UNIVERSITY OF MINNESOTA EXTENSION

AGRICULTURE, FOOD AND NATURAL RESOURCES

Pest management for the home stone fruit orchard

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INTRODUCTION

A surprising variety of apricots, plums and tart cherries can be grown in Minnesota. Although insect and disease pressure is lower here than in states to the south or east, there are insects and diseases that can destroy fruit and harm trees. Pest problems are best dealt with through the practice of Integrated Pest Management (IPM). IPM is a sustainable approach that allows gardeners to reduce pests to a tolerable level by using the best balance of cultural, physical, biological, & chemical management strategies. IPM takes into account the level of damage a pest is capable of causing, as well as the possible risks to humans and the environment associated with each pest management strategy.

In order for IPM to be effective, home gardeners must be able to recognize common pests of stone fruits and the damage they cause. Gardeners can find additional help identifying common pest

problems by using the online diagnostic tools What insect is this? and What's wrong with my plant? or by sending a sample to the UMN Plant Disease Diagnostic Clinic.

Information on planting and caring for apricots, cherries, peaches and plums can be found in the publication: "Growing stone fruits in the home garden."

Plant stone fruit in a well-drained soil or amend the soil to improve drainage. When possible, avoid planting in low areas. Low areas often have wet soils that can lead to root diseases. Trees located in low areas also suffer more frost damage and winter injury than trees located on higher ground or hillsides.

Pruning

Pruning is a key IPM tool for stone fruit production. Young fruit trees should be pruned each year to create an open and healthy branch structure. Detailed information about properly pruning young fruit trees can be found in Growing stone fruits in the home garden. Pruning stone fruits is best done in March or April, shortly before bloom, and this is also the best time to look for problems with branches in trees. Inspect each tree for crossing branches, dead branches or branches with cracks, discolored bark or abnormal growths or swellings. Branches that are crossing and touching often rub together, creating a shallow wound that can allow wood rotting fungi to enter the tree. Branches with cracked or discolored bark or with abnormal growths may be infected with a pathogen. Prune out any suspicious looking branches 4-6 inches below visible symptoms. Infected branches should be removed and destroyed. Remove enough branches so that sunlight can reach the center of the tree. Proper pruning will allow fruit and leaves to dry more quickly after rain, resulting in lower disease pressure.

Weeds

Keep the area within two feet of the trunk free of weeds for the life of the tree. Competition from weeds can reduce growth more than 30%, especially during the planting year. When planting trees in a lawn, cut and remove the sod in a section about four feet in diameter where the tree will be planted. In most lawns, few weeds will sprout where the sod was removed. The few weeds that do sprout can be controlled with mulch around the trees. Wood chip mulches control most weeds and contribute organic matter to the root zone. Keep the mulch a few inches from the trunk. Landscape fabric will control almost all weeds, but must be removed after several years. Straw mulch is not advised, because straw mulch attracts mice, which can then feed on the bark of the fruit trees. Removal of weeds near the tree also helps to minimize mouse habitat.

Pesticides

In IPM, pesticide sprays are used only when cultural controls are not effective or as a supplement to cultural controls. If using pesticides, gardeners should choose an effective product that has the lowest impact on human health, non-target organisms like bees, and the environment. Information on using pesticides safely for home gardeners can be found at the Pesticide Environmental Stewardship and the National Pesticide Information Center. Information on the correct way to apply specific pesticides can be found on the product label. If pesticides are necessary, always use them exactly as directed by the product label as mandated by federal law.

PEST MANAGEMENT SCHEDULE

In order to be successful, an IPM program should follow a schedule of monitoring and cultural controls that is repeated each year. Read about the specific pest to determine how to monitor for the pest, and to decide what level of pest infestation can be tolerated.

Table 1: Pest management schedule for stone fruit trees

Time	Action
Early spring before bud break	Prune trees before bloom to improve air circulation within the tree canopy. Remove and burn any branches with black knot or brown rot.
	Remove and dispose of any mummy fruit still on the tree.
	For plum trees with a history of plum pockets, apply a single application of fungicide.
Bud break	If the tree has a history of blossom blight and twig blight caused by brown rot, apply fungicides to protect blossoms. Repeat application according to label instructions until petal fall.
Bloom	Check trees during bloom to make sure bees are actively pollinating flowers.
	After frosts, check to see if the center of the blossoms are green (healthy) or black (dead).
2 weeks post-bloom	For cherry trees with a history of significant leaf loss from cherry leaf spot, apply a fungicide spray to protect mature leaves. Repeat application according to label instructions until after harvest.
Shuck fall to small fruit	Monitor for plum curculios; manage them if any adults are present.
Mid-May through June	Place traps for spotted wing Drosophila and check them regularly throughout the growing season.
July through harvest	If spotted wing Drosophila are present, harvest ripe fruit, properly dispose of infested fruit and apply insecticides.
Mid-June to harvest	Place sticky card traps for cherry fruit fly in cherry trees. Use appropriate management measures if adults are found.
June to August	Monitor trees for cherry leaf spot. If leaves develop spots and drop early, rake and remove all leaves in the fall. If defoliation is severe, consider using protective fungicides the following year.
2-3 weeks before harvest	For trees with a history of significant brown rot infection of fruit, apply fungicides to protect ripening fruit. Repeat application according to label instructions until harvest.
Harvest	Pick all ripe fruit on the tree. Harvest rotten fruit separately from healthy fruit. Compost or bury infected fruit. Pick up and dispose of any fruit that falls on the ground.
Fall	If cherry leaf spot infected the tree, collect and remove all fallen leaves.
	Remove weeds next to tree trunk to discourage mice.

