



## Apple Aphids

Diane Alston, Entomologist • Michael Reding, Entomologist<sup>1</sup> • Marion Murray, IPM Project Leader

### Do You Know?

- Aphids are common, secondary pests of apples, but infestations resulting in economic loss are uncommon, except for woolly apple aphid.
- Aphids overwinter as eggs on tree limbs, or as nymphs on roots and/or limbs.
- Application of dormant oil plus an insecticide at delayed dormant stage (half-inch-green) may provide season-long control of green and rosy apple aphids.
- The best timing for woolly apple aphid control is petal-fall with a systemic insecticide, or during the summer with an effective contact insecticide.
- Established trees can generally tolerate moderate to heavy infestations without loss of production or vigor; control of aphids on young trees is more critical.



Fig. 2. Rosy apple aphids.<sup>3</sup>

roll and curl, protecting the aphids inside from natural enemies, weather, and pesticides (Fig. 4). Neither species typically harms established trees, but high populations can stunt young trees. The woolly apple aphid differs from the other two, in that it feeds in both the tree canopy and below ground on the roots. Canopy feeding is primarily on the succulent growth associated with stems, pruning wounds, root suckers, and leaf axils. Damage from woolly apple aphids is caused by aphids forming galls on roots (Fig. 11) and twigs (Fig. 12). In addition, all three aphids excrete a clear, sticky, sweet substance called honeydew. Economic damage may occur when aphids build up to levels where honeydew drips onto the fruit. The honeydew provides a site for the growth of the fungus that causes sooty mold, which can discolor fruit and cause russetting.

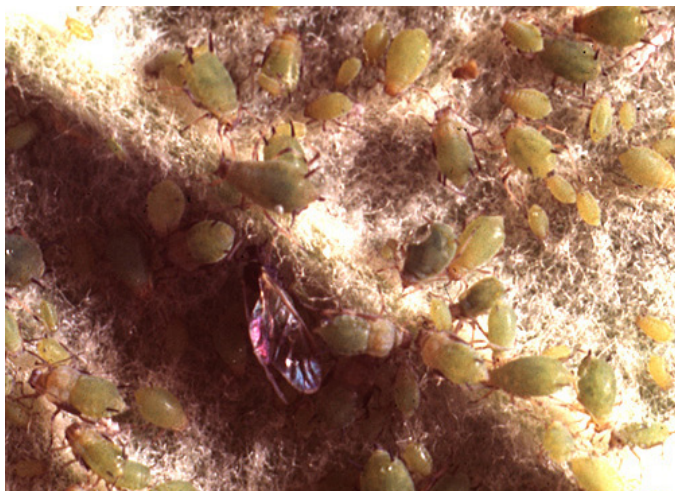


Fig. 1. Green apple aphids (note the black cornicles, or "tail pipes," on the abdomen).<sup>2</sup>

There are several species of aphids that infest apple trees in the western United States. Green apple aphid, rosy apple aphid, and woolly apple aphid are the three most common species on apples in Utah (Figs. 1, 2, and 3). The green and rosy apple aphids feed primarily on leaves and prefer the succulent growth of tender shoots. Their feeding causes leaves of the terminal shoots to



Fig. 3. Woolly apple aphids.

<sup>1</sup>USDA ARS, Wooster, OH

Aphids are secondary pests and although their colonies may be unsightly, their populations frequently do not build to economically damaging levels. Aphid densities often increase because of a reduction in their natural enemies due to toxic insecticide applications. Aphids have many natural enemies (Fig. 9) such as lady beetles, lacewings, syrphid flies, predaceous midge larvae, and predatory bugs, which can often keep aphid populations under control if they are not disturbed by broad-spectrum insecticide treatments.

## Green Apple Aphid

*Aphis pomi*



Fig. 4. Twisted leaves on apple shoot with green apple aphids.<sup>2</sup>

The green apple aphid is the most common aphid pest of apples in Utah. The green-colored young, called nymphs, begin to hatch from overwintered eggs (Fig. 5) as early as silver tip, but populations generally do not begin to build until late May to early June when shoot leaves are rapidly expanding. During spring and summer, females produce live young without mating. Aphids can complete a life cycle in as short as 1 week during the warm summer months. The short generation time and ability of these aphids to reproduce asexually allows them to rapidly increase their populations and feeding injury to apple trees (Fig. 6).

