PP-454 (Revised)



# Diseases of Apples and Other Pome Fruits

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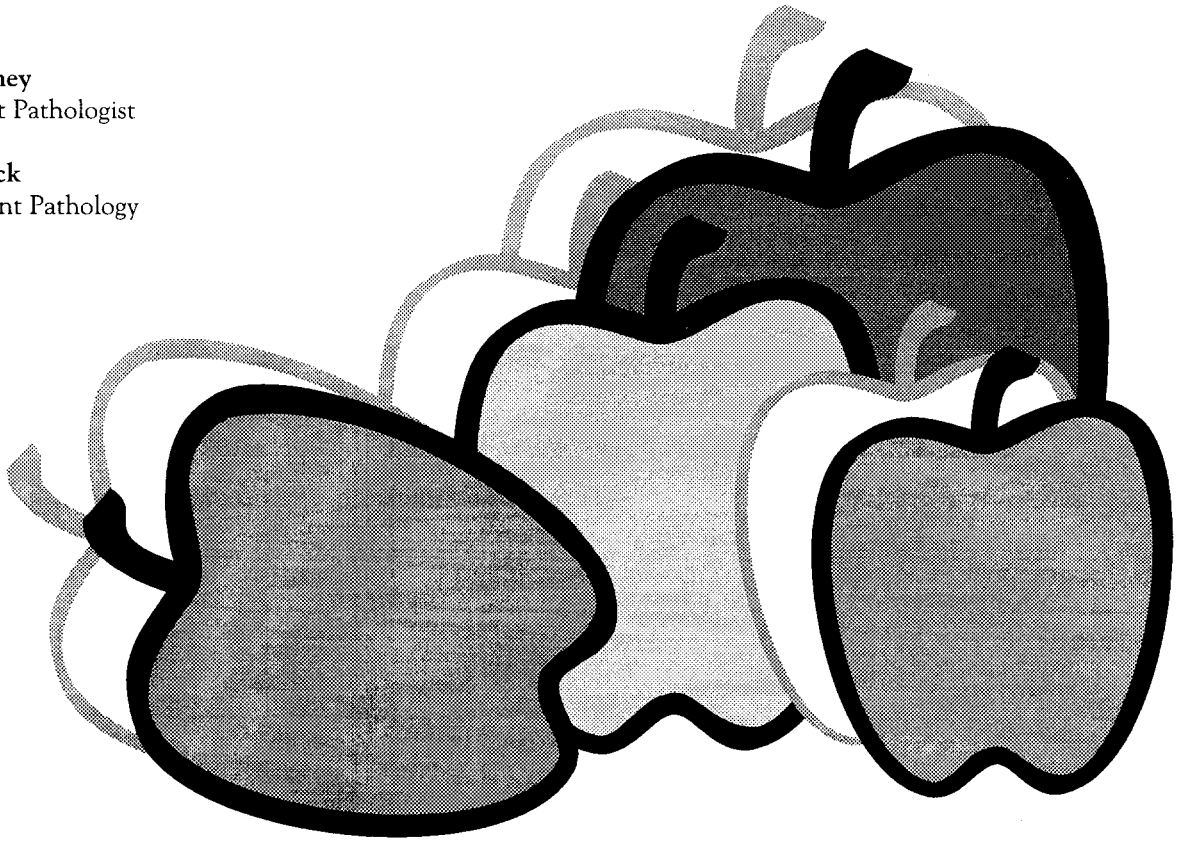



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Apples and other fruit trees are widely grown in North Dakota for home fruit or landscape purposes. However, several diseases can seriously reduce their fruit quality, aesthetic appearance and tree health.

Apples and related trees in the pome fruit section of the rose family are attacked by the same or similar disease organisms. Trees and shrubs of the pome fruits section discussed in this circular include apple (*Malus*), crabapple (*Malus*), Hawthorn (*Crataegus*), quince (*Cydonia*), pear (*Pyrus*), juneberry (*Amelanchier*), mountain ash (*Sorbus*), and cotoneaster (*Cotoneaster*). The principal pome fruit diseases in North Dakota are fireblight, scab, black rot (frogeye leaf spot) and rust, plus several environmental disorders.

# Fireblight

Fireblight is one of the most destructive diseases of apples, pears, mountain ash and cotoneaster. The bacterium (*Erwinia amylovora*) that causes this disease attacks both fruit and ornamental plants in the rose family.

Fireblight is most damaging during warm, humid weather, especially during June and July. It is characterized by sudden wilting, followed by shrivelling and blackening of the blossoms, young shoots, and developing fruit. Affected parts look as though they were scorched by fire, hence the name "fireblight." The disease cycle is shown in Figure 1.

Occurrence of the disease is sporadic and unpredictable. It may cause severe damage after being nearly absent for several years.

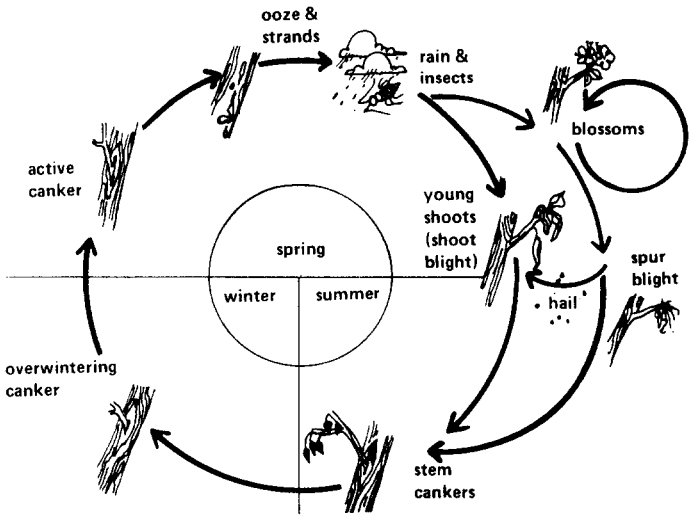



Figure 1. Fire blight disease cycle.

