E-274-W

PURDUE UNIVERSITY

Fruit Insects

Department of Entomology

QUICK TIPS FOR MANAGING IMPORTANT INSECT PESTS OF FRUIT TREES IN INDIANA

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Several insect and mite pests feed on and damage fruit trees and their fruits throughout the growing season. This bulletin provides a brief overview of the biology and management of key pests that tree fruit producers may encounter in Indiana. For insecticide recommendations, please see the Midwest Fruit Pest Management Guide (ID-465-W) and Managing Pests in Home Fruit Plantings (ID-146-W) available through the Purdue Extension Education Store.

European Red Mite (*Panonychus ulmi*)
(see Purdue Extension Entomology bulletin E-258-W)

The European red mite (ERM) is a pest of pome and stone fruit trees, as well as nuts and berries. ERM overwinters as an egg in the bark around the base of buds and spurs. When active, they are typically found in the foliage, where they feed by piercing leaf tissue and sucking up the sap that oozes out. This feeding reduces chlorophyll content, limiting the ability of leaves to capture sunlight and produce sugar. Feeding damage appears as 'bronzing' of the leaves and when severe can lead to premature leaf drop, poor fruit color, reduced fruit size and quality, and reduced fruit set the following year.

Best management practices for this pest include: (1) applying dormant oil (with good coverage) prior to bloom, (2) scouting the orchard regularly after the 'petal fall' stage through August, and (3) using reduced risk insecticides to help conserve predatory mites that attack ERM.

Figure 1. European red mite adult and egg on leaf surface. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 2. Leaf bronzing caused by European red mite feeding. (*Photo credit: John Obermeyer, Purdue Entomology*)

Woolly Apple Aphid (*Eriosoma lanigerum*)

The woolly apple aphid is a small, soft-bodied insect with a piercing-sucking feeding strategy. While these aphids are infrequent, they are serious pests of apple trees when they appear. The 'woolly' descriptor in the name alludes to the waxy secretions produced by these insects, which protects them from predators. A colony will appear as a white, cottony mass on trees, but the aphids themselves are purple in color. These aphids colonize wound sites on apple tree trunks, limbs, twigs, and roots.

Wooly apple aphids feed above and below the ground; however, it is root feeding by belowground aphids that causes the most damage, particularly to young trees. Root feeding results in the development of galls that block the movement of nutrients, leading to tree stunting, uprooting, and even death. Yellow foliage, especially on young trees, may be a sign of root infestation by woolly apple aphid.

Best management practices for this pest include: (1) planting resistant rootstocks (MM 106 and MM 111), (2) monitoring pruning scars beginning at the 'pink stage' of bud development for presence of live aphid colonies, and (3) taking action when 10% of pruning scars are infested with aphids.

Figure 3. Woolly apple aphids and their waxy secretions on a cherry tree branch. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 4. A group of woolly apple aphids, concealed by their waxy secretions, on the end of a crabapple branch. (*Photo credit: John Obermeyer, Purdue Entomology*)

Rosy Apple Aphid (*Dysaphis plantaginea*)

The rosy apple aphid (RAA) is an important and serious piercing-sucking pest of apple. These aphids overwinter as eggs in tree bark crevices, bud axils, and twigs of apple trees. Eggs hatch after the 'silver tip' stage of development, with newly hatched aphids appearing dark green in color and transitioning to a purple color as they develop into adults. Rosy apple aphids continue to feed and reproduce on apple until mid-summer, at which point they migrate to other host plants to feed. The RAA is similar to the woolly apple aphid in feeding strategy; however, unlike the woolly apple aphid, it injects a toxin that curls leaves and distorts shoots and fruits.

Symptoms of injury typically present after the 'petal fall' stage of development and appear as tightly curled leaves that turn red and have dried, necrotic regions. These aphids attack all apple trees, with 'Cortland,' 'Ida Red', and 'Golden Delicious' cultivars exhibiting the highest susceptibility to injury. Even low levels of infestation by RAA can cause damage, so it is important to monitor and spot infestations as early as possible. This insect is best managed at the 'pink stage' of bud development, before serious leaf curl develops, because it is very challenging to achieve coverage with insecticides after leaves have curled.

Best management practices for this pest include: (1) making a delayed application of dormant oil between 'green tip' and 'half-inch green' growth stages to control newly hatched aphids, and (2) carefully monitoring leaf terminals for live aphid colonies so action can be taken when a threshold of 5% of apple leaf terminals infested (with any number of rosy apple aphids) is reached.