### HOSTS

apple and pear

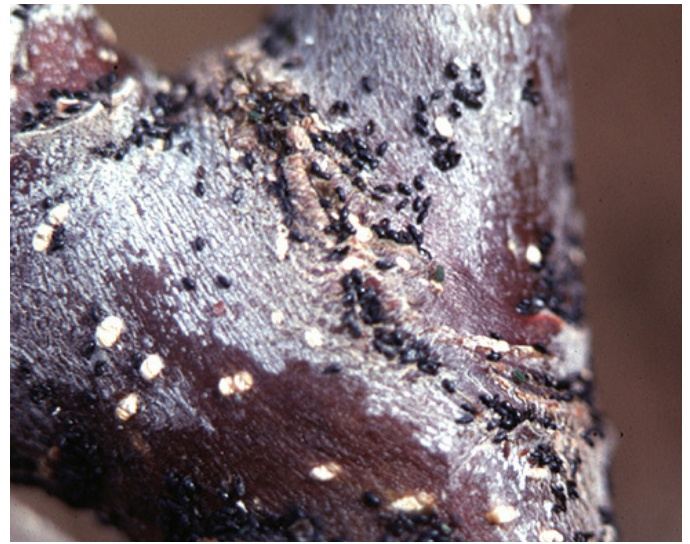


Fig. 5. Green apple aphid eggs on tree limb.

### LIFE HISTORY

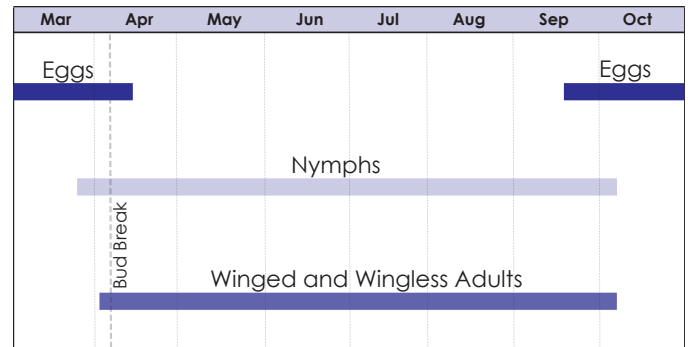


Fig. 6. Green apple aphid life history.

### Egg – Overwintering Stage

- **Size and color:** 1/50 inch long, shiny, black, and oval shaped (Fig. 5).
- **Where:** found on smooth twigs and water sprouts.
- **When:** eggs are laid in the late summer and fall.
- Green apple aphid eggs are difficult to distinguish from those of the rosy apple aphid.

### Nymph – Damaging Stage

- **Size, color, and shape:** about 1/16 inch long, yellow green to dark green, oval shaped with black cornicles (tail-pipes).
- Passes through five instars.
- **Where:** generally found on young shoots and watersprouts, primarily on the underside of leaves.
- **When:** from about budbreak through early October.

### Adult – Damaging Stage

#### Wingless

- **Size, color, and shape:** about 1/8 inch long, bright green with black cornicles (tail-pipes) and legs, oval shaped (Fig. 1).

- **Where:** generally found on succulent shoots and watersprouts, primarily on the underside of leaves.
- **When:** from about budbreak through early October.
- Those that hatch from overwintering eggs are all females and begin producing winged and wingless forms to start colonies.

### Winged

- This is the dispersal form and allows aphids to spread to other sites.
- **Size, color, and shape:** about 1/8 inch long, black head and thorax with a yellow-green abdomen, clear wings; body is narrower than wingless forms.
- **When:** during the same time as wingless forms, but may be more common early in the season.
- **Where:** generally found on succulent shoots and watersprouts, primarily on the underside of leaves.
- Through most of the season only female aphids are produced. These aphids give birth to live young and do not lay eggs. During late summer, male and female sexual forms are produced. These sexual forms mate and produce the overwintering eggs.

