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Disease Control in Cherries, Plums, and Other Stone Fruits

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Various stone fruits (Prunus species) are grown in North Dakota for their fruit or as ornamentals. These include sour cherry (*Prunus cerasus*), Nanking cherry (*P. tomentosa*), Korean cherry (*P. japonica*), choke-cherry (also called `Shubert' chokecherry and Canada red cherry, *P. virginiana*), amur chokecherry (*P. maackii*), pincherry (*P. pennsylvanica*), western sand cherry (*P. besseyi*), cultivated plum (*P. nigra* x *P. salacina* or *P. simonii*), wild plum (*P. americana*), apricot (*P. armeniaca*), flowering almond (*P. triloba*), Russian almond (*P. tenella*), Mayday tree (*P. padus* var. *commutata*), and cherry principia (*Principia sinensis*). Most stone fruit diseases in North Dakota are sporadic in occurrence because they are dependent on specialized environmental conditions at certain periods in the growth cycle of the plant.

Black Knot

Black knot, caused by the fungus *Dibotryon morbosum*, is a common and serious disease of plum and chokecherry. It is a problem on Mayday tree and occasionally occurs on sour cherry. This disease is easily recognized by the characteristic hard black elongated swellings or "knots" that develop on the smaller branches (Figure 1). Some of these knots may be a foot or more in length. Eventually they girdle and kill the smaller branches on heavily infected trees. Occasionally infections occur on the trunk or main

branches. These infections develop as elongate, knotty cankers which are per-sistent but seldom girdle the stem.

Figure 1. Black knot on a chokecherry branch.

The black knot fungus produces spores on one- or two-year old knots. The spores initially are released about the time the leaf buds are in the green tip stage. Spore release is heavy at blossom time and is completed about the time the shoots have finished growth. Spores are carried by the wind, infecting new shoots in wet weather, especially when the temperature is between 55 and 77 degrees Fahrenheit.

Symptoms from new infections may appear in the fall, but most infections are not evident until the following spring. New infections appear in the spring as soft knots with an olive-green velvety surface. Later, the knots become hard and black and may continue to grow for several years, finally girdling the branch.

Black knot infections in grafted nursery stock of Mayday tree are a special concern since these trees are often planted in highly visible locations. Infections in this host may not result in the typical black "knots." In young nursery stock, the new shoots become swollen and stunted but remain normal in color. As the tree grows this abnormal swelling continues and eventually some knot-like black tissue may appear. Available evidence indicates that black knot infection on landscape Mayday trees starts in the nursery, and that black knot in new or recently established plantings entered on planting stock and not by spread from wild plums or chokecherries. Do not purchase grafted Mayday trees which have swollen shoots. In case of uncertainty question, contact the North Dakota nursery inspector.

Control requires the removal of all developing knots from affected trees before budbreak in the spring. Prune 4-5 inches below the knot. Apply a wound dressing to large wounds. If practical, remove wild plums, choke-cherries and pin cherries within 600 feet of cultivated stone fruit trees, or prune the knots from the wild trees. Promptly destroy all pruned knots by burying or burning. Annual spring pruning may have to be done for several years before the disease level drops because of the long period before disease symptoms show.

Best control is achieved by pruning in conjunction with use of fungicides. Before bud-break, use a dormant spray of lime sulfur (Orthorix) at the rate of 10 tablespoons per gallon of water, or use Bordeaux mixture (see label for rate). Once the buds break, apply captan (1 tablespoon per gallon) + benomyl (tablespoon per gallon). Continue these applications weekly through mid-June. Commercial applicators may use thiophanate methyl (Topsin-M, lb per 100 gallons) at pre-bloom, petal fall, and first, second and third cover sprays at 10-14 day intervals. Spraying alone, without pruning to remove knots, will not control the disease. Captan should be used with caution on plum,

as it may cause leaf injury on some varieties.