Figure 5. Rosy apple aphids and their white cast-off skins on the underside of an apple leaf. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 6. Damage caused by rosy apple aphid feeding on a young apple tree shoot. (*Photo credit: John Obermeyer, Purdue Entomology*)

San Jose Scale (*Diaspidiotus perniciosus*)

San Jose scale is an important piercing-sucking pest of apple, peach, plum, and pear trees. This insect can be found feeding on tree twigs, limbs, and fruits. During feeding, San Jose scale injects toxins that damage young wood and cause red, spot-like discolorations on fruit and twigs. If populations are not managed, this insect can kill tree limbs or entire trees in as little as 2-3 years.

Adult males are tiny, short-lived, and gnat-like in appearance, while adult females are wingless, sessile, and have a waxy protective scale-like covering. Because females give live birth to the immature stage, called 'crawlers', eggs are not seen. Immature crawlers are tiny, yellow, and mobile before settling down and secreting the waxy scale covering, at which point they become sessile. The adult male and crawler stages are so small that a hand lens is required to see them. This insect overwinters as an immature scale on the tree and there are typically two generations each year.

Best management practices for this pest include: (1) timing applications of dormant oil to suffocate overwintering scales, (2) using pheromone traps and degree day models to monitor male activity, and (3) applying insecticides to target the crawlers and immature scales.

Figure 7. Adult female San Jose scales under protective covering (dark gray) and removed from waxy protective covering (yellow). (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 8. An apple branch infested with San Jose scales. (*Photo credit: John Obermeyer, Purdue Entomology*)

Plum Curculio (*Conotrachelus nenuphar*)

Plum curculio is a small 'snout' beetle, or weevil, with a chewing-tearing feeding strategy. This beetle is damaging during both the adult and larval stage and will attack apples, peaches, pears, and cherries. Plum curculio overwinters as an adult among leaf litter in wooded areas. Adults first appear in orchards during bloom but are most active after 'petal fall' when temperatures are 70°F or higher. Adults are primarily active at night and feed on buds and flowers, as well as newly set fruit. When adults feed on newly set fruit, they cause a distinctive kind of distortion to its shape, called 'cat-facing'.

Females chew 'c-shaped' wounds on fruit to deposit eggs and scarring from these wounds can make fruit unmarketable. Larvae are cream-colored, legless, and 'c-shaped' with a brown head capsule. The larvae feed internally on fruit, and infested fruits may fall from trees prematurely. Larvae within dropped fruits complete development and exit the fruit to pupate in the soil. Plum curculio has 1 or 2 generations per year.

Best management practices for this pest include: (1) monitoring new fruits for the first signs of injury, (2) monitoring adults using insect beating sheets, which are held or placed on the ground beneath trees to collect insects that fall as branches are shaken or beaten with a stick, (3) timing insecticide applications at the 'petal fall' or 'first cover' stages of fruit tree development, (4) dormant pruning of fruit trees to create a less favorable environment for plum curculio adults, and (5) removal of unmanaged or wild fruit trees that may provide alternative food and mating sites.

Figure 9. Adult plum curculio beetle on the surface of an apple. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 10. An immature apple cut in half to reveal the cream-colored, legless larva of plum curculio inside, along with feeding damage and insect waste (frass). (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 11. Feeding and egg-laying scars left behind on the surface of an immature apple by plum curculio. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 12. Example of a canvas beating sheet used to collect insects from trees and shrubs. (*Photo credit: Bioquip.com*)

Japanese Beetle (*Popillia japonica*)

Japanese beetles can be important pests of orchard shrubs and trees. Adults are showy, copper and green metallic scarab beetles that feed on the foliage, flowers, and fruits of several tree fruit species; however, they are able to feed on hundreds of species of plants, be they in the orchard or surrounding landscape. This broad host range and ability to fly long distances makes them especially challenging to manage in a focal crop.

Adult feeding on the surface of foliage is focused between leaf veins, resulting in a characteristic 'skeletonized' appearance. Adult beetles typically feed in groups, which contributes to significant feeding damage to foliage and fruits, especially young plants with limited plant tissue. Japanese beetles overwinter in the soil as white grubs and emerge mid-to-late May to mate, feed, and lay eggs. Adult activity typically peaks for two to four weeks, after which populations decline, but adults may still be seen in small numbers through August. It is important to note that Japanese beetle grubs are not damaging to small fruit or tree fruit orchards, and adult beetles do not lay eggs on fruit-producing shrubs or trees.

There are several commercial Japanese beetle traps available for purchase, and while they are quite effective at attracting adults, research has demonstrated that these traps attract many, many more beetles than are actually captured in traps. As a result, other plants in the vicinity of traps may suffer more damage from beetles that are attracted but not captured. There is one generation of Japanese beetles each year.