DISEASES

Brown rot

Brown rot, caused by the fungi *Monolinia fructicola* and *Monolinia laxa*, is the most serious disease in plums, tart cherries and apricots in Minnesota and damages shoots, twigs, and fruit. During ripening and in storage after harvest, brown rot can spread quickly from one fruit to another until most of the fruit are inedible. Brown rot can also cause twig blight, which occurs when cankers form on small branches. Twig blight caused by brown rot is particularly common in apricot trees. Twig blight gradually weakens the trees, which may become vulnerable to winter injury or wood rotting fungi.

Brown rot on 'Bali' cherry. Thaddeus McCamant, Central Lakes College.

Identification

Blossom Blight - In spring, brown rot can cause some blossoms to turn brown and die. Blossoms that die from brown rot typically stay attached to the branch with a sticky gum like droplet. In contrast, blossoms killed by frost fall to the ground.

Twig blight - The infection can progress from the infected flower to the spur holding the flower and into branch below the blossom, causing a canker in the branch. Cankers on twigs are discolored and often have drops of sticky gum between the diseased and healthy area of the branch. When these cankers encircle the twig, all leaves beyond the canker turn brown and wilt. These leaves remain attached to the branch. Of the stone fruits grown in Minnesota, apricot is most susceptible to twig blight.

Fruit with brown rot and healthy fruit on sand cherries. T. McCamant, Central Lakes College.

Fruit Rot - Brown rot on the fruit starts out as a small, firm, brown spot on ripe or ripening fruit. The brown spot quickly grows to encompass large portions of the fruit. Infected fruit remain attached to the tree. With time these fruit become dry, shriveled mummy fruit that may remain attached to the tree well into the following growing season.

Fungal spores - All infected plant parts produce tan to gray powdery clumps of spores in response to the presence of moisture at temperatures above 41˚F.

Important biology

Brown rot fungi overwinter in mummified fruit, infected twigs and cankers in the bark. The primary source of spores in the spring is mummified fruit on the trees or on the ground. In the spring, the fungus starts growing under cool, wet conditions and produces spores. Spores spread through wind or rain to the blossoms. The amount of time the flowers need to be wet in order to infect blossoms depends on the temperature. If the temperature is at 70˚F, the blossom only needs to be wet for 3 hours in order for the infection to occur. At cooler temperatures, the blossom must be wet longer. At 45˚F, the blossom must be wet for at least 6 hours in order for an infection to occur. Frequently, the infection spreads from the blossom through the stem and into the bark, where a small canker can form beneath the dead flower. Fungi in the cankers below the dead blossom can then produce secondary spores for much of the summer. In early summer, the disease spreads slowly, because developing fruit tends to be fairly resistant to infection unless damaged by insects, hail or stem rub. As the fruits ripen and change color, they become susceptible to infection. Infected fruit produce many fluffy, tan to gray spores that can easily spread to other fruit on the same tree and to other trees. Once one ripe fruit is infected, then the infection can spread to neighboring fruit until all the fruit in a cluster are infected.

Mummy plum touching a small branch. The branch shows the early stages of infection.
T. McCamant, Central Lakes College.

Management

Sanitation

Keeping the area around the trees clean of fallen fruit and other plant debris will lower the number of spores produced in the orchard and make brown rot easier to control. Pick up all fallen fruit during the summer. Harvest and either consume or dispose of all fruit as it ripens. Before bud break in early spring, remove all mummy fruit that remain on the trees. When pruning in winter, cut out all branches with cankers and remove all twigs that have died from brown rot.

Fungicides

If the brown rot fungi has caused severe twig blight or fruit rot in previous years and sanitation and pruning have not reduced disease, gardeners may consider using a fungicide to protect the tree from infection. To effectively protect the tree, fungicides must be applied at two distinct times. To protect trees from blossom blight and twig blight begin fungicide applications when blossoms first begin to open. Repeat sprays according to label instructions until petal fall. To protect trees from fruit rot, begin fungicide sprays 2 - 3 weeks prior to harvest as fruit is ripening.