## *Symptoms and Disease Development*

Any portion of susceptible plants may be attacked. The disease is first observed during the blooming period on the following plant parts:

**Blossoms and young fruits.** Fireblight causes them to wilt, dry and darken. If the bacteria spread into the fruiting spur, this is called spur blight (Figure 2).

**Tips of young shoots and water sprouts.** The terminal growth may be killed back as much as 36 inches, frequently with a bent tip. This is called "shepherd's crook" (Figure 3). Dried leaves remain attached to the dead shoots during summer and fall.

An infection may progress down a shoot and into the bark of larger limbs where dark, sunken cankers form. These cankers slowly enlarge and eventually may girdle the limb. On pears, mountain ash, and very susceptible apple varieties, trunk cankers often kill the tree.

Bacteria overwinter in cankered limbs. Droplets of sticky amber-colored ooze form on these cankers, called "holdover" cankers. These droplets contain millions of bacteria. Insects, birds, and spattering rain can carry these bacteria to the blossoms, leaves and twigs.

Figure 2. Fire blight spur blight - note dried fruit (arrow).

A combination of warm temperatures (65 to 85 degrees Fahrenheit) and high humidity created by rain, fog, or irrigation favors fireblight development. Dry weather usually prevents new infections and retards existing infections. During cool springs, the blossom or spur blight phase usually is not significant. Leaf and twig injury resulting from hail often increases the spread and development of fireblight.

## *Control*

No single practice completely controls fireblight, but a combination of the following practices reduces the chance for infection:

Prune and burn diseased twigs and branches in early spring before budbreak when the trees are not actively growing. At this time the chance of spreading bacteria is minimal. Limited late fall pruning may be satisfactory if done after several hard freezes have occurred. Blighted shoots can be readily located at that time since they retain their leaves after other leaves have fallen. Cut at least 10 inches below the edge of the infected area or canker. After each cut, sterilize the cutting tool and the cut surface with a disinfectant to avoid further spread of bacteria. Household bleach diluted to 20 percent (3 cups to 1 gallon water) and old fashioned liquid Lysol (use only the Regular Lysol in the red box or with the red label, containing o-phenyl-phenol and o-benzyl-p-chlorophenol - this should smell like creosote) diluted to 20 percent are highly effective. Denatured ethyl alcohol (available as shellac thinner) and Pine Sol (19.9% pine oil) are nearly as effective when used full strength. Dip shears, knife or saw in the disinfectant or pour over the cutting edge. Bleach and Pine Sol are very corrosive to tools, so if they are used, be sure to rinse and oil the tools after use to prevent rusting.

**Figure 3. Shepherd's crook on young shoots killed by fireblight.**

Clean cultivation and/or addition of nitrogen fertilizers combined with abundant soil moisture (irrigation or high rainfall) can promote rapid growth of fruit trees. Unless deficiency symptoms occur, avoid the use of fertilizers on young trees, especially where trees are cleanly cultivated, since fireblight is more severe on soft, succulent growth. Use a low-nitrogen balanced fertilizer when tree vigor is low. Tree vigor may be determined by leaf color and the amount of terminal growth produced each season. Twelve to 15 inches of new growth each season is adequate; more encourages fireblight. Remove suckers (water sprouts) as quickly as they develop on susceptible varieties. Their removal often avoids canker formation on the trunk.

Blossoms are the most susceptible part of the tree, but infections in blossoms usually do not continue into the limbs or terminal growth. On trees grown for fruit you can protect blossoms from infection with the antibiotic streptomycin. Follow label directions for application of streptomycin spray. Blossom sprays are not needed for flowering trees grown only as ornamentals.

If you plan to use streptomycin keep in mind the following suggestions:

Use on apple or pear varieties where the disease has been a problem in the past.

Use it at the rate of 100 parts per million (ppm) (1 1/2 teaspoons of a 17-21 percent formulation in a gallon of water).

Make first application in the pink or early bloom stage, and repeat at four- to five-day intervals for a total of three sprays. If the bloom period is prolonged, apply a fourth spray at petal fall or shortly after.

Streptomycin is most effective when used alone, but may be combined safely with lime sulfur, wettable sulfur, benomyl, or captan at peak bloom for scab control.

Do not combine streptomycin with the insecticide Sevin for blossom sprays. Sevin is highly toxic to honeybees and also may result in fruit drop after pollination.

Apply antibiotic sprays as you would spray for other diseases. Thorough coverage from both sides is essential; use about 10 gallons of spray for each mature tree. Spray blossoms thoroughly if daytime temperatures exceed 65 F.

Use after hail.

Do not apply to apples within 50 days of harvest.

Do not apply to pears within 30 days of harvest.

Streptomycin is not registered for use on cotoneaster, crabapple, or mountain ash.

Streptomycin acts systemically; that is, it is taken up by the plant. It is effective for the control of blossom blight. Blossoms that are open when sprayed are protected for three to four days. Streptomycin is much less effective for the control of shoot (twig) blight that occurs later in the season. It is effective if applied immediately after hail.

Uptake of Streptomycin by shoots is enhanced if applied in the evening. Effective control of fireblight is possible through careful pruning and spraying, if you begin before the disease becomes too advanced. In some cases, however, mountain ash, cotoneaster and susceptible apple varieties will not respond to pruning. The disease will continue to spread within the tree or bush, eventually causing the complete loss of the plant.

Resistance to fireblight has been incorporated in several good apple varieties. Those recommended for North Dakota are: Dakota, Haralson, Hazen, Red Duchess, Mandan, Sweet Sixteen, Haralred, State Fair, Northern Lights, Dakota Gold, Woodarz and Red Baron. The older varieties Garrison, Killand and Thorberg are also resistant but are not available in the trade at present.