Best management practices for this insect include: (1) applying management strategies at first sign of beetles (before groups of beetles begin to form), to reduce attraction of more beetles, (2) achieving good coverage of trees with insecticides, and (3) tolerating low levels of feeding damage on mature trees.

Figure 13. Adult Japanses beetle on a raspberry leaf. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 14. Japanese beetles and symptoms of their skeletonized feeding damage on an apple leaf. (*Photo credit: John Obermeyer, Purdue Entomology*)

Codling Moth (*Cydia pomonella*)

The codling moth is a grey moth with conspicuous bronze-colored areas at the ends of the wings. Codling moth overwinters as a fully developed caterpillar under the bark or in leaf litter near the base of apple trees. The codling moth can attack several kinds of fruit trees but prefers apple. Females lay eggs on or near developing fruits at night. The larva (caterpillar) is white to pinkish-white in color with a brown-colored head capsule. The larva is the damaging life stage that feeds exclusively on fruit.

Caterpillars burrow into apples to feed, destroying the fruit and leaving behind a trail of solid insect waste, called frass. Both external and internal feeding damage by larvae can make fruits unmarketable. There are typically 2 or 3 generations of this insect each year.

Best management practices for this pest include: (1) regular scouting of trees and fruits for damage (including frass on the exterior of fruits), and (2) coordinated use of pheromone traps and degree day models throughout the season to monitor adult flight activity and time insecticide applications accordingly. The ultimate goal of an insecticide program is to have insecticide residues present at egg hatch, so the smallest, most vulnerable caterpillars are immediately exposed when they attempt to enter fruits.

Figure 15. A pencil tip alongside an adult codling moth captured on a sticky trap. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 16. A mature apple cut in half to reveal a codling moth caterpillar and its feeding damage and frass at the core of the fruit. (*Photo credit: John Obermeyer, Purdue Entomology*)

Oriental Fruit Moth (*Grapholita molesta*)

Similar in appearance to the codling moth, but smaller in size, the Oriental fruit moth is another grey-colored moth that does not feed in the adult stage. This insect overwinters as a fully-developed caterpillar on the trunk or around the base of trees, emerging around bloom. The larva (caterpillar) stage inflicts injury to fruit trees, including apple, peach, plum, cherry, and pear. Caterpillars are off-white to pinkish-white in color, but unlike codling moth caterpillars, they do not eat seeds in the core of the fruit. However, Oriental fruit moth caterpillars are best distinguished from codling moth caterpillars by the presence of an anal comb on the last body segment.

The first generation-caterpillars burrow into leaf axils at the terminal ends of young shoots, and later generations feed within fruit during summer months. Damage to young shoots causes wilting of leaves, flagging, and die-back of tree branches. Caterpillars tunnel through fruits to feed, leaving frass at entry and exit points. These feeding wounds can cause fruits to ooze or be misshapen, lead to premature fruit drop, and serve as entry points for fruit disease. There can be up to seven generations of this pest each year, but the second and third generations are the most damaging because they cause direct damage to developing fruit.

Best management practices for this pest include: (1) using pheromone traps and degree day models to monitor peak flight activity, (2) mating disruption strategies to interfere with mating behavior, and (3) timing insecticide applications to target newly-hatched larvae.

Figure 17. A sticky trap with a codling moth (left) and Oriental fruit moth (right) side by side with a pencil tip for size reference. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 18. Damage caused by burrowing of an Oriental fruit moth caterpillar on the terminal end of a young peach tree shoot. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 19. Feeding damage to immature peaches caused by Oriental fruit moth caterpillars. (*Photo credit: John Obermeyer, Purdue Entomology*)

Apple Maggot (*Rhagoletis pomonella*)

The apple maggot, also known as the apple maggot fly or railroad worm, is a black fly that is slightly smaller than a house fly, but with white bands on the abdomen and conspicuous black bands on the wings. Apple maggot is predominately a pest of apples, but will also attack crabapple, cherry, plum, and peach. This insect overwinters as a pupa in the soil and emerges in early summer to feed, mate, and lay eggs under the skin of apple fruits. Egg-laying injury inflicted by female flies may appear on the surface of fruits as small dimples. Emergence of adults may occur over an extended period, so female flies may continue to lay eggs in fruits through August and September.