Repeat sprays according to label instructions until harvest. Take care to wait the complete 'Post Harvest Interval' (PHI) listed on the label. The PHI is the number of days a gardener must wait after applying a fungicide before harvest is allowed. This time period allows fungicide residue to break down to a safe level. Fungicides need not be applied while green fruit are on the tree as these immature fruit are relatively resistant to infection. In all cases fungicides are most effective when combined with sanitation.

The name of the plant being treated MUST BE LISTED on the fungicide label or the product cannot be used! Some products are registered for use on ornamental *Prunus* species but are not safe to use on stone fruit intended for human consumption. Always completely read and follow all instructions on the fungicide label.

Table 2: Fungicides for brown rot treatment

Active ingredient	Example trade names*	Comments
Myclobutanil	Spectracide Immunox Multipurpose fungicide	
Propiconazole	Bonide Infuse Systemic fungicide	
Chlorothalonil	Many products available	Apply only for blossom blight. Do not use for fruit rot control.
Captan	Many products available	
Sulfur	Many products available	Some formulations acceptable in organic agriculture.

*Trade names are for demonstration purposes only and do not imply endorsement by UMN Extension. Trade names may change over time. Products with the same active ingredient but different trade names should offer disease control as well.

Cherry leaf spot

Cherry leaf spot, caused by the fungal pathogen *Blumeriella jaapii*, can be a devastating disease for tart cherries in parts of southern Minnesota. Leaf spot has a scattered distribution in Minnesota. Disease pressure can be quite high in some sites, while a few miles away, the disease is absent. Where the disease pressure is high, cherry trees can be defoliated during humid summers. Trees that are defoliated in late summer are more susceptible to winter injury and grow slowly the following spring. Yields on trees defoliated in August will be reduced the following summer due to poor flower bud formation.

Identification

Cherry leaf spot starts out as purple spots on the upper surface of older leaves in early summer. The spots grow to about 1/4 inch in diameter and turn reddish brown. The spots eventually turn brown, and several spots may grow together into larger dead patches. Yellow areas form around the leaf spots and the leaves start to die and fall off the tree about one month after the infection started. Leaf spot infections on plum and other *Prunus* species often dry up and fall out of the leaves, resulting in small holes scattered across the leaf, or a "shothole" appearance. Cherry leaf spot occasionally forms on leaf or fruit stems but infection on the fruit is rare.

Important biology

Cherry leaf spot fungi overwinter in infected leaves that have fallen to the ground. Although the leaves are dead, the fungi inside the leaves survive until the following growing season. The fungi start to grow in early spring in response to warm weather and produce spores that are discharged into the air. Once the spores land on susceptible leaves, the spores will only germinate if the leaves are wet. The optimum temperature for infection is between 58 and 73˚F. Young leaves are resistant to leaf spot until they become completely unfolded. Ten to 15 days after infection, the spots appear on the leaves. Fungal spores are produced on the lower surface of leaf spots. These spores are spread by wind and splashing water, resulting in secondary infections. In years with frequent rains in May and June, the fungi can spread extremely quickly. By the end of July, most cherry trees stop forming new leaves. Since all the leaves are mature in late summer, all the leaves are susceptible to cherry leaf spot at that time, and entire trees can be defoliated.

Cherry leaf spot on 'SK Carmine Jewel' tart cherry.
T. McCamant, Central Lakes College.

Management

In Minnesota, leaf spot can be found in plums and tart cherries. European plum is less susceptible to disease. All varieties of tart cherry are susceptible to cherry leaf spot. If cherries are losing their leaves due to leaf spot, aggressive measures should be taken to control the disease.

Sanitation is a critical component of cherry leaf spot control. Collect and destroy fallen cherry leaves in September or October to remove the leaves that harbor the fungus through winter.

Fungicides

If trees have a history of leaf spot infection severe enough to result in significant leaf loss before September, fungicides can be used to protect leaves. Fungicide applications should be started two weeks after bloom, when leaves are completely unfolded and repeated at the interval specified on the fungicide label through the growing season, including one application after harvest. Fungicides with an active ingredient of myclobutanil or captan will protect leaves from infection with cherry leaf spot when applied properly. The leaf spot fungi may develop resistance to myclobutanil if this fungicide is applied too frequently. To avoid fungicide resistance, alternate between myclobutanil and captan when making repeated fungicide applications. Fungicides with an active ingredient of copper may provide some protection against leaf spot infection and some formulations acceptable for use in organic production are available. Fungicides work best if combined with sanitation.

The name of the plant being treated MUST BE LISTED on the fungicide label or the product cannot be used! Some products are registered for use on ornamental *Prunus* species but are not safe to

use on stone fruit intended for human consumption. Always completely read and follow all instructions on the fungicide label.