Fungicides registered and available for use may change from year to year. Always check the current year's fungicide recommendations published in Circular PP-469, Plant Disease Control in the Home Garden, or published in the North Dakota Plant Disease Control Guide.

Plum Pockets

Several similar stone fruit diseases are caused by fungi of the genus Taphrina. Taphrina fungi produce various types of "pockets" on wild plum, some domestic plum hybrids, sand cherry, Nanking cherry, wild black cherry (*Prunus serotina*) and chokecherry. The fruits become hollow, bladder-like and enlarged as much as eight to 10 times their normal size (Figure 2). These distorted fruits, the so-called "pockets," may range in color from greenish-yellow to a brilliant red. On sand cherry the fruits are brilliant red and pointed, and the shoots are also thickened and deformed. In addition to the fruit "pockets," enlarged and deformed shoots and curled leaves may develop on chokecherry, wild black cherry, wild plum, and domestic plum. A leaf curl and witch's broom (clusters of small branches) may develop on sour cherry, sand cherry, apricot, Mayday tree and some wild cherries, but no fruit "pockets" are formed.

Figure 2. Left, plum pockets on plum; note inflated yellow fruits are much larger than healthy fruits. Right, plum pockets on Russian almond, showing inflated, red, pointed fruit (arrow). *Photo by H.A. Lamey.*

Plum pockets may cause severe losses of fruit. Taphrina species that deform the shoots may cause serious shoot injury and twig death. Later in the summer, plum pockets and other infected parts (shoots, leaves) may become moldy and develop a dark, sooty or velvety appearance. These are of no consequence in development of the disease

although they may be unattractive.

Spores of Taphrina are dispersed in late spring as soon as pockets and other infected parts mature. Spores lodge in bud scales and other small crevices and remain dormant until bud break the following spring. Summer sprays and fall cleanup are of little value in control.

Effective control of plum pockets relies on preventing spring infection as buds break and growth begins. Eradicant sprays applied just before bud break (delayed dormant) accomplish this. Use a dormant season spray of lime sulfur at the rate of 10 tablespoons per gallon of water or Bordeaux mixture (see label for directions). Lime sulfur is most effective if applied in the spring once the temperatures are above freezing but before the buds begin to swell. Lime sulfur will burn foliage if applied while leaves are on the tree. The entire tree should be thoroughly sprayed, giving special attention to good coverage of all buds. This spray reduces the population of Taphrina fungi, providing it is applied before the buds begin to swell. Lime sulfur can also be applied in the fall after leaf drop.

In chokecherries a swollen fruit somewhat similar in appearance to plum pockets can be caused by a small fly, *Contarinia virginianiae*. The small adult fly, commonly called the chokecherry midge, lays its eggs on the young fruit shortly after bloom. The eggs hatch and larvae tunnel into the developing fruit, completely hollowing out the center. Insect-infested fruits are swollen and green, and when split open will be teeming with reddish-yellow maggots. Little is known of the biology and con-trol of this insect, but fortunately only a small percentage of the fruits are affected any one season and they usually drop before the healthy fruits ripen. Fungicidal sprays for plum pockets will not control this insect.

Brown Rot

Brown rot, caused by the fungus *Monilinia fructicola*, affects all stone fruits. Although the disease can attack blossoms, spurs, and shoots, the homeowner often is not aware of the problem until the ripening fruit rapidly develops a brown rot. When blossoms are infected, they turn brown and remain on the tree into the summer. The brown rot fungus may also move down the blossoms to the base of the flower cluster and into the fruiting spur. Cankers may then develop which eventually girdle the branch or twig. Young shoots may also be infected near the tips, which then wither rapidly. Brown rot may develop on green fruits as small, circular spots that are light brown in color. However, the disease is most serious on ripe maturing fruits. When weather is favorable, entire fruits may rot in a few hours. In wet weather pale brownish, felt-like masses of fungus spores cover the rotting fruit. Rotted fruits may fall to the ground, or they may become shrunken and remain on the trees as "mummies."