Crabapples for North Dakota that show good fireblight resistance include Dolgo, Red River, Centennial, Centurion, Jack (or Korean), Siberian, Manchurian, White Candle, Thunderchild, Radiant and Vanguard. The varieties Radiant and Vanguard are susceptible to apple scab. The varieties Spring Snow and Red Splendor show intermediate resistance to fireblight.

Resistant varieties are not immune to fireblight and can be infected in severe fireblight years; however, the level of infection in resistant varieties will be less than in susceptible varieties, which may be destroyed in a severe season. Control measures are more likely to be effective in resistant than in susceptible varieties. There are some reports that the understock used on apples may affect susceptibility. The Malling-Merton and East Malling understocks appear to increase susceptibility over seedling understocks.

Apple varieties that have been reported susceptible to fireblight include: Mantet, Beacon, Wealthy, Lakeland, Honeygold, and Prairie Spy. Crabapple varieties reported susceptible to fireblight include: Almey, Hopa, Strathmore, Purple Wave, Flame, Snowdrift, Whitney, Royalty and Calocarpa (also called Redbud or Zumi).

It is most important to detect blight in the early stages of development and start control measures immediately. After most of the branches of a tree are infected, there is little hope of saving it. In advanced cases of blighted cotoneaster it is better to remove the plant, including the roots, and to start a new one in its place.

Fireblight cankers serve as avenues for entry of canker-causing or wood-decay fungi. Untreated fireblight cankers, especially holdover cankers on larger branches, may serve as infection sites for fungi of two types: those causing death of bark tissue (= canker fungi) and those attacking the wood of the tree (= wood-decay or wood-rot fungi).

Several different pathogenic fungi are capable of infecting through old fireblight cankers. The most commonly encountered in North Dakota is the black rot fungus *Physalospora obtusa*. This fungus causes perennial cankers which enlarge each year until the branch is girdled. (A more complete description of black rot is given later in this circular.) Black rot cankers which follow fireblight are frequently mistaken for continued damage by fireblight.

Fireblight cankers on main limbs or trunks may also be infected by wood-rotting fungi. The chance of this infection can be reduced by painting exposed wood with an alcohol-base shellac followed by a commercial tree wound dressing such as a water emulsion of asphalt.

# Apple Scab and Related Diseases

Apple scab is a common disease on apples growing in North Dakota. The fungus (*Venturia inaequalis*) that causes this disease is a threat to apple foliage and fruit every year. The same or closely related species of *Venturia* cause similar diseases on pear, hawthorn, mountain ash and cotoneaster.

## *Symptoms and Disease Development*

Scab produces spots on leaves, petioles, and fruits. On leaves the spots are at first a velvety olive-brown with a feathery margin. Later the spots turn dark brown to black (appear sooty) and have a definite margin (Figure 4). Severe leaf spotting leads to defoliation. Scabs on the fruit have early symptoms similar to those on leaves. Later, fruit scabs become brown and corky-russeted. If infection occurs early, fruits do not expand properly on the infected portions and fruits are undersized and gnarled (Figure 5).

The apple scab fungus overwinters in dead leaves under the tree. As warmer days begin in the spring, the fungus produces spores in tiny black fruiting bodies embedded in the old leaves. These spores are carried by air currents to newly developing leaves and fruits on the trees, resulting in scab infection (primary infection). Secondary spores are produced on the scabs with subsequent reinfection of leaves and fruits.

## *Control*

Resistance to apple scab differs with varieties. Haralson and Red Duchess are the varieties recommended for North Dakota that are most resistant to scab. Dolgo, Centennial, and Manchurian crabapple are also resistant to scab.

Since the fungus overwinters in infected leaves, the first step in controlling the disease is to clean up and destroy fallen leaves in autumn or early spring. Homeowners can use the fungicides captan or benomyl plus captan during the growing season to prevent infections. Begin at the early bloom period and repeat at seven to 10-day intervals when apple scab is a problem. Sprays act to prevent infections but do not "cure" infections that are already there. Home gardeners may need to initiate a fungicide spray program if scab has caused severe defoliation over several years. This defoliation can seriously weaken trees, reducing the productivity and survival capability of fruit trees as well as the aesthetic value of ornamentals.

Orchardists frequently rely on a rigorous spray schedule to reduce scab to a minimum. Commercial fruit growers should contact the NDSU Extension Service for current recommendations.

Primary spores (ascospores) of *Venturia* require at least nine hours of continuous wetness on leaves to complete the infection process, while secondary spores (conidia) require at least six hours. These minimum times are at the optimum temperature for infection, between 61 and 75 F. As temperatures go above or below this range, the period of leaf wetness needed increases. The wet periods required are given

Figure 4. Apple scab on crabapple leaves.

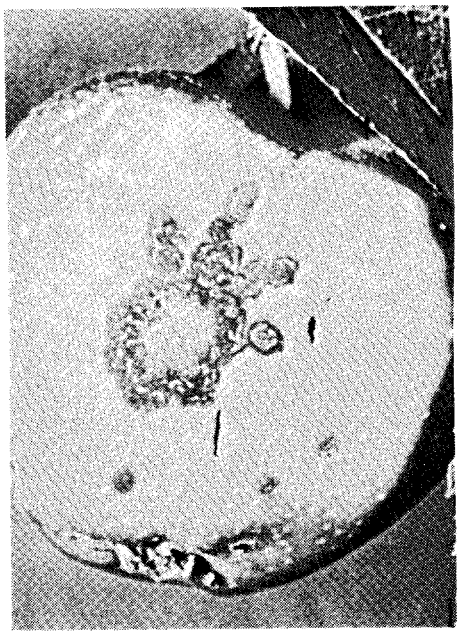


Figure 5. Apple scab on apple fruit.

