EB1812

PLANT DISEASES

COOPERATIVE EXTENSION
Washington State University

CONTROLLING LATE BLIGHT IN COMMERCIAL POTATO FIELDS

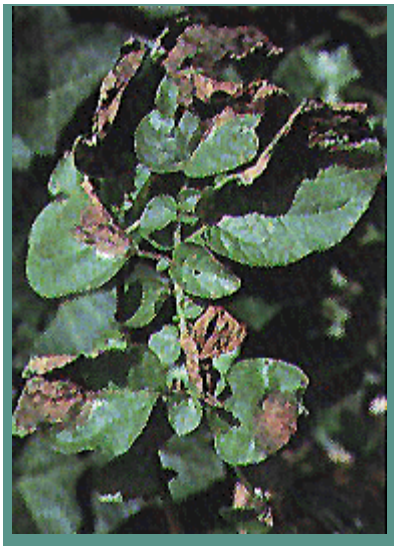
IN WASHINGTON

During the early 1990s new and aggressive strains of the fungus causing potato late blight ***(Phytophthora infestans)*** appeared in Washington, and as a result, the disease has become more difficult to control. The new strains originated in Mexico and are believed to have migrated to almost all potato growing regions of the world. Some of the strains are resistant to Ridomil (metalaxyl), an important fungicide once commonly used for control. Some of the strains are also of the A2 mating type and have the ability to genetically fuse with the old strains (of the A1 mating type) to form specialized survival spores, called oospores, that can possibly survive in dead tissue and in the soil.

Wet weather in Washington has further contributed to the severity of recent blight epidemics. The fungus requires a relative humidity of near 100% and temperatures between 60° and 72° F to produce sporangia (summer repeating spores). Sporangia lose their viability in 3 to 6 hours at relative humidities below 80%. Sporangia germinate in as quickly as 0.5 to 2 hours at 50° to 60° F but only if free water from rain, dew, or irrigation is present on plant foliage or tubers. In the Columbia Basin, late blight outbreaks since 1974 have occurred during years with a higher than normal number of rainy days in April and May.

In Washington, Ridomil resistance, the possible existence of oospores, and the role of weather now need to all be considered in late blight management. An integrated disease management program including sanitation and cultural practices, host tolerance, disease forecasts and chemical applications is necessary for successful control.

Figure 1. Infected potato plants develop brown, purple or black lesions, streaks or blotches on the leaves and



stems. Lesions on infected tomato leaves and stems are similar to those on potato.

Figure 2. Infected potato tubers develop brown to purple, metallic-appearing areas in the skin. When cut open a copper discoloration is usually visible just under the surface or extending 1/4 to 1/2 inch into the tuber.

Figure 3. Late blight stem lesions often are only discernible when the upper part of the plant canopy is pushed away.

Sanitation Practices and Cultural Control

Certain sanitation and cultural practices can contribute significantly to late blight management by limiting overwintering and development of the fungus.

1. It is important to destroy the means by which the blight fungus survives and/ or increases, i.e., on cull potatoes and tomatoes, on volunteer potato plants, and weeds like hairy nightshade. Destroy all

commercial cull and rotted potatoes from storages by allowing them to freeze, burning them completely, or burying in deep pits (below at least two feet of soil so that green shoots do not reach the soil surface). Culls also can be macerated in wood chippers or snow blowers or smashed with heavy equipment and then spread on fields to rot. These overwintering inoculum sources need to be destroyed by early spring to avoid production of spores that can infect the newly planted crop. Potato debris and culls coming out of storages in late winter or early spring are especially threatening sources of inoculum because infected tubers have been protected from low winter temperatures. If these tubers develop late blight, the fungus is poised to move onto susceptible emerging volunteers and current season plants.

If potato culls are fed to livestock, precautions must be taken to prevent the culls from sprouting or establishing volunteer plants, i.e., culls should be secured during transport, dumped only in specified areas, stored only on impervious surfaces, and fed or ensiled within a few weeks after delivery. Culls also can be composted but temperatures must be high enough to kill the fungus throughout the entire pile. Since it is not known whether oospores can pass unharmed through the digestive systems of animals or withstand typical composting temperatures, these practices may not necessarily destroy the specialized survival spores if they are present.

2. Remember that late blight sporangia arise from many sources and whenever possible take measures to minimize or protect these sources, i.e., cull piles, volunteer potatoes in rotation crops like peas and wheat, volunteers arising from seed pieces discarded while cleaning planters, susceptible cultivars like Hilite and Norkotah, especially when planted early, host plants in shaded areas of fields (in western Washington), tomatoes and potatoes in home gardens, weedy hosts like hairy nightshade, unsprayed host plants along field headlands.