### HOST INJURY

- Generally, the visual appearance of apple aphids in trees is much worse than the injury caused by their feeding.
- Apple aphids prefer feeding on succulent tissue where they suck sap from the phloem.
- This feeding results in leaf curling and sometimes shoot curling (Fig. 4).
- Feeding by aphids does not harm established trees, but can stunt young trees.
- Honeydew produced by the aphids may drip onto fruit, which causes discoloration and provides a site for the growth of blackish-gray sooty mold.

## Rosy Apple Aphid

### *Dysaphis plantaginea*

This aphid is easily distinguishable from the green apple aphid by its rose-colored body (Fig. 2). Rosy apple aphids generally increase their populations during the spring, which is earlier in the season than green apple aphids. Their feeding causes leaves to curl and deforms shoots. When feeding occurs in fruit clusters, the toxic saliva, which is injected into the tree during feeding, stunts and distorts fruit growth (Fig. 7). These aphids migrate from apple trees to weed hosts in late June to early July (Fig. 8); therefore, controls for this species are not necessary in orchards during summer.



Fig. 7. Apple fruit distortion caused by rosy apple aphid feeding.<sup>2</sup>

### HOSTS

apple (winter and spring), plantain (summer), and dock (summer)

### LIFE HISTORY

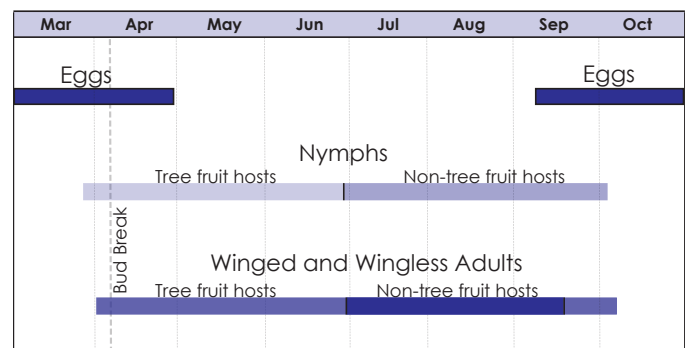


Fig. 8. Rosy apple aphid life history.

### Egg – Overwintering Stage

- **Size and color:** 1/50 inch long, shiny, black, and oval shaped.
- **Where:** found on smooth twigs and water sprouts.
- **When:** eggs are laid in the late summer and fall.
- Difficult to distinguish from the eggs of the green apple aphid.

### Nymph – Damaging Stage

- **Size, color, and shape:** about 1/16 inch long, rosy brown or purple with a dusty-white covering.
- Has long, rosy-colored cornicles (tail-pipes).
- Passes through five instars.
- **Where:** generally found on succulent shoots, watersprouts, and developing fruit clusters, primarily on the underside of leaves.
- **When:** from about budbreak through late June.

## Adult – Damaging Stage

### Wingless

- **Size, color, and shape:** about 1/8 inch long, rosy to purple with a dusty-white covering, oval shaped (Fig. 2).
- **Where:** generally found on succulent shoots and watersprouts, primarily on the underside of leaves.
- **When:** early bloom through late June.
- Those that hatch from overwintering eggs are all females and give birth to live young.
- Several generations are produced in spring and early summer.
- Each succeeding generation has a higher percentage of winged forms.

### Winged

- This is the dispersal form and allows aphids to migrate to summer weed hosts and back to apple orchards in the late summer to early fall.
- **Size, color, and shape:** about 1/8 inch long, brownish green to black and more elongate than wingless forms.
- **When:** most common from early June through early July.
- **Where:** generally found on succulent shoots and watersprouts, primarily on the underside of leaves.
- In early fall, winged adults migrate from weed hosts back to apple. These adults give birth to sexual females. Males also develop at this time. They mate with the females, which lay overwintering eggs.

