

Management Of Potato Diseases In The Home Garden

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Potatoes are a popular and reliable crop for the home gardener. Although many diseases can attack potatoes, home-grown potatoes are usually grown successfully if a few basic precautions are taken.

One of the most important steps the home gardener can take is to prevent disease. Many diseases are carried in the tubers used for planting, so disease prevention begins with the selection of healthy seed tubers. Always purchase certified seed potatoes for planting. Saving some of last year's crop to plant is an invitation to many different diseases. Planting eating potatoes from the grocery shelf guarantees total failure, because these potatoes are treated with a sprout inhibitor and will not grow.

Common disease problems in home grown potatoes include foliage (leaf) diseases, wilts, diseases of young plants, tuber diseases, virus diseases, and diseases caused by mycoplasma-like organisms.

Foliage Diseases

Early Blight

Early blight, caused by the fungus *Alternaria solani*, develops on the leaves in July and August as plants begin to mature. It shows up first on the lower leaves as dark circular spots with concentric rings that increase to about 1/4 inch in diameter (Figure 1). The spots develop a target pattern. Similar spots may also develop on the stems later in the season. Spots may also develop on the tubers -- these spots are sunken or raised with a definite margin. The internal tuber tissues are brown to purple in color, often with a yellowish margin. However, early blight tuber rot is not common in North Dakota.

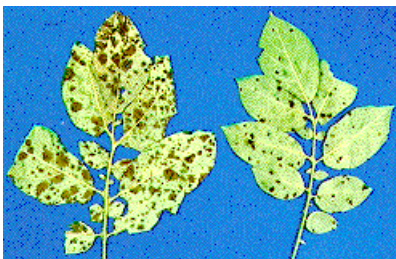


Figure 1. Early blight on leaves.

The early blight fungus overwinters in potato tubers, on potato crop refuse and in the soil. The fungus produces spores which are carried by the wind. Infection occurs when spores land on leaves that remain wet for a few hours. Early blight is favored by warm, humid weather. Early infection reduces tuber yields by reducing the amount of leaves and the amount of food that will be stored in the tubers.

Control of early blight begins with a fall cleanup of all potato crop refuse and by using healthy seed tubers in the spring. Potatoes should be planted in a different part of the garden than last year. If early blight shows up on the lower leaves before or at flowering, spray the plants with fungicide to prevent new infections on healthy leaves. Early blight almost always occurs on the vines as they mature later in the season. This late infection does not reduce yield and control is not necessary. Chlorothalonil fungicides (Ortho Multi-Purpose fungicide) offer the best control of early blight while copper fungicides are less effective, providing only fair control.

Late Blight

Although late blight is the most devastating potato disease, it is rare in North Dakota, occurring in years that are unusually cool and wet. Affected leaves develop dark, greasy green or watersoaked spots that later turn black with water-soaked margins (Figure 2). These spots enlarge in humid weather and a faint white fuzz develops on the lower leaf surface near the leaf edge on the advancing margin of the leaf spot. Disease can occur any time, and if left unchecked late blight can defoliate and kill the entire plant. Tubers can also be infected. Affected areas on the surface of the tuber range from pink or purplish to a dark metallic color. The tuber tissues are penetrated deeply and irregularly and have no yellow margin. The infected tubers have a rusty-brown color internally beneath the infected areas.



Figure 2. Late blight on leaves.

Late blight survives on infected tubers, including discarded tubers and cull piles. These provide the source of early season infection. The late blight spores may be blown long distances in storms (up to 50 miles, with 5 to 10 miles being common). Late blight is favored by cool (60-80 degrees Fahrenheit) weather with long dew periods and relative humidity levels of 90 percent or more. If the average of the maximum and minimum temperatures for five consecutive days is less than 78F and if more than 1.2 inches of rainfall has occurred in the past 10 days, the weather favors late blight. These conditions do not develop every year in North Dakota, so the disease is sporadic in occurrence. Hot dry weather can halt the development of the late blight fungus. Rain can carry the late blight spores down through cracks in the soil to infect the tubers.