3. Plant certified seedpieces.

4. Consider the effect of planting date on blight occurrence in areas like western Washington where potatoes planted after June 1 sometimes are more seriously affected than those planted earlier because of low cloud ceilings and high sporangia loads in August and September when the crop reaches maturity.

5. Avoid overfertilization with nitrogen which causes dense plant growth. Dense foliage growth increases the amount of time foliage is exposed to periods of relative humidity greater than 90%. Such humidity is favorable for late blight. Less dense foliage dries out more quickly by sunlight and air movement.

6. Adequately hill tubers to minimize the opportunity for sporangia to wash from the foliage through cracks in the hill to the tubers.

7. Scout fields regularly for symptoms. Look for large black or purplish lesions on stems within the canopy (where the disease often begins) or on the new foliage. The size and shape of the lesions is very dependent on weather conditions. During periods of high humidity from fog,

drizzle, dew, rain or sprinkler irrigation, the lesions are covered by a white, downy fungus growth containing sporangia. Dry weather stops the development of the disease and the white fungus growth disappears; however, the disease will resume activity when moist conditions return. Concentrate scouting in low-lying areas, in areas that are protected from the wind or in shaded areas (in western Washington) where leaves tend to remain wet longer. Some growers and fieldpersons have had success using diagnostic kits sold commercially for early disease detection.

8. Schedule irrigations to minimize excessively long periods of leaf wetness. Avoid irrigation during rainy weather or cool, cloudy weather that follows prolonged rainy weather. Apply irrigation water so that wet periods on plant foliage are reduced and all of the foliage has a chance to dry between water applications. Heavy less frequent irrigation applications are better than light frequent applications. Irrigation should be decreased near the end of the growing season.

Tubers become blighted when sporangia of the late blight fungus wash down from infected potato stems and foliage through cracks in the soil and come into contact with the tubers. Contaminated soil and vines can initiate further tuber infections at harvest. Certain practices will prevent infection of tubers at the end of the season and during harvesting, and thereby, limit the later development of tuber blight in storage.

9. Kill potato vines before harvest. There should be at least a 2-3 week interval between the time vines are dead and tubers are harvested. It is advisable to continue treatments with protectant fungicides as long as vines are still green and to cease irrigation at this time. The 2-3 week interval minimizes the chance that soil adhering to tubers during harvest is contaminated and also allows time for tubers that may already be infected to decompose. Unless vines have been dead for 2-3 weeks, pre-harvest irrigation to reduce bruise should not be done. Use the 2-3 week interval even if a fungicidal spray program schedule has been followed because a small amount of foliage infection can lead to serious storage problems later. Tubers harvested 2-3 weeks after all tops have been killed by frost or chemicals develop less storage rot, data showing that one chemical vine killer is better than another in respect to managing late blight is not available.

10. When late blight occurs, avoid haulm pulling as a means of vine destruction because it can increase the incidence of tuber blight due to disruption of the hill which allows sporangia to reach the tubers.

11. Avoid harvesting during wet conditions or before skins are set. If it is raining or starts to rain, stop harvesting if the tubers are going into storage. Soil moisture levels can be replenished by irrigation to reduce bruising prior to harvest, but first, make sure vines are dead for 2-3 weeks and that soil cracks are covered. Areas of fields that are severely blighted can be marked, and if intended for storage, the harvest delayed so that infected tubers have additional time to rot; tubers from these areas should be positioned in the storage so they can be monitored and also be accessible if removal is necessary.

Blight infections on tubers usually become visible within the first month

of storage but symptoms may continue to appear throughout the storage season. Tubers that do not show late blight symptoms during storage may develop symptoms during reconditioning or transit if shipped at ambient temperatures. At first, the infected portion of the tuber is dry and firm with a carmelized sugary texture. Cut surfaces have a coppery-colored appearance. When the storage air is dry and the temperature is low, the disease is similar to a dry rot, forming irregular sunken patches that stay firm. Under these conditions, tubers may shrink inward, but remain hard. If the relative humidity is very high or if there is free water on the tuber, soft rot bacteria invade the tuber and the whole tuber breaks down. Infected areas of the tuber tend to be high in sugars and may ooze liquid. This moisture supports further soft rot growth in the pile. Late blight does not usually spread readily from tuber to tuber during storage, but it does provide an opportunity for bacterial soft rot to take over and spread rapidly.

12. Avoid harvesting during high temperatures if tubers are going into storage. When possible, use refrigerated air to cool tubers rapidly to the desired storage temperature. Do not bring in air that is warmer than the potatoes in the pile.

13. Make decisions about storage based on the level of late blight in the field. Tubers from fields with moderate to severe infections should not be put into long-term storage. Grade out diseased tubers and handle the remainder carefully to prevent injury since the fungus readily infects injured areas.