The brown rot fungus survives the winter in mummies on the tree, mummies on the ground, and twig cankers. In the spring, spores are produced on the mummies and cankers. These spores are carried by wind and splashing rain to blossoms, where they

germinate, producing infections. The brown rot fungus is not very active during much of the summer but is quite active again as the fruits mature. Infected blossoms and green fruits furnish spores for the infection of ripening fruits. The disease builds up rapidly in warm, wet, humid weather.

Begin brown rot control in late summer or fall. All remaining fruit, mummies, and cankered twigs should be removed. Whenever possible, mummies on the ground should be removed or buried by cultivation before blossom time. Fungicide sprays may be needed for control on fruit trees. Use benomyl at - 1 tablespoons per gallon or captan at 1 - 2 tablespoons per gallon. Apply the first spray as soon as the blossoms show color. If the weather is wet and night temperatures are above 55 F, apply a second spray at full bloom and a third at petal fall. Spray again when the green fruits are fully developed but have not yet turned color and repeat in 10-14 days if the weather is humid and temperatures are in the 60-80 F. range. Control insects that wound the fruit to reduce the danger of infection on the green fruits. Do not use benomyl alone for the entire season as this will give the fungus a chance to develop benomyl-resistant strains.

Perennial Canker

Perennial canker, caused by the fungi *Valsa cincta* and *V. leucostoma*, is a disease of cherry, apricot, plum and chokecherry. The cankers are oval in shape and enlarge gradually from year to year until the affected branch or trunk is girdled and dies. Gums are often secreted (gummosis), but other factors may also cause gummosis. There is often a roll of callus tissue around the edge of the area killed by the canker fungus (Figure 3).

Figure 3. Valsa canker. Note drops of gun (gummosis). *Photo by R.W. Stack.*

The canker fungus produces tiny black fruiting bodies in the cankers and in the dead wood. In the spring spores ooze from these fruiting bodies as tiny thread-like tendrils. The spores are spread by splashing rain and wind and infect branches through damaged or injured bark. As sites for infection, winter injury is very important, but pruning wounds, mechanical damage, insect injury, and leaf scars are also important.

The key to control of perennial canker lies in reducing the number of damaged areas where the fungus can gain entrance and in reducing the number of fungus spores. Do not plant on poorly drained sites. Do not plant young trees next to old, cankered trees. Prune in spring after growth has started so wounds will heal quickly. Remove cankers and badly cankered branches and destroy the cankered wood by burying or burning. Fertilize trees early in the season according to recommended practices. Avoid mechanical injury, including "lawn mower blight." Do not leave long pruning stubs. Paint pruning wounds with a fungicidal dressing. Apply a captan fungicide spray to the entire tree after pruning but before the next rain. Prune to avoid leaving weak crotches. Control insects that might cause injury. Apply white interior water base latex paint to the southwest side of trunks and main branches to help reduce winter sunscald injury.

Verticillium Wilt

Verticillium wilt, caused by the soil-borne fungus *Verticillium alboatrum*, causes light colored leaves with a dull appearance in early summer. The leaves then begin to drop without wilting, starting at the bases of affected branches and progressing upward. The symptoms may involve only one side of the tree or they may involve the entire tree. Stunting occurs in trees that have been affected for several seasons. When an affected branch is cut off, a ring of discolored wood can be seen, with the color varying from gray to light or dark brown. If the bark is peeled back, discolored streaks can be seen in the wood (Figure 4).