## HOST INJURY

- Feeding by rosy apple aphids causes leaves to curl and deforms shoots.
- When feeding occurs in fruiting clusters, toxic saliva stunts and distorts fruit growth (Fig. 7).
- Root growth and photosynthesis may also be reduced.
- Damage is most severe on young trees.
- Rosy apple aphids produce copious honeydew which may drip onto fruit. Honeydew on fruit may cause russeting and provides a site for the growth of the blackish-gray fungus that causes sooty mold.

## TIMING CONTROL

### Green Apple Aphid and Rosy Apple Aphid Delayed-Dormant

One of the most opportune times to control both aphid species is at delayed-dormant (bud break up to half-inch-green). Horticultural oil plus an insecticide will kill most of the eggs and hatching nymphs. This treatment

generally provides optimum control of rosy apple aphids and additional treatments may not be needed. Clues that may indicate aphid control is necessary are high aphid populations the previous season and the presence of overwintered eggs on young apple limbs and twigs. Black aphid eggs (Fig. 5) can be observed during tree pruning and other spring activities.

Green apple aphids are more likely to become a problem later in the season than rosy apple aphids. If green apple aphid populations begin to increase, monitoring should be conducted to determine if treatment is necessary. Many factors can influence the amount of potential damage, such as tree structure and age, time of year, and apple variety.

## Summer Treatment Thresholds

### Green Apple Aphid

There are two basic methods which are commonly used for determining the need for treatment against green apple aphids in established trees during summer and early fall.

- 1) Randomly choose 10 shoots from each of 10 different trees and treat when 75% of the terminals are infested.
- 2) Randomly choose 10 shoots from each of 10 different trees and treat when an average of three leaves per shoot are infested.

Time of year and prevalence of natural enemies should also be considered when making a control decision. If it is mid- to late summer and natural enemy populations are building, then aphid controls are probably not economically justified.

## MANAGEMENT

### Green Apple Aphid and Rosy Apple Aphid

Delayed-dormant sprays are the first step in controlling green and rosy apple aphids (see "Timing Control" above). If during or following the flush of spring growth, aphid populations build or remain high, then additional controls may be necessary. However, established trees can tolerate fairly high aphid populations without loss of production or vigor (see "Summer Treatment Thresholds" above). Rosy apple aphids move from apple to their summer weed hosts by late spring to early summer, so controls for this aphid are unnecessary if populations in apple are already on a decline. Treatment thresholds for green apple aphid described above should be used to determine if this aphid is approaching levels of economic concern. However, in a young apple orchard, spring and/or summer aphid controls may be necessary to prevent stunting of tree growth.

Aphids prefer feeding on succulent shoots and their populations are more likely to build when there is abundant succulent tissue present in the orchard. Pruning and fertilization practices that minimize growth of water-sprouts and lush shoot growth should be used

to help manage aphids. Vigorous apple varieties that produce lush growth may be more prone to large populations of aphids. In most years, succulent shoots begin to harden off at the time when aphid populations begin to increase. This will slow down the rate at which the aphid populations increase and may be sufficient to prevent damaging population levels from developing.

## Biological Control

Aphids have many natural enemies including lady beetles (adults and larvae), lacewing larvae, syrphid fly larvae, predaceous midge larvae, and predatory bugs such as pirate bugs, damsel bugs, and campyloomma (Fig. 9).

The natural enemy complex often changes as the season progresses because some predators are more common early and some are more common later in the season. Also some are more tolerant of insecticides than others. Biological control can be disrupted by insecticides applied against other pests. When possible, use softer pesticides, because these materials are less likely to disrupt predator populations. Predator complexes are generally more diverse in sites where fewer insecticides are applied.

Scout for the presence of predators when assessing aphid densities in orchards. If natural enemies are present in the aphid colonies, re-sample in a week or so to see if the predators are providing control. Incidences of complete summer aphid control by natural enemies are common in Utah. Remember that established apple trees can tolerate moderate to large aphid populations, so give the natural enemies a chance to reduce aphid numbers and spray only as a last resort.



**Fig. 9.** Common predators of apple aphids, clockwise from top-left: ladybeetle adult and larva, lacewing adult and larva<sup>4</sup>, and syrphid fly adult and larva<sup>5</sup>.

