Diseases of Potato:

Late Blight

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Late blight of potato, caused by the fungus *Phytophthora infestans*, is potentially a very destructive disease of potato in Michigan. During favorable weather — periods of moderate temperatures, high humidities, and frequent rainfall — the disease can spread extremely rapidly by means of asexual spores known as sporangia (Fig. 1), and it has the potential of completely defoliating fields within three weeks of the first visible infections if no control measures are taken. In addition to blighting the foliage, the spores of the fungus can infect tubers before or during harvest, and lead to tuber rot.

Late blight has become more difficult to control since the introduction into the United States of new genetic types of the fungus. The four genotypes known to occur in the United States as of 1995 are US-1, US-6, US-7, and US-8 (Table 1).

Table 1.
Four genotypes of Phytophthora infestans occurring in the United States.

Genotype	Mating type	Metalaxyl[1] reaction	Host(s)
US-1	A1	Sensitive	Potato
US-6	A1	Resistant	Potato/tomato
US-7	A2	Resistant	Potato/tomato
US-8	A2	Resistant	Potato

[1] *Sold under the trade name Ridomil.*

Before 1993, only the US-1 genotype had been found in Michigan. US-1 is sensitive to the systemic fungicide metalaxyl and is mating type A1. The late blight fungus requires two mating types, known as A1 and A2, which have to come into contact to produce a sexual spore known as an oospore (Fig. 2). Oospores are resistant to freezing and other environmental extremes and can survive in diseased leaves or stems, or free in soil. When only one of the mating types is present, the fungus can survive only as vegetative mycelium in infected tubers. If infected tubers freeze and die over winter, or if they are buried too deeply to sprout in a landfill, the disease cycle is broken, and very often the disease does not appear even when weather conditions are favorable. With the arrival of the A2 mating type, the potential exists for the production of resistant overwintering oospores that can survive in dead leaves or free in the soil. Unfortunately, not much is currently known about the length of

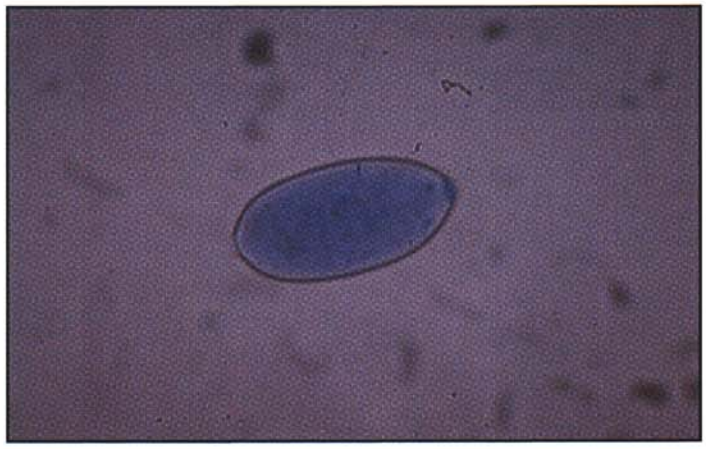

Figure 1. A sporangium (asexual spore) of the late blight fungus *Phytophthora infestans*.

Figure 2. A young oospore (sexual spore) of the late blight fungus *Phytophthora infestans*.

time these oospores might remain viable under Michigan conditions.

Another complicating factor in control was the appearance in 1993 of insensitivity (resistance) to the systemic fungicide metalaxyl (Ridomil) in late blight fungus populations. Metalaxyl has been a major factor in controlling late blight because of its systemic property that allows it to be absorbed into plant tissue. Once absorbed, the fungicide will not wash off of foliage. On late blight strains sensitive to this fungicide, effectiveness lasted for 10 to 14 days on foliage and the fungicide was translocated into tubers. However, since the introduction of metalaxyl-resistant strains of the late blight fungus, control of late blight with metalaxyl has not been nearly as effective.

New genotypes US-6, US-7, and US-8 appear to be more aggressive and destructive than US-1. In addition, genotypes US-6 and US-7 readily infect tomato as well as potato, so potatoes should not be planted within one mile of commercial tomato fields if possible. Hairy nightshade (*Solanum sarachoides*) has been reported as a weed host of late blight.

Symptoms

The first symptoms of late blight in the field are fairly large, dark, more or less circular spots (Fig. 3). Lesions may be on lower leaves where the microclimate is more humid, or they may occur on upper leaves if weather conditions are favorable and they have been carried into the field by air currents. If you check plants early in the morning during favorable weather, you can observe a white fuzzy growth on the undersides of leaves where the fungus is forming the spores that spread the disease (Fig. 4). Lesions

Figure 3. Young late blight lesions on potato leaflets.

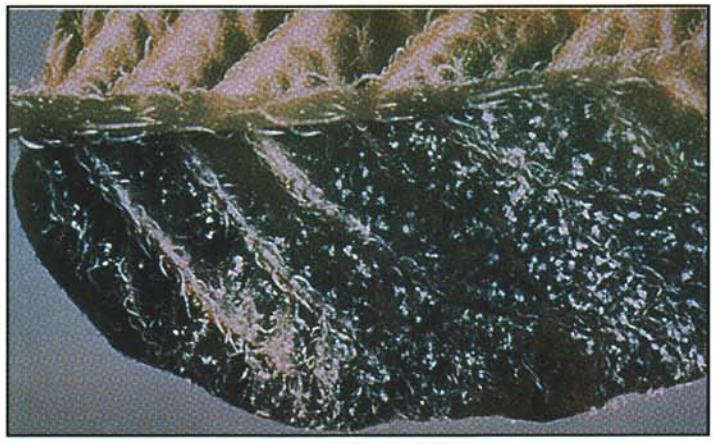

Figure 4. The late blight fungus forming spores on the underside of an infected leaf.