To control late blight, make certain that only healthy tubers are planted and that no cull potatoes are allowed to overwinter in the garden. If late blight appears and weather favors further development, spray with a fungicide. Chlorothalonil or Bordeaux mixture are both effective. Copper fungicides may provide the best protection in weather favoring severe late blight. Hill up around the base of vines, then kill the vines with recommended vine killing chemicals or by simply chopping off the vines at the soil line at least two weeks before harvest. This will reduce the danger of tuber infection. Late blight will also infect tomatoes, so they should also be protected. For more information on late blight, see circular PP-1084, Leaf Blight Diseases of Potato.

Wilt Diseases

There are two wilts that affect potatoes in North Dakota. These are caused by the fungi *Fusarium* sp. and *Verticillium* sp. Although there are slight differences in symptoms, these two diseases are not easily distinguished in the home garden. Early symptoms are a yellowing and drooping or curling downward of the lower leaves. Later, one side of the plant or the entire plant may show these symptoms. Leaves may also have dark flecks or spots, or a bronzed appearance. If the stem is cut open, discoloration of the ring of vascular tissues is visible.

The wilt fungi survive on infected tubers. Symptoms are not always evident in the case of *Verticillium*, and even certified seed may not be free of *Verticillium*. The wilt fungi may also survive in the soil for up to seven years. The *Verticillium* fungus is perpetuated in the home garden by other susceptible crops including tomatoes, eggplants, and peppers. Other *Fusarium* fungi cause dry storage rot of the potato tubers (see circular PP-1039, Dry Rot of Potatoes).

Wilt cannot be completely eliminated, but it can be minimized by growing potatoes in different parts of the garden in successive years, rotating with immune crops such as corn, using certified seed (even though it may not be completely free of *Verticillium*), and by fall sanitation (removal of all potato refuse from the garden). Most varieties are not resistant to this

disease. If Verticillium wilt is a serious problem, do not plant Kennebec, as this variety is particularly susceptible. Wilt generally causes yield reduction and early plant death. There are no chemical controls for wilt diseases.

Diseases of Young Plants

Black Scurf/Rhizoctonia Canker

This disease, caused by the soil fungus *Rhizoctonia solani*, is extremely common in North Dakota and can cause extensive damage. Sprout tips from germinating seed pieces may turn brown and die. The underground portion of the stem and the rhizomes (horizontal under ground stems on which the tubers form) may develop spots which are light brown, later turning dark brown and sunken. These lesions can cause pinching off of the stolons and reduced tuber set. Plants so affected may tend to wilt and tiny "aerial" tubers may form in the axils of the lower leaves where they join the stem. Hard black crusty spots resembling "dirt that won't wash off" form on the tubers (Figure 3). In warm, humid weather a gray dusty or flaky growth resembling dried mud forms on the stem just above the soil line.



Figure 3. Black scurf on tuber/dead sprout tips.

A variety of conditions favor the different phases of this disease. The fungus survives in the soil, on tubers, and may also attack other garden vegetables.

This disease cannot be controlled completely, but various practices will reduce the disease. Planting healthy seed pieces (seed tubers without scurf) will reduce the number of sprouts that do not emerge. Scurfy seed is the most important source of the disease in the field. Plant shallow and plant after the soil temperatures have reached 50F. These conditions are important because they allow for rapid emergence of the crop yet slow development of this warm-weather fungus. Planting before the soil temperature reaches 50F slows potato emergence and is not recommended.

Blackleg

This bacterial disease, caused by *Erwinia carotovora*, causes some plants to die before they emerge, resulting in missing plants in the row. Plants that do emerge may be stunted, have bronzed leaves, and finally wilt and die. The base of affected plants will have a shiny wet black rot extending from under ground up the stem several inches above the soil line. This symptom, the "blackleg," is diagnostic (Figure 4). The seed tuber may rot from Fusarium dry rot or bacterial soft rot, both of which may provide plant stress that triggers blackleg development. Blackleg may also occur on upper parts of the stem, a condition called aerial blackleg, when overhead watering is used.



Figure 4. Blackleg on lower stem.

Blackleg bacteria are present in almost all tubers, including seed, but generally do not cause disease unless weather conditions are favorable. Cool, **wet** weather at planting favors both decay of the seed piece and blackleg. Blackleg is favored by wounding during cultivation, wounding from insect feeding and fertilizer burn.