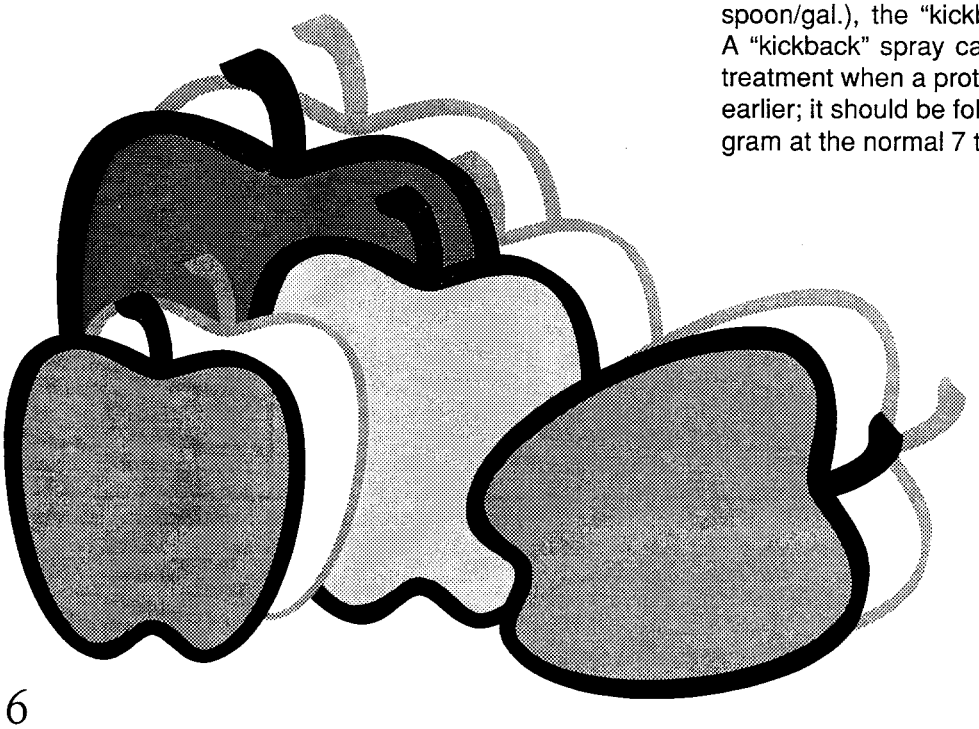
**Table 1. Approximate hours of wetting at indicated temperatures required for leaf scab infection, and days required for lesions to appear.**

| Average temperature (°F) | Hours wetting required for infection[a] From primary inoculum (ascospores) (spring infections) | From secondary inoculum (conidia) (summer infections) | Days required for lesions to appear[b] |
|---|---|---|---|
| 78 | 13 | 8.7 | |
| 77 | 11 | 7.3 | |
| 76 | 9.5 | 6.3 | |
| 63-75 | 9 | 5.9 | 9 |
| 61-62 | 9 | 5.9 | 10 |
| 60 | 9.5 | 6.3 | 11 |
| 58-59 | 10 | 6.6 | 12 |
| 57 | 10 | 6.6 | 13 |
| 56 | 11 | 7.3 | 13 |
| 55 | 11 | 7.3 | 14 |
| 54 | 11.5 | 7.7 | 14 |
| 52-53 | 12 | 7.9 | 15 |
| 51 | 13 | 8.7 | 16 |
| 50 | 14 | 9.3 | 16 |
| 49 | 14.5 | 9.7 | 17 |
| 48 | 15 | 9.9 | 17 |
| 47 | 17 | 11.3 | |
| 46 | 19 | 12.6 | |
| 45 | 20 | 13.3 | |
| 44 | 22 | 14.6 | |
| 43 | 25 | 16.5 | |
| 42 | 30 | 19.9 | |
| 33-41 | >30 | >20.0 | |

[a] Leaves remain wet for varying lengths of time after the rain stops, depending on conditions. Wetting periods from intermittent showers should be added together. Average temperature for the period should be determined from hourly readings.

[b] Days required for lesions to appear once infection has been established. No further wetting is required. For this column daily maximum and minimum temperatures are adequate for determining the average.

(Source: New York State Agricultural Experiment Station publications).



in Table 1 and are calculated as the average temperature for the wetting period.

Leaves (and fruit) remain wet for varying times following a rain. With daytime showers and normal breezy weather, leaves may dry off quickly, aborting the infection process. When rain occurs in evening or at night, leaves may remain wet all night, especially if there is fog or the air is still. Commercial orchardists use instruments to determine the exact duration of leaf wetness. The home fruit grower can estimate this period.

Under North Dakota conditions the most risky times will be 1) late afternoon or evening rains where skies remain overcast at night and where temperatures are 55 F or higher and 2) rainy-misty days where such conditions persist for 24 hours or more and temperatures are 41 F or higher.

Although most fungicides act primarily to prevent infections, certain fungicides have a few hours of "kickback" activity. This is the period of time after the infection process has started when a fungicide can be applied and still stop an infection. Captan, benomyl plus captan or dodine (available only to commercial orchardists) have 18-24 hours of "kickback" activity against apple scab. If one of these fungicides is applied within 18-24 hours of the start of an infection period (when the tree first becomes wet), the infection can be stopped. Dichlone has a longer "kickback" but is not as readily available to orchardists. Mycobutanil (Nova or Rally) and fenarimol (Rubigan), available to orchardists, have up to 96 hours "kickback" activity.

In our area, dichlone may be available from a few suppliers as Quintar 5F. If Quintar is used at 3.2 fl oz/100 gal. of spray (1/4 teaspoon/gal.), the "kickback" is 30-36 hours; if used at 6.4 fl oz/100 gal. (1/2 teaspoon/gal.), the "kickback" period is 36-48 hours. A "kickback" spray can be used as an emergency treatment when a protective spray was not applied earlier; it should be followed by a protective spray program at the normal 7 to 10-day intervals.