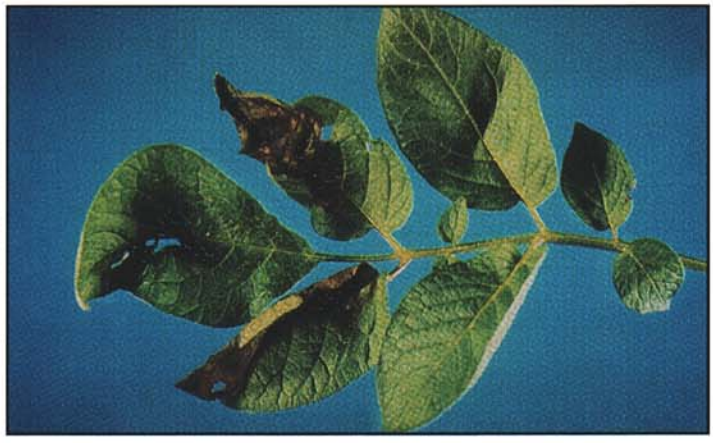

Figure 5. Well developed late blight lesions and curling and cupping of leaflets.

Figure 6.
Lesions on petioles of potato caused by the US-8 genotype.

expand rapidly, and if they are formed at leaf tips or edges, they can cause young expanding leaves to be misshapen (Fig. 5). The new genotypes often cause lesions on leaf petioles or stems (Fig. 6). Lesions on petioles and stems were formerly quite rare. Plants severely affected by late blight have a distinctive odor resulting from the rapid breakdown of potato leaf tissue. It is the same odor evident after chemical vine kill or a severe frost.

Disease Cycle and Control

Late blight is a water mold that forms relatively large, clear, lemon-shaped spores called sporangia (Fig. 1) on stalks called sporangiophores. Though they are relatively large in comparison to other fungi, these spores cannot be seen without the aid of a microscope that can magnify at least 100 times. The sporangiophores have periodic swellings at points where sporangia were produced.

Sporangia may germinate at temperatures of 44 to 55 degrees F when free water is present on leaves by forming 8 to12 motile zoospores each. These swim freely in water films, encyst on leaf surfaces, and infect the plant. Encysted zoospores infect leaves by penetrating leaf surfaces with a germ tube, either through stomata (breathing pores) or by means of direct penetration. At temperatures of 55 to 70 degrees F, sporangia germinate by means of a single germ tube. Night temperatures of 50 to 60 degrees F accompanied by light rain, fog, or heavy dew, followed by days of 60 to 75 degrees F with high relative humidity, are ideal for late blight infection and development.

Tubers may become infected if sporangia produced on the foliage are washed down into the soil by rain or irrigation water. It appears that water-borne spores follow stems and stolons in a water film into the soil, reach tubers, and cause infection. Tubers near the soil surface are more likely to be infected. Late blight infection on tubers is characterized by irregularly shaped, slightly sunken areas of brown to purplish color (Fig. 7). A tan to brown, dry granular rot found under the skin extends into the tuber (Fig. 8). How far rotting extends into the tuber depends on the susceptibility of the cultivar, the length of time after infection,

Figure 7. Well developed symptoms on the exterior of infected tubers.

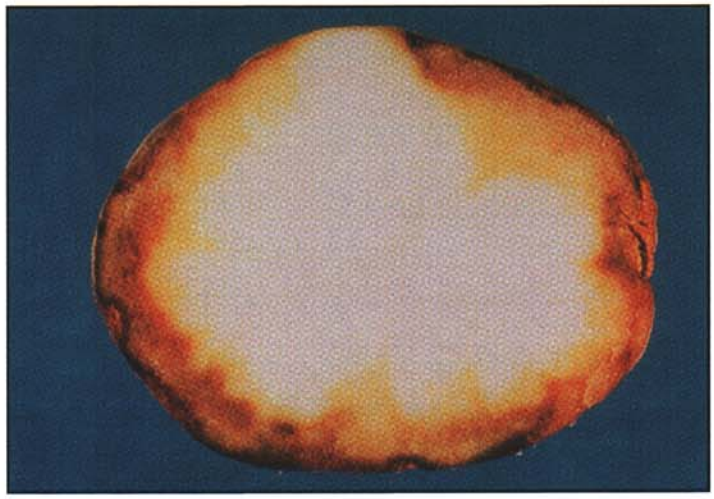

Figure 8. A cross-section of a tuber showing brown, granular tissue beneath the tuber skin.

and the temperature. The boundary between diseased and healthy tuber tissue is not sharp. Brown, peg-like areas may extend into otherwise healthy tissue at various depths.

The late blight fungus usually survives from year to year in infected tubers placed in storage, in piles of cull potatoes, or in volunteer potatoes. Infected tubers in cull piles are probably the most important source of spores in spring to begin the disease cycle. Infected seed potatoes can also initiate disease, so it is very important to plant with blight-free seed. Remember that there has to be more than 1 percent infection of certified seed potatoes before a seed lot can be rejected by an inspector. Some infected tubers may rot in the soil before emergence, and not every potato that emerges from an infected tuber will contract late