Control blackleg by planting only certified seed after soil has warmed to 50F. Sterilize the cutting knife between cuts. Do not plant into cold, wet soil. Allow seed tubers to "warm up" three to seven days before cutting or planting. Follow the "Planting Tips" outlined near the end of this publication -- this will minimize seed decay which in turn will reduce the amount of blackleg.

Decay may move into the tubers, causing a soft rot of the potato. More information on blackleg and soft rot can be found in

Tuber Diseases

Soft Rot

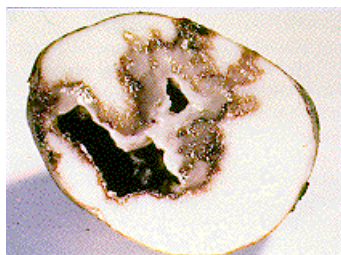


Figure 5. Soft rot of tuber.

Much of the information on blackleg also pertains to soft rot. However, soft rot may be a greater problem under warmer soil conditions. Planting cold seed into sandy soil may increase the amount of soft rot. Sandy soils warm up rapidly causing the seed piece to sweat and predisposing it to soft rot. Soft rotting bacteria, **also** *Erwinia carotovora*, may be borne on seed tubers, which leads to decay under the proper environmental conditions. Soft rot is a wet, slimy looking decay with a white color (Figure 5). Management of this disease is the same as for blackleg.

Dry Rot



Figure 6. Dry rot of a stored tuber.

As was alluded to under the section on wilt diseases, *Fusarium* sp. may cause a dry decay of the potato tissue (Figure 6). Dry rot appears as a powdery, decayed cavity in the potato tuber. Potatoes that have been wounded are most likely to develop dry rot in storage. These potatoes serve as poor seed sources since their vigor is reduced. After being planted the seed piece may continue to decay and fail to emerge. For more information on dry rot, see circular PP-1039, Fusarium Dry Rot.

Ring Rot

This bacterial disease, caused by *Clavibacter michiganense* ssp. *sepedonicus*, affects both tubers and the entire plant. Symptoms on the plant usually show only as the plant nears maturity. Often one or two stems in a hill may begin wilting at midday. The disease progresses until all leaves are wilted. Leaf margins may roll upward and the areas between the leaf veins may turn yellow. In advanced stages, a creamy or cheesy material can be squeezed out of the vascular ring of a stem cut near ground level. Infected tubers will show a discoloration in the vascular ring toward the stem end, and the same cheesy substance can be squeezed from the vascular tissue (Figure 7). Tubers with ring rot are often subjected to secondary invasion by soft rot and other bacteria and fungi. This can result in total rot of tubers in the field or in storage.



Figure 7. Ring rot in a potato tuber.

Ring rot is favored by temperatures of 64-72F. The ring rot bacteria can be transmitted from diseased tubers to healthy tubers by the cutting knife when cutting seed tubers -- in fact after cutting an infected tuber, up to the next 20 healthy potatoes may be contaminated.

Ring rot can best be managed by planting certified seed potatoes. Certified seed potatoes have been inspected for ring rot. Cutting knives must be carefully sterilized (see Planting Tips) between cuts to avoid contaminating healthy tubers. For more information on ring rot, see circular PP-507, Ring Rot of Potatoes.

Common Scab

This disease, caused by *Streptomyces scabies*, produces roughened or scabby areas on the tubers (Figure 8). Some of the scabby areas may be raised slightly, and others may be sunken. Although this destroys the market value of commercial potatoes, homeowners can prepare scabby potatoes for boiling simply by peeling the potato more deeply than normal. The edibility of the remaining potato flesh is not affected.

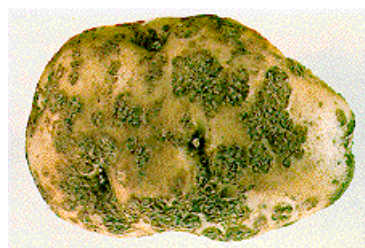


Figure 8. Common scab on tuber.