# Cedar-Apple Rust and Related Rusts

Cedar-apple rust attacks apples and crabapples. It is caused by the fungus *Gymnosporangium juniperi-virginianae*.

Several other closely related species of *Gymnosporangium* may also attack apple and juniper. These also are found on other trees of the apple family including hawthorn, quince and juneberry. Table 2 lists the species of *Gymnosporangium* known to occur in North Dakota.

## *Symptoms and Disease Development*

Cedar-apple rust symptoms develop on both apple leaves and fruits. Small, yellow-to-orange spots develop on the upper leaf surface shortly after bloom. Black dots soon appear in these spots. The infected spots are often thickened or blistered. In mid-summer tiny orange-colored tubes form on the lower leaf surface opposite the spots on the upper surface. These tubes split open and curl back (Figure 6). Heavy infection can result in severe defoliation. Spots on the fruits are similar except that the tubes are not always formed.

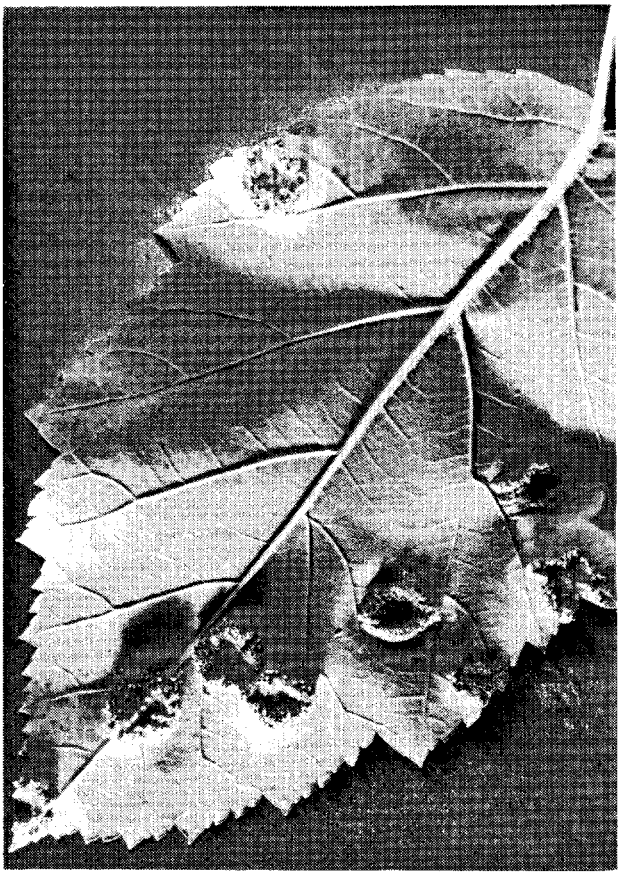


**Figure 6. Cedar-apple rust on the underside of a hawthorn leaf. The pustules are bright orange.**

Like many other rust fungi, cedar-apple rust alternates between two kinds of plants - one being the apple. The alternate hosts (plants on which it completes its life cycle) are red cedar (*Juniperus virginiana*) or Rocky Mountain juniper (*Juniperus scopulorum*).

On red cedar, red-brown galls form over a period of nearly two years. In the spring the mature galls ("cedar apples") produce orange gelatinous tendrils ("horns") during moist weather (Figure 7). The spores formed on these tendrils infect apple leaves and fruits.

**Table 2. Hosts of Gymnosporangium rusts.**

| | Juniper Host[1] | Prome Fruit Plant Part Attacked |
|---|---|---|
| Cedar-apple rust - G. *juniperi-virginianae* | ERC, RMJ | Leaves, fruits of apple. |
| Quince rust - G. *clavipes* | ERC, RMJ, CJ, BJ | Fruits, especially hawthorn. |
| Hawthorn rust - G. *globosum* | ERC, RMJ | Foliage, especially hawthorn; also on apples, mountain ash and pear. |
| Juneberry rust - G. *nidus-avis* | RMJ, ERC, CJ | Fruit, stems, leaves of juneberry, quince, apple, mountain ash. |
| (No common name) G. *bethelii.* | RMJ | Hawthorn foliage |
| (No common name) G. *clavariforme* | BJ | Juneberry, hawthorn, cotoneaster foliage |

[1] ERC = eastern red cedar (*Juniperus virginiana*)
RMJ = Rocky Mountain juniper (*J. scopulorum*)
CJ = creeping juniper (*J. horizontalis*)
BJ = common (Bush) juniper (*J. communis*)

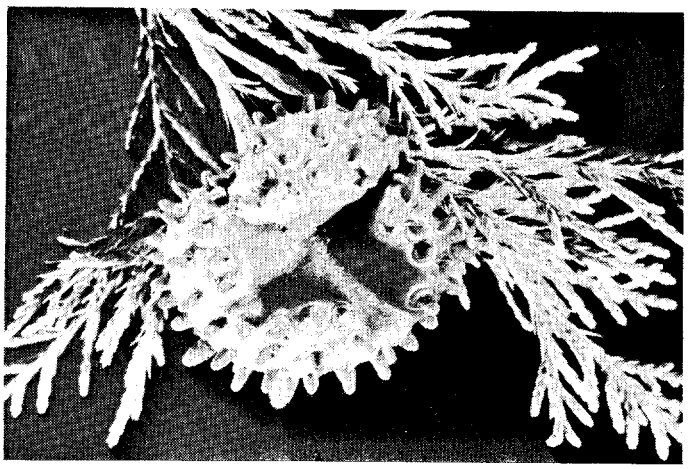


**Figure 7. Rust gall ("cedar apple") on red cedar.**

In *G. clavipes* (quince rust) the galls are elongate, perennial and may live for several years, producing new crops of spores each spring.