Powdery mildew

Powdery mildew, caused by the fungus *Podospheara clandestine*, is a disease found wherever stone fruit trees are grown. Cherry, plum, and apricot are all susceptible to powdery mildew. The disease primarily infects new leaves and young, green twigs. Leaves on branches on the inside of the tree canopy are most susceptible. Leaves with powdery mildew usually stay on the tree. Powdery mildew will reduce growth on infected branches and will occasionally kill small twigs, but rarely causes significant damage.

Powdery mildew on 'Bali' pie cherry. T. McCamant, Central Lakes College.

Identification

Powdery mildew infections start as white fuzzy patches on the lower surface of new leaves. As the disease progresses, the entire lower portion of the leaves become covered with the white mildew and small white patches can be seen on the upper surface of the leaves. Mildew can spread to young twigs with green bark. Later in the summer, the fungi form dark spore producing structures that look a little like pepper scattered on the lower portion of the leaves. Infected leaves tend to be small and distorted, with younger leaves being especially malformed. Infected leaves occasionally become brittle and fall off. In years with warm wet springs, powdery mildew can infect the fruit resulting in round sunken areas with white fluffy fungal growth on the surface.

Important biology

Powdery mildew primarily overwinters in infected buds. At bud break, the fungi produce spores that primarily spread through the air and will infect new leaves that are wet from dew or rain. Powdery mildew can spread when there is no rain, as long as the leaves are wet from dew each morning. Powdery mildew is most common during warm, dry summers.

Management

Powdery mildew in stone fruit trees in Minnesota rarely hurt the trees enough to require a fungicide spray. If severe disease has occurred several years in a row, fungicides with an active ingredient of sulfur, captan, myclobutanil or propicanazole can be applied to protect young leaves.

The name of the plant being treated MUST BE LISTED on the fungicide label or the product cannot be used! Some products are registered for use on ornamental *Prunus* species but are not safe to

use on stone fruit intended for human consumption. Always completely read and follow all instructions on the fungicide label.

Branch cankers

A canker is an infection that kills the bark. Cankers first appear as dark discolored areas of the bark. The infection often starts as a small oval or circle. In cherries, the bark next to the cankers often exudes gum. As the infection spreads, the branch may be girdled, killing the branch above the canker. Cankers can occur on small twigs hidden within the tree canopy, on large branches, or on the main trunk. Cankers on large branches or the trunk can kill the tree. Cankers can be caused by several different pathogens, but the most common canker causing organisms in Minnesota are the bacteria *Pseudomonas syringae pv. syringae* and *P. morsprunorum* and *Cytospora* spp. fungi. Bacterial cankers are most common on cherry trees, while Cytospora can be found on apricots and plums as well as cherries. Canker causing pathogens survive in infected branches and twigs. Both pathogens are spread by splashing water from one part of the tree to another and infect through wounds and natural openings.

Bacterial canker in cherry branch. Michelle Grabowski, UMN Extension.

Cankers can be controlled by minimizing injury to the bark and by removing diseased branches. Prune young trees to encourage strong healthy branches. Pruning should be done during the first warm, dry weather in early spring to promote quickly healing of the pruning cut. Never leave a branch stub as these can be points of entry for canker causing and wood rotting pathogens.

Prune out branch cankers four inches below the visibly infected section of the branch. Sterilize pruners with rubbing alcohol, 10% household bleach, Lysol, or Listerine after pruning out infected branches. Burn or bury infected branches. Avoid hammering nails into the bark of cherry trees or damaging the bark in other ways.

Black knot

Black knot is a very common disease in landscape and native *Prunus* trees and shrubs, which occasionally infects susceptible plum, apricot and cherry varieties. It is caused by the fungus *Apiosporina morbosa*. Black knot causes branches and twigs to develop a raised, rough, tumor-like black growth called a gall. The black knot gall causes infected branches to either

weaken or die. Left uncontrolled, the disease spreads to other branches on the same tree, until the tree becomes so weak that it no longer produces fruit and should be removed. In most cases, black knot can be controlled with careful pruning. During dormancy remove and destroy all knots, or all swollen stems. Cut infected areas four inches below the visible swelling.

Black knot in chokecherry. M. Grabowski, UMN Extension.

Plum pocket

Plum pocket or bladder plum is an unusual disease that causes unripe plums to grow abnormally large within a month or two after bloom. Plum pocket is caused by the fungus *Taphrina communis*. The infection starts with a small blister on the fruit, which rapidly grows and soon covers the entire fruit. Infected fruit may grow to ten times their normal size, have a spongy texture, and become covered with velvety gray fungal spores. Eventually infected fruit dry out and turn black. If cut open, the center of these affected plums is empty. The fungus can cause the leaves to thicken and curl, but this is not common. Infected fruit usually fall to the ground, but some will stay on the tree through winter.