The scab organism survives in the soil and occasionally may attack certain other garden vegetables, including beets, radishes, carrots, and parsnips. The disease is favored by alkaline and by dry soils, which are common in North Dakota. The scab organism is not affected by passage through the digestive tracts of livestock and can be disseminated in barnyard manure.

To avoid damage from scab, do not use barnyard manure on land to be planted to potatoes or other susceptible vegetables. In gardens where scab has been a problem, do not rotate with beets. Plant resistant potato varieties such as Russet Norkotah or Goldrush or moderately resistant varieties such as Norland or Superior.

Late Blight

Late blight tuber rot is a firm rot that occurs when the spores of the late blight fungus are washed off the leaves of infected plants and down through cracks in the soil, where they come in contact with and infect the developing potato tubers. Decay usually does not become obvious until the potatoes are stored. The rot first appears as a coppery-brown discoloration of the surface of the potato. The infection moves inward and develops into a brown net-like discoloration just below the skin. Potatoes with rot should be destroyed. These potatoes serve as an important source of the disease in the following year.

Pinkeye

Pinkeye produces a dark pinkish discoloration on the tuber surface around the eye, appearing when the potato is dug. This disease is most noticeable on white-skinned potatoes but will also occur on russets and red-skinned varieties. The disease causes the skin to thicken in the affected areas and may cause difficulty in peeling. Despite this problem the edibility of the tubers is unaffected. Pinkeye is usually associated with wet soil conditions but has no known specific cause. Planting potatoes in a well drained location is the best control measure. Pinkeye is sometimes associated with tubers of *Verticillium* wilted plants but may also occur on plants not infected with *Verticillium* wilt.

Silver Scurf

Silver scurf is caused by a soil-borne fungus (*Helminthosporium solani*) but appears to be more of a concern when it is introduced on infected seed. This scurf disease causes a silvery, metallic sheen on the surface of all market classes of potatoes but is most noticeable on red-skinned varieties. Scurf does not affect the edibility of the potato, only the presentation of the fresh tablestock. The best control for silver scurf is to use disease-free seed.

Virus Diseases

There are numerous virus diseases of potato. Many do not produce noticeable symptoms. The two most common diseases will be discussed here.

Mosaic

The mosaic symptom may be caused by any of several viruses. A few cause the veins to turn light green or produce a

crinkled or mottled leaf (Figure 9), while others produce very subtle or unapparent symptoms, depending on the potato variety affected. Each of these viruses may reduce yields, are carried in infected seed tubers, and most are spread by aphids. There is no control once disease is present. Severely infected (stunted) plants should be removed immediately to prevent virus spread. These diseases can be reduced by planting certified potato seed tubers.



Figure 9. Mosaic infected plant.

Leafroll

Leafroll appears on the plants first as a reddish or yellowish discoloration of the lower leaves. Later, the leaves begin to roll upward, usually from the bottom of the plant first. Leafroll will also cause the plant to be stunted. This virus is carried in infected seed tubers and is spread by aphids. The best control for the disease is to plant certified seed tubers and to remove any infected plants. Certified seed has been inspected for virus diseases and may carry only a very low level of disease.

Mycoplasma Diseases

Mycoplasmas are very tiny organisms somewhere between bacteria and viruses in size and nature that are transmitted by insects. The only mycoplasma that may occur on potatoes in North Dakota is the aster yellows mycoplasma. This mycoplasma is transmitted by the aster leafhopper, *Macrostelus fascifrons*. Most of these leafhoppers migrate into North Dakota from farther south.

Aster yellows on potato produces a disease called purple top or haywire. The disease usually appears after midseason. The upper leaves remain small, wilt, and may be light green, but frequently the upper portion of the plant has a purple coloration. Aerial tubers the size of marbles often form in the axils of the leaves, that is, the point where the leaves attach to the stem. Keeping weeds out of the potato patch and the surrounding areas and control of insects will reduce the danger of purple top infection.

Physiological Disorders

Physiological disorders are not infectious and will not spread in the garden, but they may affect the appearance of the plants or the storability of the tubers.