### *Control*

In commercial orchard practice the disease can be controlled by removing cedars within two miles of apples and crabapples. In cases where this is not practical, apply mancozeb, myclobutanil (Nova or Rally) or fenarimol (Rubigan) periodically, starting when the flower buds show pink and at 14-day intervals to a maximum of three sprays, or until cool wet weather (spring or early summer) is past. This will protect the emerging leaves and developing fruits. Select the more cedar-apple rust resistant varieties such as Dakota, Haralson, Mandan, or Red Duchess. The reaction to other rusts is unknown.

Mancozeb is no longer registered for use in the home garden. Sulfur, registered for scab control, may help to suppress rust development on apple trees grown by the homeowner. Native crabapples are susceptible to cedar-apple rust; Asiatic crabapple varieties are generally resistant. Dolgo, Centennial, and Manchurian crabapples are resistant to cedar-apple rust. The reaction to other rusts is unknown.

In a home garden, removal of galls on junipers by pruning out in late winter may give some control. No species or cultivars of *Juniperus* are resistant to all of the *Gymnosporangium* rusts. Many cultivars advertised as resistant are only so to cedar apple rust.

## *Powdery Mildew*

Powdery mildew is potentially a serious problem on apples. On highly susceptible varieties it can cause death of vegetative shoots, death of flower buds, and russetting of fruit. Losses in North Dakota usually are not severe, since most varieties grown are not highly susceptible. Powdery mildew of apple is caused by the fungus *Podosphaera leucotricha.*

### *Symptoms and Disease Development*

Mildew occurs in the nursery on terminal shoots. On established apple trees it appears on leaves, flowers, shoots, and fruit. On leaves, whitish, felt-like patches of fungus appear and soon cover the leaves (Figure 8). Infected leaves are abnormally narrow and become stiff and brittle with age.

Blossom buds infected by powdery mildew may winterkill or may open several days after normal buds. Infected shoot buds produce diseased leaves. These leaves are covered with the white fungus from the time they emerge.

Powdery mildew lives over the winter in infected tissues. Infection occurs readily at temperatures of 60 to 80 F whenever the relative humidity is high (no film of moisture is required on the leaf).

### *Control*

In most seasons, no control measures are needed under North Dakota conditions for urban trees. With these conditions, the regular spray schedule for scab and rust will usually give effective control of powdery mildew as well. If powdery mildew becomes a problem, the disease can be controlled by spraying fungicide as soon as the disease appears. Fungicides for homeowners to use are benomyl or wettable sulfur. Commercial orchardists can also use fenarimol (Rubigan) or myclobutanil (Nova or Rally). The fungicide application should begin when the flower buds are in the tight cluster stage and continue until terminal growth stops.

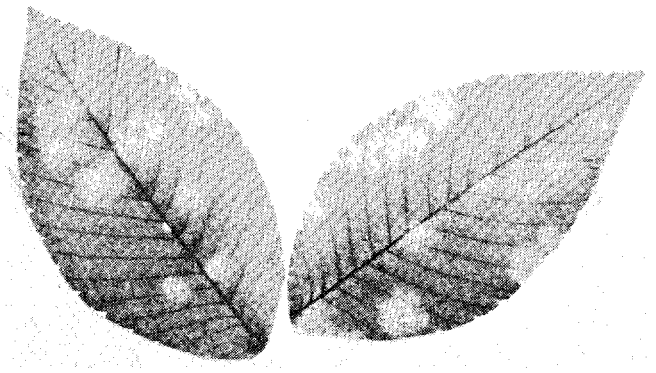


**Figure 8. Powdery mildew on leaves.**

# Black Rot-Frogeye Leaf Spot

Two seemingly different but related diseases, frogeye leaf spot and black rot canker, are caused by the same fungus, *Physalospora obtusa.* Branches or twigs infected with black rot canker are often the source of the spores which infect leaves, causing frogeye leaf spot.

## *Symptoms and Disease Development*

The leaf spot phase is called frogeye leaf spot and starts as small purple spots which may enlarge with concentric zones - hence the name. Older lesions have a pale tan center surrounded by a purplish ring. Frogeye leaf spot shows up mostly when late May and June weather is exceptionally rainy. The black rot fungus also attacks fruit, causing a dry rot. Infected apples eventually shrivel and become black "mummies," hence the name "black rot" (Figure 9). Spores infecting leaves or fruits usually come from undetected or untreated branch cankers.

Control of frogeye leafspot in the home garden relies on timely pruning of black rot cankers, which are the source of the frogeye leafspot fungus. Orchardists may also use scab fungicides such as mancozeb.

Black rot canker can be especially serious. It is common on crabapples and mountain ash in North Dakota, especially in years after a severe fireblight epidemic or sunscald. This fungus enters through wounds in the bark. Unprotected fire-blight cankers or sunscald wounds are especially suitable entry points for black rot. Once established, black rot cankers may girdle large branches or even main stems of young trees. Black rot cankers expand 6-12 inches along the branch each season. This killed bark is discolored and when cut will be brown inside rather than the green or white of healthy bark. On last year's cankers the black rot fungus produces spores profusely in rows of raised black pimples in the bark (Figure 10). These pimples produce large numbers of spores of the black rot fungus.

## *Control*

Since spores for the frogeye leaf spot phase come from infected twigs and branches, a necessary first step in preventing leaf spot is careful winter cleanup. Remove dead twigs and branches. Paint cuts with alcohol-based shellac followed by an asphalt-base tree paint. Clean up brush and pruned branches from around and under trees and remove from the area or burn. Remove any black rot mummied fruits hanging on the tree.