Plum pocket. Robert Moll.

Plum pocket primarily infects wild plums and American type plums. In many trees only a small number of fruit are infected. Few dessert plums suitable for Minnesota are susceptible to plum pocket. The disease can be reduced by removing infected plums before they are covered with spores. If plum pocket is causing crop losses by killing leaves or destroying most of the fruit, fungicides applied before bloom will help control the disease. Plum pockets can be prevented with a single fungicide application just before bud break in early spring. Bordeaux mixture (copper-sulfate), liquid lime sulfur or chlorothalonil can all be used to manage plum pockets.

Plum pocket brown with age. M. Grabowski, UMN Extension.

ABIOTIC PROBLEMS

Winter injury

Winter injury limits the distribution of many types of stone fruits in Minnesota. Peaches, sweet cherries and Japanese plums cannot be reliably grown in most parts of the state due to our severe winters. Varieties rated for zones 3 or 4 can have winter injury after severe winters or if the trees are stressed or diseased.

Occasionally, whole trees die after cold winters. In some cases, the trees will leaf out in the spring and die after the temperature warms. Branches of fruit trees that die from winter injury may have dark wood below green bark.

Winter injury in the wood of an apple tree. The bark is green but the wood is dark. The tree died in July. T. McCamant, Central Lakes College.

Winter injury can be minimized with proper tree care. Both cherry leaf spot and brown rot can dramatically increase the chance of winter injury. Cherry leaf spot can cause all the leaves on a tree to fall off by August or early September, making the trees vulnerable to winter injury. If new leaves start forming in September after the old leaves have fallen off, that branch will almost always die. Brown rot can cause twig blight which then weakens the tree, leaving the tree vulnerable to winter injury.

Always make sure the trees have sufficient water in late fall. Avoid pruning living wood after July 1, because pruning can delay dormancy. Plant varieties that have been shown to survive Minnesota winters. Characteristics of Minnesota hardy stone fruit varieties can be found in the publication Growing stone fruits in the home garden.

Poor fruit set

Poor fruit set is a common problem in plums and tart cherries. Poor fruit set can be caused by winter injury, frost damage in the spring, poor pollination or plum curculios. If poor fruit set has been a problem in previous years, inspect the trees before, during and after bloom.

Poor fruit set due to winter injury and frost

In late winter, look for fruit buds on the tree. Flower buds are larger and usually more round than leaf buds. They swell faster in the spring than leaf buds. Flower buds can be killed during winter cold snaps even when the rest of the tree shows no sign of winter injury. It is possible for a severe winter to kill all flower buds, resulting in no flowers and no fruit in the following growing season.

If the flower buds survive the winter, there is still a possibility of a late frost killing the flower itself before it is able to set fruit. When the blossoms open, center of a healthy blossom has a green ovary that will turn into the apricot, plum or cherry fruit. After a mild frost, the ovary can be black, while the rest of the flower remains perfectly healthy. Once the ovary dies, the fruit will not form and the flower will drop from the tree.

Leaf buds and flower buds on 'Bali' tart cherry. The flower buds are on the sides while the leaf buds is in the middle.
T. McCamant, Central Lakes College.

Poor fruit set due to poor pollination

If the blossoms are healthy, they will attract insect pollinators. Look for bumble bees, honeybees and other insect pollinators on mild, sunny days. A blooming plum or cherry tree should be buzzing with insect activity on a sunny day with temperatures in the 70's. Conversely, if the weather is cool and cloudy, insect pollinators are less active and these trees may not be sufficiently pollinated. Poor pollination can also be due to not having the right mix of varieties. Tart cherries are self fertile, and should form fruit if the blossoms open and there are insect pollinators. Most plums and apricots need two or more varieties to assure adequate cross pollination. Many plums hardy in Minnesota are difficult to pollinate. Sometimes, two plum varieties next to each other will bloom at different times. Other times the pollen types are incompatible. If pollination is the reason why a tree is not producing fruit, the blossoms and small fruit will fall off a few days after petal fall. The best practice to improve pollination is planting

multiple varieties of plums in a small area. For recommendations on compatible cultivars, see the publication Growing stone fruits in the home garden.

Poor fruit set due to plum curculios

If the blossoms are adequately pollinated, then the fruit will start growing immediately. About one week after petal fall is the shuck splitting stage. The shuck holds the petals and surrounds the green center of the blossom or ovary. When the ovary turns into a small, green plum or cherry, the fruit quickly grows and breaks through the shuck. If the fruit goes through the shuck splitting phase and then the small green fruit fall off the tree, the most likely cause for the crop failure is the insect plum curculio.

INSECTS

Plum curculio

The plum curculio (*Conotrachelus nenuphar*) is a weevil native to Minnesota that is found throughout most of the state. Plum curculio has a wide host range that includes apples, plums and cherries. Plum curculios can cause large crop losses in both cherries and plums.

