for the development of molds and storage rots. If the disinfectant used does not require rinsing, then drying takes place immediately after disinfecting. Drying involves removing any surplus water and giving the storage rooms a good airing. If outside conditions are hot and dry, then outside air can be forced inside. Maintaining a high temperature and low humidity in the off-season can help to reduce the growth of pathogens in the storage.

\*\* For more detailed information on active ingredients and allowable concentrations please refer to the following document by Health Canada [http://hc-sc.gc.ca/dhp-mps/prodpharma/applic-demande/guide-ld/cat-iv-mono/surfac\\_cat4\\_e.html](http://hc-sc.gc.ca/dhp-mps/prodpharma/applic-demande/guide-ld/cat-iv-mono/surfac_cat4_e.html)