As mentioned above, regular sprays used for apple scab control will also protect leaves against frogeye leaf spot. Black rot cankers can be excised and cankered branches removed as for fireblight. Follow the sanitary precautions outlined under fireblight.

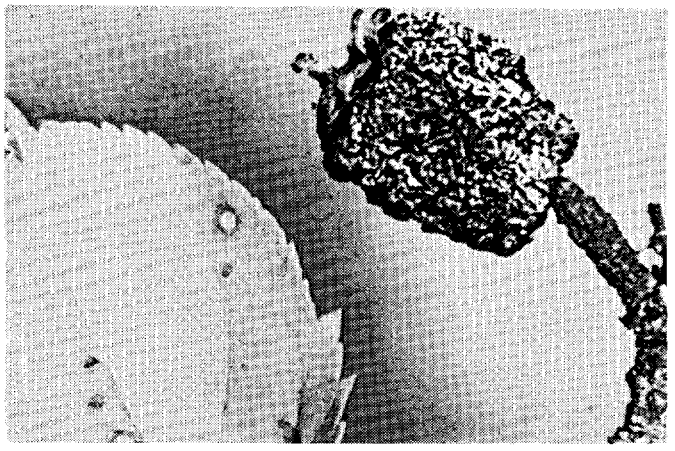


**Figure 9. Black rot mummy and frog eye leaf spot.**

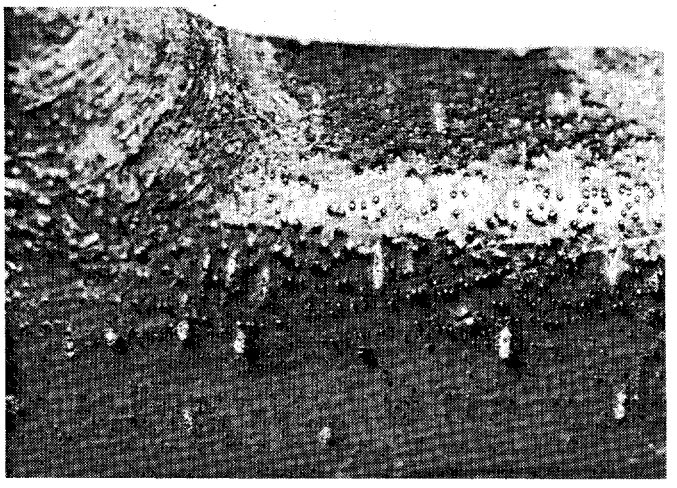


**Figure 10. Black rot on branch. Note rows of black fruiting bodies.**

## Sunscald - Plant Injury

This environmentally-caused problem is very serious on apples, other fruits and other thin-barked trees grown in North Dakota. Sunscald results from winter injury. Apple and mountain ash are two of the most sunscald-susceptible tree species in North Dakota.

Sunscald injury usually occurs in late winter or early spring when bright afternoon sun, plus reflected light from snow, warms the south and southwest side of the tree trunks and branches. The absorption of heat by the dark colored bark activates growth beneath the bark. Damage results when a rapid drop in temperature at sunset kills the activated tissues. The injured areas on the lower branches and trunk turn brown and begin shrinking. Later the bark cracks and peels. Research has shown that late and/or improper pruning of apple trees on south and west sides can lead to increased chances of sunscald.

Young trees that have large sunscald areas on the main trunks may die the following season. Less severe injuries are invaded by canker-causing or wood-rotting fungi if the sunscald wounds are not cared for in a manner to induce rapid healing.

### *Control*

Preventing winter sunscald is an unrelished chore that must be done. The bark must be shaded from the sun's rays. Train young trees by pruning so that the lowest limb is on the southwest side of the trunk and the limb shades the trunk. Various materials may be applied to the south and southwest sides of the trunk. To be effective, these materials must reflect the sun's rays, thus preventing afternoon warming of the trunk in winter. The most effective materials are highly reflective commercial materials similar to household aluminum foil with a fiberglass or polyurethane backing. Household aluminum foil might serve as a substitute, but would not have the insulating properties. White plastic spiral guards may be placed around small tree trunks. These plastic guards are moderately effective but should be removed in the spring to allow normal trunk growth and to prevent the buildup of bacteria and fungi under the guard. One of the simplest procedures is to apply a white, interior latex water-base paint on the south and southwest sides of the trunk. The paint helps to reduce afternoon warming, but is less effective than the other techniques listed above. Lath or boards may also be used to provide shading. Brown kraft paper wraps are not effective.

## Sunscald - Fruit Injury

Summer sunscald results when fruit is exposed to the sun's rays during excessively hot weather. Affected fruit becomes brown-skinned and often a corky layer of cells forms beneath the exposed surface.

# Other Diseases

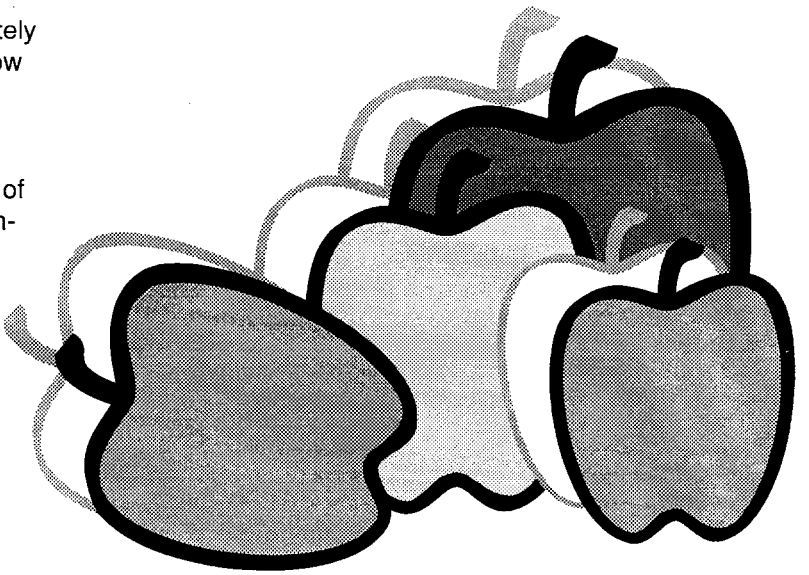
## Leaf Spots

Several fungi cause blotches or spots on foliage of apples, pears, mountain ash or hawthorn. Except for those already mentioned (rust, scab, frogeye leaf spot, and powdery mildew), leaf spots are generally not serious enough in North Dakota to merit control measures beyond raking up leaves and fallen fruit in the fall and destroying by burning or burying.