Adult plum curculio. Clemson University, USDA Extension Slide Series.

Identification

Plum curculio adults are about 1/4 inch long with a mottled grayish and brown back that has several bumps on each side. They also have short, curved snouts, which are about 1/4 the entire length of the insect. The color and the bumpy back allow the curculios to blend in easily into the bark of mature trees.

Mature plum curculio larvae are a little larger than 1/4 long, which is slightly longer than adults. They are white, with no legs, and a small, brown head.

In May and June, when the plums start to grow, female curculios make distinct, crescent shaped oviposition scars on the fruit when they are laying eggs. The female inserts her egg and then cuts a small crescent-shaped flap around each egg that it lays on the fruit. In most oviposition scars, a round egg scar about the size of a pin head is visible inside the crescent.

All stone fruit with curculio larvae are unfit for consumption. Curculio larvae burrow through the developing plum or cherry fruit. Larvae that emerge before the pits harden feed through the developing seed, causing the fruit to fall to the ground. Larvae that emerge after the pits harden often stay in the developing flesh through June and into July. Fruit with curculio larvae rot during ripening.

Plum curculios are the most serious insect pest in plums in Minnesota and the most common reason for crop failure. In untreated plum trees with high curculio pressure, every plum on the

tree will have at least one crescent shaped oviposition scar, resulting in a total crop loss. Tart cherries usually produce more flowers and fruit than plums, and there are rarely enough curculios to infest every fruit. In some years, tart cherries will ripen while the curculio grubs are still in the fruit, resulting in "wormy" cherries. Tart cherries with curculio larvae have rotten black spots on the fruit.

Adult plum curculios emerge in August and feed on plum and apple fruit that is starting to ripen. Adult curculios feed on the surface of the fruit, forming small, almost perfectly round holes in the plum skin. In plums, feeding injury by adult curculios can increase the incidence of brown rot.

Oviposition scar on a plum. T. McCamant, Central Lakes College.

Important biology

Plum curculios have one generation per year in Minnesota. Adults overwinter in brush near the plum trees. In the spring, the adults emerge shortly after bloom. Plum curculio adults can fly, but prefer to walk. The adults usually climb tree trunks to reach the developing fruit, rather than flying to branches. In sites with low curculio pressure, typically only one plum or cherry branch will have infested fruit, while other branches have no damage.

Cool weather slows down the development of the curculios relative to the plum or cherry fruit. In warm springs, adults will begin depositing eggs when the fruit is a half inch in diameter or less, while during a cool spring, the adults may not start laying eggs until the middle of June, after the pits start hardening. Plum curculios typically lay their eggs during warm, humid evenings.

Plum curculio larva in a ‘Sapalta’ plum.
T. McCamant, Central Lakes College.

After hatching, the larva burrows through the fruit. The curculio larvae will survive both in fruit that remains on the tree and in fruit that falls to the ground. After a month of feeding, the larvae will pupate in the soil for another month and the adult will emerge in late summer.

Management

Plum curculio populations can be reduced through a combination of cultural controls, physical removal, and insecticide sprays.

Monitoring
Start monitoring plum curculios after the shucks split in order to find when the adults are active in the fruit trees. The shuck encloses the center of the flower. After bloom, the shuck turns brown and either splits or falls off as soon as the developing fruit starts growing.

One way to check for curculios is to place a cardboard box or a piece of tarp under a branch and vigorously shake the branch. If there are curculios on the branch, they will fall onto the cardboard and play dead. Shaking branches will show that curculios are on the trees even before they start laying eggs.

A second method for monitoring is to check for oviposition scars on fruit. This method is only effective if oviposition scars are detected shortly after adults have started to lay eggs; if these scars are not discovered until after most or all of the fruit have been attacked, then it will be too late for effective management. When monitoring for plum curculios, remember that they can be abundant in one tree and absent in nearby trees. Plum curculios should be managed if any adults are detected.

Sanitation
When possible, pick up and dispose of infested fruit that falls to the ground in May and June, or infested fruit that stays on the tree in July, before the larvae crawl out of the fruit to pupate.

Physical removal
One unorthodox way to kill plum curculios without insecticides is to shake the trees when the females are actively laying eggs. Shortly after the first plums show oviposition scars, place a tarp under the tree and shake different branches of the tree. Adult curculios will fall off the tree and play dead. The adults can then be picked up and killed by hand. Unfortunately, curculios that play dead look very similar to pieces of bark that also fall on the tarp. While total control of curculios is difficult with branch shaking, enough can be killed to save most of the fruit. Shaking is most effective on warm evenings when the females are laying their eggs.

Insecticides
Curculios can also be controlled with insecticides. Sprays should be timed shortly after the first adult curculios are detected in the spring. Insecticides that kill plum curculio adults include spinosad, esfenvalerate, gamma cyhalothrin and carbaryl. Spinosad is a product often approved for organic production.

