Leaf Blight Diseases of Potato

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Figure 1. Leaf lesions of Late blight.

Two leaf diseases are common on potatoes: late blight and early blight. Late blight, an extremely destructive disease, does not occur every year in North Dakota because it requires a cool and moist environment. Early blight occurs every year, attacking mature foliage on plants. The terms "late blight" and "early blight" are somewhat misleading, since late blight often occurs earlier in the season than early blight, depending on environmental conditions.

Late Blight
Late blight of potato, caused by the fungus *Phytophthora infestans*, has the potential to be an extremely destructive potato disease in North Dakota. It attacks both tubers and foliage during any stage of crop development.

Epidemics of the disease occur infrequently in North Dakota since the disease is highly dependent on favorable environmental conditions. Those conditions are not typical in North Dakota, but when late blight does occur it usually appears about midseason. When conditions are favorable, the fungus can spread rapidly through the foliage and is capable of causing complete blighting of foliage within a very short time. If no controls are implemented, entire fields can be destroyed. Tubers can be infected while they are still in the ground or in storage.

Because of the high potential for loss, crops should be monitored for this disease and controls should be implemented as disease risk increases. Soft rot (see PP-903, Blackleg and Soft Rot of Potatoes) of tubers often occurs in storage following late blight tuber infections, adding to indirect losses from late blight. Consequently, the tolerance for late blight tuber blight in storage should be quite low.

### Symptoms

The first symptoms of late blight in the field are small, light to dark green, circular to irregular-shaped water-soaked spots. These lesions usually appear first on the lower leaves. Lesions often begin to develop near the leaf tips or edges, where dew is retained longest. During cool, moist weather, these lesions expand rapidly into large, dark brown or black lesions, often appearing greasy (Figure 1). The lesions are not limited by leaf veins, and as new infections occur and existing infections coalesce, entire leaves can become blighted and killed within just a few days. The lesions may expand down petioles and stems of the plant.

*Figure 2. The Late blight fungus sporulating on a potato leaf.* (Used with permission from Cornell University)

If infected leaves are examined in the early morning or during other cool damp weather, a white mildew growth may be seen on the underside of those leaves (Figure 2). A pale green to yellow border is often present around the lesions. Plants severely affected by late blight have a distinctive odor resulting from the rapid breakdown of potato leaf tissue. A similar odor may occasionally be detected after chemical vine-kill or a severe frost.

Positive identification of late blight can be made by microscopic examination of samples from infected leaves or tubers collected during damp cool weather when the fungus is forming spores. The fungus can be quickly identified by the distinctive size and shape of spores and spore-bearing stalks.
Late blight infection of tubers is characterized by irregularly shaped, slightly depressed areas of brown to purplish color of variable size on the skin. These symptoms may be less obvious on russet and red-skinned cultivars. A tan to reddish-brown, dry, granular rot is found under the skin in the discolored areas, extending into the tuber (Figure 3) usually less than one half inch. The extent of the rotting in a tuber depends on susceptibility of the cultivar, temperature, and length of time after the initial infection. The margin of the diseased tissue is not distinct. The margin is marked by brown finger-like extensions into the healthy flesh of the tuber. Severely infected tubers may display extensive rot, often accompanied by soft rot. The mildew-like growth of the causal fungus may appear on the surface of tubers.

### Disease Cycle

The fungus can only survive in living infected potatoes, including potatoes in storage, infected tubers missed during harvest and remaining unfrozen over the winter (volunteers), and infected cull piles. The fungus can be transmitted from infected tubers to potato foliage by airborne spores. Initial sources of the late blight fungus can be piles of infected cull potatoes, seed tubers, or volunteer plants. The spores of *Phytophthora infestans* are carried to nearby fields primarily by wind.

The late blight disease is favored by high moisture and moderate temperatures for periods of several hours. Night temperatures of 50-60 degrees Fahrenheit and day temperatures of 60-70 F are most favorable for disease development. Rain, dew, sprinkler irrigation, and high relative humidity (greater than 90 percent) may all provide favorable conditions for disease development. The spores require water to germinate and penetrate the potato tissue.