If serious leaf spotting causes problems such as early defoliation, sprays may be needed. A laboratory diagnosis of the pathogen involved is needed before proper sprays can be applied. Also compare with scab, rust, frogeye leaf spot, and powdery mildew.

## Canker Diseases

Several fungi may infect the bark of branches or main stems causing killed areas in the bark which are called "cankers," Most canker fungi need wounds or injuries to enter. These may be small or large and can be of many types: insect injury, pruning wounds, hail damage, sunscald, or fireblight infection.



## Fruit Spots and Rots

Most fruit-rotting organisms need a wound to enter the fruit. Wounds may be from hail, chafing against a branch, or insect feeding. Only minute wounds are needed for rot organisms to enter.

Fruit rots are caused by fungi or bacteria. The exact diagnosis requires laboratory examination. The inoculum for fruit rot infections comes from cankered branches or twigs. Control of fruit rots is best accomplished by careful removal of all such cankers, as described for fireblight. Several fungi cause superficial spots or specks on fruit surfaces. These do not affect the eating quality of the fruit.

## Chlorosis

Chlorosis is a common disorder of apple, crabapple, mountain ash and related trees in which the leaves become yellow and are abnormally small. One of the most common forms of chlorosis is iron chlorosis.

In the case of iron chlorosis the leaves become progressively more yellow with green veins. When iron chlorosis is severe, the leaves are small, areas of brown dead tissue form between the veins, and growth almost completely ceases. Iron chlorosis occurs when the iron in the soil is unavailable to the plant. This is a common problem in many North Dakota soils which are alkaline, making the iron unavailable. Iron chlorosis can be treated by using an iron chelate. Spraying the leaves with iron chelate will help the leaves turn green within a few weeks but has little long-term effect. Spading iron chelate into the soil, according to label directions, may correct the problem for several years. Implant capsules are also available and may help correct the problem for several years. These remedies vary in effectiveness and in some cases severe chlorosis responds poorly to treatment.

Chlorosis may be a symptom of root injury or of poor drainage. Waterlogged soil is unsuitable for apples, crabapples, etc. Do not plant in low or poorly drained locations.

## Virus Diseases

Several virus diseases are known on pome fruits. Although some are important in large orchard plantings in major fruit growing regions, virus diseases of apples and related trees are seldom encountered in North Dakota. Typical virus symptoms on leaves may be distortion or chlorotic lines, rings, etc. Compare with chlorosis. Some viruses also cause fruit distortion or reduced yield. In North Dakota shoot or leaf distortion is more likely to be caused by herbicide misapplication or drift than by virus. Virus-infected fruit trees cannot be "cured." If the tree is grown primarily for ornamental purposes, the presence of a virus will seldom reduce the tree's value. In orchards, removal and replacement is the only solution.

## Root Injury and Damage

One of the most common and yet least recognized causes of tree problems is root disturbance, often associated with some sort of construction activity. An established tree has a wide, spreading root system. Loss of a substantial part of this root system will result in decline of the tree unless corrective measures are taken. Old or very large trees seldom have sufficient regenerative capacity to survive major root damage, although it may take such a tree several years to die.

Changes in grade will also damage tree root systems by upsetting the balance of air and water the roots need to survive. Soil compaction from heavy vehicles can also kill roots. When tree roots are damaged by any of these causes, the tree begins to decline. The first symptom may be leaf scorch. Twigs and shoots die back, then whole branches may die. Death of the tree may follow.

### Control

Protect tree root systems, not just the trunk, during construction. Prevent heavy equipment or traffic from traveling near trees. If this is unavoidable, aerate the soil immediately following such activity. Do not allow utility trenching near trees.

If tree roots are damaged, careful pruning to balance top and roots can sometimes help the tree survive. Get the help of a professional arborist. Your city or state forester may recommend someone or offer direct assistance. Water and fertilize to promote vigorous growth.

## Decay and Heart Rot

Wood of apples, mountain ash and related trees is very susceptible to decay. Fireblight cankers and sunscald injuries seem to be particularly important sites for infection by decay fungi. Although several fungi cause wood decay in apples and related trees, the most commonly encountered is the fungus *Schizophyllum commune*. This fungus produces its small (1-2 inch), white, papery or leathery "conks" or "mushrooms" in clusters on infected branches and stems (Figure 11). Once established in a tree, eradication of *Schizophyllum* is virtually impossible. Removal of the fruiting bodies (conks or mushrooms) has no effect on the progress of the fungus inside the tree. These are the result of the infection, not the cause. Another common fungus causing decay is *Polyporus tulipiferae*. The control is similar to *Schizophyllum*.

### Control

Protect trees from sunscald. Train trees when young to avoid major pruning later on. Water and fertilize to promote tree vigor which minimizes the damage done by heart rot.

## Summary

Control of many of these problems depends on exact diagnosis. Submit samples through county extension offices for diagnosis at the NDSU Plant Pest Diagnostic Laboratory. Before sampling, contact your county extension office for sampling procedures.

Figure 11. Fruiting bodies of the heart rot fungus *Schizophyllum commune*. The white papery 'conks' are 1 to 2" wide.

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