Spotted wing Drosophila

The spotted wing Drosophila (SWD) (Drosophila suzukii) is a new pest in Minnesota that has been found throughout the state. It has a wide host range, including some plums, cherries and most berries. Tart cherries appear to be one of the preferred hosts of SWD.

Identification

SWD adults look very similar to the fruit flies that accumulate near overripe fruit during late summer. They are about 1/8th inch long, have a tannish body, red eyes, and brown bands on their abdomens. Male SWD can be recognized by a distinct black spot near the tip of each wing. The female SWD can only be distinguished from other species by looking at the tip of their abdomen under a dissecting microscope; you need to examine their distinctly serrated ovipositor to properly identify them.

The larvae (maggots) are white, with a body that tapers at one end. They only grow as large as 1/8 of an inch long. If you are unsure whether SWD larvae are in cherries, place four or five cherries in a water and salt solution (one tablespoon of salt per one cup of water) in a small container. Gently crush the cherries to break the skin. After 30 minutes, any larvae that are present will float to the surface. Infested cherries typically have multiple larvae.

Male spotted wing Drosophila. Martin Hauser, CA Dept. of Food and Ag.

Damage

SWD turn cherry fruit flesh brown, making the fruit unappealing for both fresh consumption and for processing. The white maggots are easy to see in the red flesh of the cherries, and the maggots will grow even after the fruit is picked. Cherries with maggots decay rapidly. Tart cherries are commonly attacked; there have been reports of SWD infestation rates exceeding 50% of the fruit on some trees in central Minnesota.

Discoloration on a 'Meteor' cherry with spotted wing Drosophila maggots.
T. McCamant, Central Lakes College.

Important biology

SWD have multiple generations per summer. They overwinter as adults in brush near orchards and fruit trees. SWD adults first appear during late June or early July, and the numbers may increase rapidly during the middle of summer, the time the first cherries start to ripen. A female lays several eggs in each cherry. The eggs hatch quickly, and maggots turn into mature SWD rapidly. During warm weather, SWD can go from egg to mature adult in seven days.

Management

Management of SWD can be challenging but is best achieved through a combination of detection, sanitation, and insecticides. The best control appears to be when gardeners destroy infested fruit to kill larvae, while using an insecticide to kill the adults at the same time.

Detection

Gardeners who are concerned about SWD should monitor for the presence of adults. Take a large clear plastic cup with a cover. Make several holes, 3/16 in diameter, near the top on one side of the cup. Larger holes will allow larger flies and other insects such as sap beetles to enter the trap, making detection of the SWD more difficult. The easiest way to make the holes is to heat a small (8 or 10 penny) nail, which can melt the right size hole in the cup. Pour one to two inches of apple cider vinegar into the bottom of the cup. You can then either add a yellow sticky card slightly above the vinegar or a little bit of liquid soap such as dish soap. Hang traps on branches in a shaded location near fruit. Replace the sticky card and apple cider vinegar bait at least once a week for SWD, disposing of the apple cider vinegar away from the trap location. Checking traps more often can be beneficial for early detection of adult SWD, especially early in the growing season.

A trap for monitoring spotted wing Drosophila. Steve Van Timmeren, Michigan State University.

Sanitation

Remove and dispose of all infested fruit to keep SWD numbers low. The larvae can be killed by microwaving the fruit, cooking the fruit or placing the fruit in a sealed plastic bag that will be put in the trash. Do not bury infested fruit or place fruit in a compost pile as the adults can still emerge.

Insecticides

Apply insecticides as soon as adults are caught in a trap. Repeat applications will probably be necessary; continue to monitor the trap throughout the growing season. Insecticides should be applied in the evening to avoid killing honeybees and other pollinators. Available insecticides to kill adult SWD are permethrin, carbaryl, malathion, spinosad and pyrethrin. Spinosad and pyrethrin are approved for organic production. Always read and follow labels when spraying pesticides, and follow the pre-harvest interval for all products.

Cherry fruit fly

There are two species of cherry fruit fly in Minnesota that lay eggs in ripening cherry fruit: the eastern cherry fruit fly (Rhagoletis cingulata) and the black cherry fruit fly (Rhagoletis fausta). Both cherry fruit flies are native to the Upper Midwest and only infest cherry species, including

sour cherry, sweet cherry, black cherries and pin cherries. The eastern cherry fruit fly is the more common species in Minnesota cherry trees.

Identification

Cherry fruit flies are about 1/4 inch long, or about the size of a house fly. Both the eastern cherry fruit fly and the black cherry fruit fly have a black thorax, and a black abdomen with white stripes. The two cherry fruit flies have distinct bands on clear wings that can easily be seen with the naked eye. The bands of the black cherry fruit fly are black, while those of the eastern cherry fruit fly are grayish, and the bands on each species have distinctly different patterns. Cherry fruit fly adults are nearly twice as large as spotted wing Drosophila (SWD) adults.