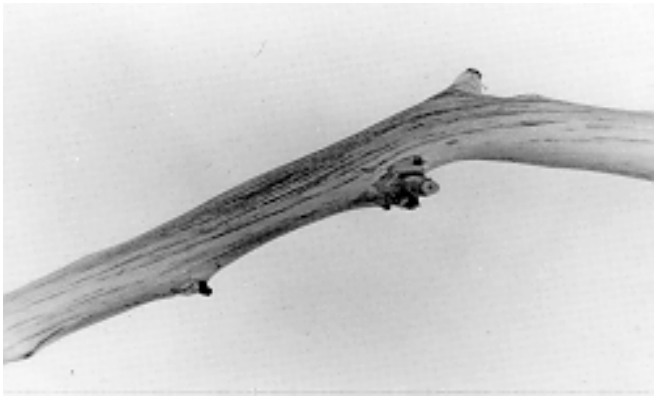

Figure 4. Branch affected with Verticillium wilt. Bark has been removed to show streaking. *Photo by R.W. Stack.*

The Verticillium fungus invades through the root system. All stone fruits are susceptible, but the danger is greatest when a highly susceptible rootstock is used. Verticillium wilt is most common on apricot, sour cherry and plum. The fungus attacks over 300 species of cultivated plants.

There is no good control for Verticillium wilt. Sometimes a tree will recover if affected branches are pruned out and proper fertilizing and watering is provided to help promote vigorous growth. If a tree must be removed because of Verticillium wilt, do not plant another susceptible tree in the same spot, as the Verticillium fungus survives a number

of years in the soil. Highly susceptible trees to be avoided in such a spot include another tree of the same species, a tree on the same rootstock, a maple, or an elm. Plantings on land formerly in potatoes or vegetables may be particularly likely to get Verticillium.

Bacterial Spot

Two similar diseases, bacterial spot and "shothole," caused by the bacteria *Xanthomonas pruni* and *Pseudomonas syringae* are problems on apricot, plum and chokecherry and may also affect sour cherry and flowering almond. Although infections of fruit and young shoots occur, the disease is usually noticed on the leaves. Leaf spots first appear as watersoaked spots on the under-surface of leaves. These spots are somewhat angular and later turn brown to black. The centers of many spots fall out, leaving red margins around the holes (Figure 5). Leaves with many leafspots turn yellow and drop, causing premature defoliation that reduces fruit size weakens the tree. Spots on fruits are dark brown or reddish-brown; and if infection occurs early, the spots are sunk-en. Twig infections are not readily noticed.

Figure 5. Bacterial spot on chokecherry leaf. *Photo by R.W. Stack.*

Autumn twig infections show up the next spring as "spring cankers." They are neither numerous nor obvious, but they are the source of spread in the spring. Bacteria ooze from these cankers and are carried by splashing rain to developing leaves, fruits, and shoots. Driving rains are especially effective in spread and may result in bacterial spot being more severe on one side of a tree than on the other. Additional spread occurs whenever there are periods of wet, windy weather in June and July. Hot, dry weather reduces further spread.

Bacterial spot and `shothole' are not easily controlled, but some cultural practices will help. Avoid planting young susceptible trees near old ones. Use a balanced fertilizer; avoid excess nitrogen, as this promotes disease development. Avoid lawn fertilizer, as it is high in nitrogen. Most home garden fungicides are not effective against bacterial spot, although some of the copper fungicides (eg. Bordeaux mixture) may slightly reduce disease development.

Powdery Mildew

Powdery mildew, caused by the fungus *Podosphaera oxyacanthae*, affects apricot, sour cherry, sand cherry, pin cherry, chokecherry, plum, flowering almond and black cherry. Infected leaves are covered with a powdery white growth, and when severely affected the leaves are distorted and curled upward. Later, tiny black dots (cleistothecia) form on the powdery surface. Shoots are also attacked and may be stunted and distorted. The powdery mildew fungus survives the winter on the buds. Infected shoots produce airborne spores that spread the fungus in humid weather.

Powdery mildew is seldom serious enough under North Dakota conditions to warrant control. If control is necessary powdery mildew can be controlled by applications of benomyl fungicide at the rate of 2 teaspoons per gallon of water. A brown rot control program involving the use of benomyl will also control powdery mildew.