## Insecticides

Insecticides can be very effective against aphids; however, repeated use of the same products has resulted in aphid resistance. Good coverage is important. Aphid feeding causes leaves to curl and within these curled leaves the aphids are partially protected from insecticides. The available materials which are effective are limited and some are very toxic to natural enemies. The limited variety of materials increases the possibility of aphid resistance. For these reasons, insecticide use should be limited.

### Recommended Chemicals:

- acetamiprid (Assail)
- azadirachtin (Ecozin, Aza-Direct)<sup>o</sup>
- chlorpyrifos (Lorsban<sup>®</sup>) – apply with oil at delayed dormant timing only
- clothianidin (Belay, Clutch)
- diazinon (Diazinon<sup>®</sup>)
- flonicamid (Beleaf)
- horticultural oil<sup>o</sup>
- imidacloprid (Admire Pro, Provado)
- insecticidal soap (M-Pede)<sup>o</sup>
- peppermint oil, rosemary oil (Ecotec)<sup>o</sup>
- pyridaben (Pyramite) – after petal fall only, suppressive
- pyriproxyfen (Distance)
- spirotetramat (Movento) – works best when applied at petal fall
- thiacloprid (Calypso)
- thiamethoxam (Actara, Flagship)

<sup>®</sup>Restricted use

<sup>o</sup>Organic formulations available

NOTE: Check preharvest interval and registered crops before using any of these chemicals. All brand names are registered trademarks. Examples of brands may not be all-inclusive, but are meant to provide examples of effective products registered in Utah.

## Woolly Apple Aphid

### *Eriosoma lanigerum*

The woolly apple aphid is native to North America. This aphid can be found in all apple growing areas in the United States and Canada. Several generations occur each year. The nymphs are produced asexually by mother aphids. Small colonies of nymphs may survive the winter on limbs, but most overwinter on roots and move onto limbs in June. Adults and immatures are reddish-purple in color with a white, waxy covering. From a distance, a colony of woolly apple aphids appears as mass of cotton on the tree (Fig. 3). This cottony mass is a result of long, white, filamentous, waxy secretions from the back of the adult aphids. This waxy mass protects

the woolly aphid from insecticides, weather, and natural enemies. Without chemical or natural controls, woolly apple aphids can increase to high numbers in apple orchards.

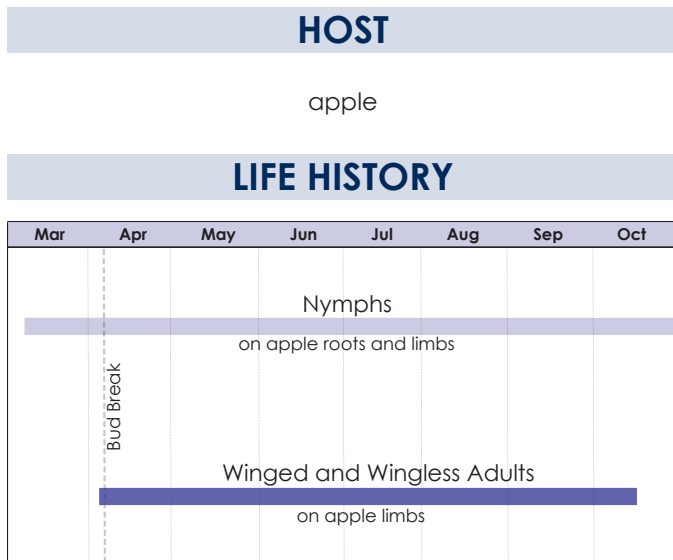


Fig. 10. Woolly apple aphid life history.

Woolly apple aphids (WAA) overwinter as nymphs on galls formed on apple tree roots (Fig. 10). During mild winters, some WAA may survive the winter in protected locations on above ground branches and stems.