Adult eastern cherry fruit fly. Bo Zaremba, Nantucket, MA.

Cherry fruit flies have cream-colored maggots. They have a maximum size of 1/4 inch with a cylindrical shape that tapers towards the head. There is typically only one maggot per cherry. The larvae of these fruit flies are very difficult to distinguish between those of SWD. It is best to determine what insect is present by monitoring for the adults.

Damage

Cherry fruit flies turn the cherry fruit flesh brown and will often eat the majority of the flesh inside a cherry, making the fruit unacceptable for either eating fresh or for pies. Cherries infested with maggots often decay or develop brown rot. Cherry fruit flies are locally abundant in southern Minnesota, where some trees will have a maggot in nearly every cherry.

Important biology

Cherry fruit flies have one generation per year. Adults emerge from the soil in late June and early July and females seek out suitable hosts to deposit eggs. Cherry fruit flies have a narrow host range, laying their eggs in cherries, including tart cherries and wild pin cherries. The flies emerge one to two weeks before they start depositing eggs. Egg laying usually begins when the cherries are turning yellow and continues for another month. The female pierces the fruit with her ovipositor and inserts a single egg just below the surface. The larva hatches 4 to 7 days later, and the maggot burrows through the cherry flesh towards the pit. The larvae remain near the pit as it matures, but will often bore a hole at the bottom of the cherry to get access to air. After about two to three weeks, the larva bores through the skin and drops to the soil where it pupates. The pupa stays in the soil until the following summer.

Management

Monitoring
Monitor cherry fruit flies to determine when the flies are active and estimate pest pressure. The most common method to monitor for cherry fruit flies is with yellow sticky cards. Place the cards in the tree canopy shortly after bloom.

Sanitation
Remove and dispose of all infested fruit to help prevent the cherry fruit flies from overwintering next to producing trees. The population of cherry fruit flies will grow from year to year if larvae are allowed to pupate and overwinter in the soil below the cherry trees when infested fruit is not removed.

Insecticides
When using an insecticide, apply it before adult flies start depositing their eggs in the ripening cherries. Adult cherry fruit flies emerge one to two weeks before they start depositing eggs. The first insecticide should be applied as soon as the first adults are caught on sticky cards. If necessary, a second spray can be applied ten days later. Insecticides that can be used to control cherry fruit fly are acetamiprid, carbaryl, malathion and spinosad.

Lesser appleworm

The lesser appleworm or plum moth (*Grapholita prunivora*) is a native to Minnesota and found over most of the state. Lesser apple worm has a wide host range that includes many apples, plums, hawthorn fruit, and June berries. They feed inside plums and can be abundant in some orchards.

Identification

Adult lesser appleworm moths are about 1/4 inch long and dark brown with grayish orange bands on their wings. The larvae are creamy white to pink caterpillars with a brown head capsule. The caterpillars look quite similar to codling moth larvae, but are about half the size at maturity. Mature larvae are about 1/3 inch long when mature.

Plums with caterpillars exude a waxy substance after the larvae enter the fruit. Less appleworm larvae make small capsules just below the surface of the fruit and rarely feed much deeper than 1/2 inch.

Damage

Unlike plum curculio, lesser appleworms are most common in ripe fruit, but the fruit is typically edible. Since the capsules created by the moths are small, the damaged area can be cut out of the plum, provided there is only one caterpillar per plum.

Important biology

Lesser appleworms have two generations per year per year in Minnesota. The moths overwinter as larvae in cracks in the tree trunk and in leaf litter on the orchard floor. The larvae pupate in early spring, and the adults typically emerge the first week of June. Females lay their eggs on the surface of the fruit or on leaves near young fruit. The larvae search for fruit after emerging and begin mining the fruit just below the skin. First generation larvae often pupate in the tree or even

in the fruit. Adults of the second generation emerge in early August in Minnesota and their offspring are most likely to infest ripe plums.

Management

Lesser appleworms can be monitored with pheromone traps, but the traps are expensive and not widely available. The Minnesota Department of Agriculture does have apple growers monitor for lesser appleworms each year using pheromone traps, and the results can be accessed in the IPM newsletter, published weekly for much of the growing season.

The traps only indicate when adults are present and are not a good estimate of how numerous they are at a given location. A gardener can also inspect the ripe fruit at the end of summer for the waxy secretions.

Once it is determined that lesser appleworm is present, each gardener needs to decide how much damaged fruit is acceptable for them. If minimal damage is the goal, then spray plum trees during the second flight of adult moths in early August. Effective insecticide sprays to treat lesser appleworm are acetamiprid, carbaryl and malathion.