Cherry Leaf Spot

Cherry leaf spot, caused by the fungus *Coccomyces hiemalis* or closely related species, affects sweet and sour cherries, chokecherry and plums. Cherry leaf spot infections are small (1-3 mm) rounded spots which become yellow and then brown (Figure 6). If infection levels are low, a few spots on a leaf may pass unnoticed. When infection levels are high, the combined effect of many spots per leaf causes the leaves to turn yellow and fall prematurely. Defoliation can occur as early as mid-summer under severe disease conditions.

Figure 6. Cherry leaf spot. *Photo by R.W. Stack.*

The fungus survives from season to season in fallen leaves. In the spring ascospores

are discharged from minute structures (apothecia) in the fallen leaves and infect new leaves on the tree. Infection does not begin until leaves mature, about petal fall stage. Further infection cycles may occur as new spores (conidia) are produced in these early infections.

Because the fungus survives on fallen leaves, a thorough fall cleanup can control the disease under most home garden conditions. Larger plantings and commercial fruit orchards may require regular spray programs beginning at petal fall and repeated every 10-14 days until harvest. A post-harvest spray two-three weeks after harvest may help retain foliage later in the season and improve tree vigor and hardiness. Spray with benomyl using -1 tablespoons/gallon, or use tablespoon benomyl + 2 tablespoons captan/gallon. Captan at 2 tablespoons/gallon can also be used but is less effective. Do not use benomyl alone for the entire season as this will give the fungus a chance to develop benomyl-resistant strains.

X-Disease

X-disease (also called Western X disease) attacks many stone fruits. The disease occurs frequently on chokecherry, which is its most common wild host. Newly infected chokecherries begin growth later in the spring than healthy trees. Six to eight weeks after growth begins, the leaves on the infected chokecherries turn bright orange to red and many affected leaves drop off. A second flush of growth may occur in mid-summer; at first the leaves may be a yellowish-green but later they turn red. The fruits on these trees are pointed and remain pale red. In succeeding years, the growth forms rosettes or tufts of leaves which are a dull yellow. The leaves are fewer and smaller than normal and there are few fruits. Twig and branch dieback occurs, and the trees die within three or four years of infection.

On X-disease-infected sour cherries, the fruits are smaller than normal, pale red to greenish white, and often pointed. Normal and abnormal fruits may be mixed on the same branch, with the abnormal ones failing to ripen. By late summer a few leaves on infected branches may be rusty colored with traces of red or orange along the midrib. Severely diseased trees have rosetted terminals, pale green foliage, and twig and branch dieback. Wild plums (*P. americana*) may be symptomless hosts.

X-disease is caused by a specialized kind of bacterium called a mycoplasma. It is transmitted from tree to tree by grafting and by various species of leafhoppers. Wild chokecherries are the natural reservoir host and X-disease spreads from them into new orchards or other plantings.

The only control available is the use of disease-free planting stock and isolation of the planting. Removal of wild infected trees, including all chokecherries, within a radius of 500 feet, where practical, may help reduce the spread of this disease. This control is used around commercial orchards but is of questionable value around homes or where chokecherry is the desired species.

Virus Diseases

There are numerous virus diseases that attack stone fruits. One of the most common is Prunus ringspot virus, which attacks almost all Prunus species, causing various types of leaf abnormalities including yellow rings, lines, bands, spots, mottles, and mosaics, as well as death of leaf tissue, leaf deformity and tree stunting. Prunus ring-spot virus is transmitted by grafting, by contact with diseased plants, and also in the seed. The only control for Prunus ringspot is use of disease-free planting stock and removal of infected trees.

Another virus disease is sometimes seen in choke-cherries in North Dakota. The disease is called "sour cherry yellows" after the most economically important host. Sour cherry yellows affects sour cherries, choke-cherry and wild plums. Symptoms of sour cherry yellows are suppressed branching, fruit abortion, and early fall color. After several years, infected plants have many long, willowy, unbranched shoots which have foliage only at the tips and little fruit set. In sour cherry, decline and death eventually follow, although the poor fruit set renders the trees uneconomic long before actual death. Chokecherry apparently can remain infected and symptomatic indefinitely. Some infected chokecherries showing unusually pronounced symptoms may have been propagated as horticultural cultivars.