Greening

This is a physiological response that occurs when tubers are exposed to light. If plants in the garden are not hilled properly so that the upper portions of tubers are exposed to light, these exposed portions will turn green. If harvested potatoes are stored in the home under low levels of light, the tubers will turn pale green. Tubers which turn green produce an alkaloid called solanin which imparts a bitter taste to the cooked potatoes -- it is also poisonous if consumed in a large quantity. Excessively green potatoes should not be consumed. Small green portions should be cut out before eating.

Greening can be prevented by hilling up around plants to prevent exposure to light and by storing the harvested crop in the dark. If the home storage area is not completely dark, provide dark by storing in paper bags to allow air movement.

Hollow Heart/Brown Center

This physiological disorder is caused by rapid tissue growth, resulting in an irregular brown cavity in the center of the potato. Hollow heart and brown center is a more serious problem during cool, wet weather. Certain varieties are more prone to this disorder. Hollow heart tubers are edible.

Windburn

Periods of hot, windy weather may cause the tips of the leaves to turn brown and die. This damage is minor, and unless the unfavorable weather continues will not do much damage.

Swollen Lenticels

Lenticels are the small specks on the surface of the tubers. These specks are organs used by the plant to "breathe." When potatoes are subjected to soils that are saturated with water, the lenticels may swell as their function is impeded by the water. Swollen lenticels may appear as white bumps on the potato surface. This condition may reduce the storability of the potato by increasing susceptibility to soft rot.

Insect Damage

Damage from two insects, leafhoppers and flea beetles, result in disorders that can cause striking symptoms often mistaken for diseases. Flea beetle feeding results in numerous small, round pinhead size holes in the leaves. Leafhopper damage, referred to as hopper burn, is caused by a toxin introduced into the leaf as the leafhoppers feed. The first damage appears as a small brown tip burn. Eventually, the entire margin of the leaflet turns brown and rolls upward as though burned by fire. The burning pattern usually is wedge-shaped. Insect damage can be controlled by appropriate sprays.

Planting Tips

Purchase and plant certified seed tubers. Certified seed always is labelled with an official state tag meaning that disease was minimal or not found and they have not been treated to suppress sprouting. Warm the seed at room temperature for about one week, or until eyes just begin to sprout before cutting. Cut seed, sterilizing the cutting knife and other tools between tubers. Use 10 percent household bleach (1 ½ oz or 3 tablespoons in a pint of water) or a "tamed" iodine disinfectant (available at dairy supply stores). Bleach is very corrosive to metal tools, so wash and oil them after use. Allow the cut seed to heal (suberize, or cork over) for three days in a warm moist area, then plant in warm (at least 50F) moist soil. Plant potato seed pieces 3-4 inches deep and mound soil around the potatoes "hilling" as they grow for best tuber growth. There should be 2-3 feet between potato rows and 12 inches between plants in the row. Ideally, the seed piece and the soil should be the same temperature to reduce the chances of soft rot.

Harvesting and Storage Tips

Potatoes can be harvested any time for eating. As the plants begin to mature at the end of the growing season, the vines will begin to yellow and die. If the potatoes are going to be stored instead of consumed immediately, it is important that the tubers be allowed to "harden" in the soil before digging. Hardening allows the skin to thicken, preventing storage diseases and shrinkage due to water loss. Vines should be killed or removed two weeks before digging the potatoes. A longer period of hardening will increase the amount of black scurf that may develop on the tubers and should be avoided. Vines can be killed by normal maturity, frost, pulling, or simply cutting the vines off at the soil line. Avoid bruises and injury during harvest, as these provide entry sites for storage diseases.

After harvest, store potatoes for the first two weeks at about 65F to allow injuries to heal. For best results, tubers should then be stored at 35-40F in the dark for the remainder of storage.

Two previously discussed diseases are also common in storage - soft rot and dry rot. As the names imply, soft rot is a wet, mushy decay and dry rot is a dry, crumbly decay. Tubers which decay in storage should be removed to prevent the decay from spreading to the other potatoes.

General Tips For Healthy Potatoes

- Don't overwater. Keep the soil moist but not soggy.
 - Don't plant potatoes and tomatoes near each other -- they are affected by the same diseases.
 - Remove infected or diseased plants from the garden.
 - Remove potato debris from the garden after harvest.
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