The most damaging life stage of this insect is the larva (maggot), which feeds throughout the fruit on juices from fruit flesh, leaving behind irregular-shaped tunnels that turn brown. Infested fruits often drop from the tree before maturity. Larval development may be completed in as little as two weeks in early-maturing apple varieties or require several months in late-maturing winter varieties. Once development is complete, apple maggot larvae exit the fruit and pupate in the soil. There is one generation of this insect per year; however, some adults may not emerge from puparia in the soil until the second year.

Best management practices for this pest include using yellow sticky traps and red sticky ball traps to monitor first adult emergence and the beginning of egg laying, respectively, so insecticide applications can be timed effectively.

Figure 20. Apple maggot adult. (*Photo credit: Joseph Berger, Bugwood.org*)

Figure 21. A mature apple cut in half to reveal symptoms of apple maggot feeding damage to the inside flesh of the fruit. (Photo credit: *HJ. Larson, Bugwood.org*)

Brown Marmorated Stink Bug (*Halyomorpha halys*)

The brown marmorated stink bug (BMSB) is an important piercing-sucking insect pest of pome, stone, and nut trees, especially peaches, nectarines, apples, pears, and hazelnuts. This insect is particularly challenging to manage because it is capable of feeding on many different plants, both wild and cultivated, and is able to move easily between them because it has a strong flight capacity. BMSB overwinters as an adult in protected places and emerges the following spring to mate and lay eggs. Both adults and nymphs feed on leaves and stems; however, they inflict the most damage to reproductive structures including fruits, nuts, and seed pods during the late spring (once crops set fruit) and throughout the summer months.

BMSB damage varies depending on the fruit that is attacked. In tree fruit, damage may not be immediately apparent after feeding. Rather, as time passes, fruits that have been attacked show symptoms such as oozing at the feeding site (young fruits), surface depressions or deformations, and internal necrosis that varies in appearance from distinct reddish-brown spots to whitish necrosis with no clear shape. Damage caused by the insect's mouthparts entering the fruit may also be seen when fruits are sliced open, and present as light-brown colored lines extending from the skin into the fruit. It is important to note that BMSB damage can be easily mistaken for physiological disorders like bitter pit and cork spot. Feeding damage inflicted just prior to harvest may also present after post-harvest cold storage. BMSB completes 1-2 generations each year.

Best management practices for this pest include: (1) seasonal scouting and monitoring of adults with commercially available pheromone traps in both the interior and border of orchards to time insecticide applications, (2) limiting the use of broad-spectrum insecticides to conserve natural enemies of the BMSB, and (3) applying insecticides with highest efficacy later in the season to target the more susceptible overwintering generation.

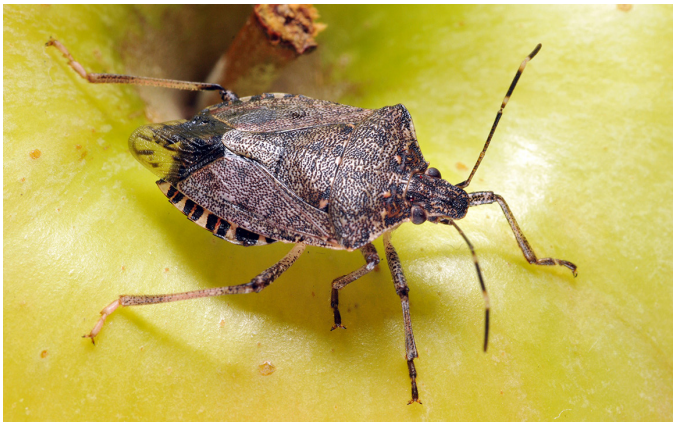

Figure 22. A brown marmorated stink bug adult on the surface of an apple. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 23. Small depressions on the surface of immature apples caused by brown marmorated stink bug feeding. (*Photo credit: John Obermeyer, Purdue Entomology*)

Figure 24. An immature apple with a surface slice removed to reveal small, brown necrotic spots on the inside flesh of the fruit, caused by brown marmorated stink bug feeding. (*Photo credit: John Obermeyer, Purdue Entomology*)

READ AND FOLLOW ALL LABEL INSTRUCTIONS. THIS INCLUDES DIRECTIONS FOR USE, PRECAUTIONARY STATEMENTS (HAZARDS TO HUMANS, DOMESTIC ANIMALS, AND ENDANGERED SPECIES), ENVIRONMENTAL HAZARDS, RATES OF APPLICATION, NUMBER OF APPLICATIONS, REENTRY INTERVALS, HARVEST RESTRICTIONS, STORAGE AND DISPOSAL, AND ANY SPECIFIC WARNINGS AND/OR PRECAUTIONS FOR SAFE HANDLING OF THE PESTICIDE.

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