### Nymph – Overwintering and Damaging Stage

- **Size, color, and shape:** size about 1/20 inch long, reddish to purple in color and covered with a white cottony wax.
- They pass through four instars.
- **Where:** 1st instar nymphs are considered the dispersal stage as they are the most active.
- This stage can migrate to tree limbs or roots to form colonies. When the nymph finds a suitable spot to feed, it settles down and begins a new colony.
- **When:** aphids which overwintered on the roots begin dispersing to tree limbs in June. Dispersal to the roots can take place anytime during the summer or fall.
- In large colonies, the nymphs are found beneath the adult females.

### Adults – Overwintering and Damaging Stage

- **Size, color, and shape:** adults are approximately 1/16 inch in length and reddish-purple and covered with a white cottony wax (Fig. 3).
- Adults observed on apple trees are females, males are rare.
- Females produce live young without mating.
- Egg production is rare, and is associated with their alternate host, the American elm. Eggs may not occur in western North America.

- Several generations of WAA occur during the summer.
- Winged adults are formed during mid to late summer. These winged adults disperse to new host trees.



Fig. 11. Woolly apple aphid induced galls on roots.



Fig. 12. Galls on twigs caused by woolly apple aphid feeding.

## HOST INJURY

WAA feeding on roots causes gall formation (Fig. 11). The galls increase in size over time as aphid feeding continues. The galls inhibit root function and under severe infestations can stunt or weaken the tree. Severe root infestations can kill young trees. Heavy infestation on aerial portions of the tree can cause twig galls (Fig. 12) and leaf yellowing. Canopy infestations can lead to honeydew deposits on fruit causing the growth of the fungus that causes sooty mold, and subsequent downgrading of fruit. Ruptured WAA stem galls can serve as infection sites for spores of *Cryptosporiopsis perennans*, the fungus that causes perennial canker on apple. This disease is rare in Utah. WAA colonies can also serve as a nuisance to pickers, as the crushed aphid bodies stain skin and clothing.

## TIMING CONTROL

Watch root suckers and pruning wounds in the lower part of the tree canopy for the cottony colonies starting in early to mid summer. Treatment thresholds have not been developed.

A systemic insecticide can be applied preventively at petal fall if a large population occurred in the previous year, or others can be applied if limb colonies begin to increase in the summer.

## MANAGEMENT

### Biological Control

In organic orchards, and those managed with minimal use of broad-spectrum insecticides, WAA populations are controlled by a number of natural enemies. The most important natural enemies are general predators such as green lacewing larvae, lady beetle adults and larvae, and syrphid fly larvae (Fig. 9). Flowering plants in or on the borders of orchards provide nectar and pollen, which helps maintain and attract natural enemies. Recent research in Washington state has shown that plantings of alyssum within or near apple orchards can attract natural enemies of WAA. In some apple growing areas, a small parasitic wasp, *Aphelinus mali* (Eulophidae) attacks WAA. In those orchards which have low to moderate populations of WAA, *A. mali* can provide good control. The use of broad-spectrum insecticides eliminates beneficial parasitic wasps from the orchard.

### Cultural Controls

If replanting or starting a new orchard, plant resistant rootstock. The Malling-Merton (MM) rootstock series, MM.106 and MM.111, have been bred to be resistant to WAA.

### Insecticides

To increase insecticide efficacy, it is recommended that a horticultural oil or other effective spreader-sticker be added to the tank mix to penetrate the waxy aphid covering. Refer to the insecticide label for adjuvant recommendations. Thoroughly cover the tree with the spray solution.

#### Recommended Chemicals:

- carbaryl (Sevin)
- diazinon (Diazinon<sup>®</sup>)
- endosulfan (Thionex<sup>®</sup> – 21 day PH1, 4 day REI)
- horticultural oil<sup>°</sup> – suppressive only; mix with other insecticides to aid spray in penetrating waxy covering on aphids
- spirotetramat (Movento) – systemic, apply at petal-fall for adequate uptake and translocation

<sup>®</sup>Restricted use

<sup>°</sup>Organic

NOTE: Check preharvest interval and registered crops before using any of these chemicals. All brands are registered trademarks. Examples of brands may not be all-inclusive, but are meant to provide examples of effective products registered in Utah.

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<sup>3</sup>Michigan State University

<sup>4</sup>University of Florida

<sup>5</sup>University of California

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