Lesions on leaves and stems become visible as small flecks within a few days after infection. The lesions expand to water-soaked, gray-green areas on the leaf. The affected tissue becomes gray to tan, dry, and dead within a few days. Lesions are often surrounded by a halo of lighter green tissue. The disease may also develop on leaf petioles and stem tissue.

Conditions must remain moist for a minimum of seven to 10 hours for spore production to occur. Because of this relationship, spores or lesions are most apparent after wet nights or periods of rainfall. The fungus may appear as a white, mildew-like growth at the edge of the lesion, primarily on the underside of the leaf. It is this white growth that distinguishes late blight from several other foliar diseases of potatoes. The spores are carried by wind and rain to healthy plants where the disease cycle begins again. The fungus can complete many reproductive cycles in a season, accounting for the rapid increase of disease once it becomes established in a field.

Tubers are infected by spores washed from lesions to the soil. Tuber infections are characterized by...
patches of brown to purple discoloration on the potato skin. Cutting just below the skin reveals a dark, reddish-brown, dry, corky rot.

Management

Effective control of this disease requires implementing an integrated disease management approach. The most important measures are cultural. Resistant cultivars and chemical controls can also be utilized.

Cultural

Cultural practices are the first line of defense against this disease. Avoid introducing late blight into a field by planting only disease-free seed tubers, preferably Certified seed.

Keep a clean operation by destroying all cull and volunteer potatoes. These potatoes can serve as a site for the pathogen to overwinter and spread to nearby potato fields. Bury culls or spread them over a field in a thin layer in the fall to ensure that they will freeze over the winter.

Avoid frequent or night-time overhead irrigation of potatoes. This practice maintains leaf wetness and high humidity in the plant canopy, which is favorable for the disease.

Hilling will reduce the incidence of tuber infection. The fungus infects tubers by washing through the soil and contacting the tubers. Good soil coverage provides better protection of the potato tubers.

Harvest should not be started until vines are completely dead. At least one week, and as much as two to three weeks, should pass after vine killing for harvest of fields in an area where late blight is known to occur. In fields where late blight was confirmed, a minimum of two weeks should pass between vine killing and harvest. Late blight will not survive on dead vegetation, so the tubers that are exposed at harvest are less likely to be infected.

Remove infected tubers before storage to reduce additional losses from soft rot. Tubers should be dry when placed in storage. If any infection is believed to be present, forced air ventilation through the storage bin can help minimize spread from tuber to tuber. Storage of seed potatoes with small amounts of late blight at 38 F will retard late blight tuber rot. The storage temperatures required for processing potatoes (48-52 F) make storing late blight-infected potato tubers very difficult since these temperatures also favor disease development. Potato lots with excessive tuber rot (greater than 5 percent total decay) are probably not storable and should be sold or processed directly from the field.

Resistance
No cultivar is **immune** to late blight and most cultivars planted in the Red River Valley are susceptible to late blight. However, some cultivars offer partial resistance to this disease. These moderately resistant cultivars could be planted if blight was expected to be a problem. It should be assumed that all varieties grown in this geographic area are susceptible to late blight.

A few varieties produced in the area are slightly resistant, including Atlantic, Russet Burbank and Snowden. Red Norland is also slightly resistant and may not express foliar symptoms of the disease very clearly. Kennebec is moderately resistant to late blight, but presents other hazards to production due to its association with Verticillium fungi.

### Crop Monitoring and Disease Forecasting

Efforts must be made to closely monitor crops for the incidence of disease. Field scouting should be concentrated in areas of the field most likely to have high moisture, dew, or relative humidities for the greatest length of time. Low spots where soil moisture is highest and parts of the field shaded by windbreaks are examples of areas where scouting should be intensified. As soon as the disease is detected, other control measures can be examined. Computer based programs are available to track weather conditions and help predict or forecast when the disease may occur. Disease forecasting programs predict when environmental conditions favor disease and recommend when fungicide applications may be needed. As the risk of disease becomes greater, crop monitoring should be intensified.