As with other virus diseases, no cure is available. In orchards, prompt removal of infected trees may slow spread to adjacent trees. Removal of chokecherries in nearby hedgerow areas adjacent to cherry orchards may reduce occurrence of the disease. In home gardens, infected chokecherries probably will live indefinitely but may be a reservoir of inoculum if susceptible sour cher-ries are planted nearby.

Many other viruses may also infect various Prunus species, but symptoms and controls are more or less similar to those described for Prunus ringspot virus. Viruses seldom cause death of trees, although they may predispose twigs to winter injury.

Winter Injury

Various types of winter injury may occur. Freezing can kill the flower buds and it can also kill young twigs, resulting in dead branch tips. Freezing can also cause frost cracks (splitting) in the trunk. Such injury is most frequently caused by a rapid temperature drop in early fall before the tree is completely hardened off, by a late spring cold snap after the tree is coming out of dormancy, or by extremely cold winter temperatures. Planting in a protected location may help to minimize these effects.

The other type of winter injury is sunscald. This occurs in late winter when the sun warms the bark on the south or southwest side of the trunk or main branches. If the sun warms the bark enough, the inner living bark becomes physiologically active. If the temperature then drops rapidly to sub-freezing temperatures after this warming, the

inner bark on the southwest side may be killed, resulting in a discolored area on the bark that later becomes sunken. The dead tissue becomes a site for infection by various organisms, including the perennial canker fungus.

Prevent winter sunscald by shading the southwest side of the trunk and main branches. The trunk can be wrapped with various commercial reflective or white trunk wrappers, or the trunk and main branches can be painted on the south or southwest side with a white interior water base latex paint. Particular attention should be paid to trunks and main branches on which the bark is still thin and smooth.

Crown Gall

Crown gall is the name given to a disease caused by the soilborne bacterium *Agrobacterium tumefaciens*. When plant tissue is infected by this bacterium, the host cells multiply uncontrolled, producing a large woody or corky tumor or gall. The name `crown gall' refers to the most common site for infection, on the stem just above or below the soil line, although infections higher on the stem or on roots are also common. The crown gall bacsteria infect through wounds, especially those near the soil line arising from cultivation and on roots broken at planting time. Several galled nursery plants are shown in Figure 7.

Figure 7. Crown gall. *Photo by R.W. Stack.*

Crown gall bacteria survive in plant debris in the soil for several years, so planting sites with a history of crown gall are likely to continue to show problems. Crown gall is usually diagnosed based on symptoms, since the bacteria are difficult to recover once the galls reach any size. Nursery beds with a history of crown gall problems should be planted to non-host plants, fallowed, or fumigated. Since the crown gall bacterium has a very wide

host range including not only woody plants but many vegetables and weeds, rotation crops should be carefully chosen.

Control

Most homeowners encounter crown gall when they purchase infected planting stock. Do not purchase plants having galls on stem or roots. If you receive galled plants by mail order, **do not plant them in your garden**. Demand replacements or refunds and notify your state nursery inspector.

All stone fruit trees (Prunus species) are susceptible in some degree to crown gall. Young trees grown from grafted stock or cuttings are especially likely to become infected because of wounds involved in propagation.

Plants infected with crown gall cannot be cured. New planting stock found to be infected should be destroyed.

Some trees may survive for a long time with large crown galls. If isolated, such plants may be left as long as the unslightly (some would say "having character") galls are not objectionable. Cutting off galls will not cure the problem and may actually make it worse.

Landscape replacement trees and shrubs which do not get crown gall include Juneberry, barberry, birch, Kentucky coffeetree, hop hornbeam, Amur cork tree and sumac.

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Source: http://www.ag.ndsu.edu/pubs/plantsci/hortcrop/pp689w.htm (accessed 2/2011)