### Chemical

When disease is found in the field or is predicted by disease forecasting, fungicides may be applied. Research indicates that fungicide applications are most successful if they start when the canopy begins to close within the row. Applications should continue, as needed, throughout the growing season. Complete coverage is critical to the performance of protectant fungicides. Protectant fungicides should be used before development of disease in a field. If late blight is present in a field, a combination of protectant and systemic eradicant fungicides should be used. The late blight fungus has shown the ability to develop strains that are resistant to some systemic/eradicant fungicides. Resistance to protectant fungicides has never been identified. Because of this threat, eradicant fungicides should always be applied in combination with protectants. A list of currently approved fungicides is available from your County Extension Office.

### Early Blight

Early blight is a very common disease of potatoes in the Red River Valley. Early blight, caused by the fungus *Alternaria solani*, is a disease that is most severe on maturing or under-fertilized potato vines.
The disease actually occurs late in the season, often first appearing in late July.

Symptoms usually develop first on the older leaflets of mature plants, spreading to the younger leaves under favorable weather conditions. This disease occurs over a wider range of climatic conditions than late blight.

Early blight may also infect tubers. This is very rare in North Dakota. The lesions appear on the surface of tubers as dark, sunken, irregularly shaped areas. The lesions are often surrounded by a raised violet border. The fungus will invade the tuber, causing shallow, dark, necrotic, hollowed out areas in the tuber that can be traced to surface lesions.

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**Symptoms**

Symptoms begin as small, dark brown to black spots on older leaflets on lower portions of plants. The spots enlarge and develop a characteristic "target spot" appearance of concentric rings in the dead tissue (Figure 4). These spots are often irregular in shape. Large spots may be limited by large leaf veins. A narrow light green to yellow halo frequently surrounds the spot. The spots may enlarge and coalesce, causing leaflets to die. Lesions may develop on stems, but it is rare for significant injury to occur from this infection.

![Figure 4. Early blight lesions on potato leaves.](image)

The early blight fungus can often be recovered from healthy-looking leaf tissue prior to the onset of tubers but causes no visible symptoms until potatoes approach maturity. The reasons for this are not clearly understood. Evidently the early blight fungus is not a strong pathogen on young healthy tissue but can attack older, less vigorous tissues. This helps explain why infection usually begins on lower foliage that is the most mature.

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**Disease Cycle**

*Alternaria solani* overwinters in the field on dead leaves and vines or on infected tubers. Early blight will usually be found first along margins of fields that border fields planted to potato the previous season. Spores are carried primarily by wind and infect potato leaves under favorable conditions of warm temperatures (68-86 F) and heavy dews or rain. Disease development is favored by high (about 95 percent) relative humidity. Most rapid progress of the disease occurs during periods of alternating wet and dry weather. Early blight is often more severe when the potato crop has been under stress of poor nutrition, injury, insect damage, drought, or other types of stress. Plants expressing common mosaic
Leaf Blight Diseases of Potato (caused by Potato Virus Y) are also much more susceptible to early blight than nearby healthy plants.

Management

While no truly resistant cultivars are available, highly susceptible cultivars such as Red Norland, Norchip, and Superior should be avoided where losses to early blight are significant. Very early maturing cultivars are often very susceptible to early blight. Since early varieties become diseased earlier than do later varieties, care should be taken to avoid planting early and late varieties in the same or adjacent fields. The early variety could act as a source of infection of the later variety.

Application of protectant fungicides is important in suppressing damage by the early blight fungus. Consult with your County Extension Office for current fungicide recommendation. Sprays should commence just after bloom or at the first sign of early blight infection, whichever is earlier. Regular inspection of fields after plants reach 12 inches in height can be very helpful in detecting early infections. Development of early blight is generally ideal when the leaves of adjacent rows touch, which provides optimum conditions of high humidity, leaf yellowing of lower leaves and moderate canopy temperatures. Disease forecasting models that will lead to more effective timing of fungicide applications are available. A weather network called NDAWN (North Dakota Agricultural Weather Network) has been established across North Dakota (Figure 5). Data from this network can be used to predict the onset of early blight and the timing for the first fungicide applications.

Figure 5. NDAWN locations across North Dakota.

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