14. Dry tubers as quickly as possible after harvest; do not wet or wash tubers if they are going to be stored. Initially, it may be necessary to run ventilation fans with reduced or no humidity for a short time to dry tuber surfaces adequately. Removal of vines and soil before storage will help improve air circulation.

15. Keep stored tubers under continued observation, use continuous ventilation with relative humidity low enough to avoid free moisture on tuber surfaces. Relative humidity and storage temperatures should be as low as is compatible with the final use of the potatoes. Expect shrink losses to be higher than normal. Sell healthy tubers as soon as possible from commercial storages suspected of having infected tubers.

Cultivar Resistance

Some potato cultivars are more resistant to late blight than others so the crop needs to be managed according to the resistance of the cultivar. For example, **Norchip, Hilite, Russet Norkotah, Goldrush, Superior, Shepody,** and **Red LaSoda** are more susceptible to foliage infection than **Russet Burbank** and fields of these cultivars need to be scouted early and protected early with fungicides. **White Rose** and **Russet Ranger** are similar to **Russet Burbank** in late blight foliage susceptibility. **Norkotah** and **Shepody** seem to be especially prone to tuber rot so it is important to take precautions during harvesting and storage to minimize the infection of tubers.

Chemical Control

Chemical control programs for late blight in commercial plantings involve the application of protectant type fungicides (Table 1). These fungicides work by providing a protective layer on the surface of leaves and stems that kills late blight sporangia or prevents infection. Because protectant fungicides do not stop established infections they must be applied before infections occur in the course of a disease outbreak and reapplied before there are additional wet periods.

16. Begin fungicide applications early (when late blight is forecast, when wet weather conditions are anticipated, when plants are 6 to 8 inches tall or when plants close within the row). Scout potato fields for late blight at least weekly, beginning early in the season, especially for very susceptible cultivars like **Russet Norkotah** and **Hilite,** and monitor volunteer potatoes regularly.

17. Continue protectant fungicide applications on a regular basis until disease pressure no longer exists or until vines are completely dead. Thorough coverage utilizing high pressure and high volume per acre is important to get the fungicide onto the middle and lower leaves of the canopy. Shorter intervals between sprays are needed when disease pressure is high. A 5-7 day interval is needed in many potato areas of the world where weather favors blight, and a 10-14 day interval may otherwise be used. If applications are made by center pivot irrigation, fungicides should be applied with less than 0.2 inch of water. When using fungicides always check the label for correct application rates, methods and intervals, and days to harvest. Remember also to observe maximum allowable amounts per acre per season as they vary for different fungicides.

Ridomil has been an important fungicide in the past for late blight control. However, Ridomil-resistant strains of the late blight fungus have become established in Washington and Ridomil has not been effective in managing late blight in some areas. Some growers have continued to use Ridomil because populations of the late blight fungus can be "mixed" (have both Ridomil-resistant and non-resistant strains). Also, Ridomil can be an effective tool in reducing pink rot and Pythium leak in storage. WSU research has demonstrated that protectant fungicide spray programs either with or without limited Ridomil prepack applications result in a significant reduction in late blight caused by Ridomil resistant strains of the late blight fungus, and a significant increase in yield.

18. Ridomil prepacks can be used through the time of flowering but should not be used at the end of the season or to "cure" existing infections. This practice encourages the development of Ridomil resistant strains of the fungus. Growers should stop using Ridomil if it is ineffective.

Late blight forecasting systems help to identify the occurrence of

specific weather conditions that will promote the disease. They also enable growers to begin fungicide applications early during disease development when they can be most effective, and to save the cost of fungicides when they are not needed.

19. Refer to weather and disease forecasts when planning fungicide applications. A prediction of the likelihood of a late blight outbreak in south central Washington is available through the Department of Plant Pathology at Washington State University each year after June 1.

Table 1. Some protectant fungicides used for late blight control in commercial potato fields. Check the label before using them. The following does not include all of the products and Section 18 emergency exemptions that have been cleared for usage and is not an endorsement of any particular product.

Chemical Name	Some Trade Names
mancozeb	Dithane M-45; Dithane F-45; Dithane DF; Manzate 200 DF; Penncozeb; Penncozeb DF
maneb	Maneb 75 DF; Maneb 80; Maneb + Zinc; Manex
metiram	Polyram 80DF
anilazine	Dyrene 50% WP
chlorothalonil	Bravo 90DG, Bravo 720, Bravo W-75, Bravo Ultrex; Bravo S, Bravo ZN; Bravo 500; Evade; Echo 500; Echo 720;Terranil 6L; Terranil 90DF
triphenyltin hydroxide	Super Tin 4L and Super Tin 80WP
copper sulfates, copper metallics and copper hydroxides	Kocide 101; Kocide DF; Kocide LF; Champ Formula 2; Tenn-cop 5E; Copper Count N; Basicop; Nordox; Clean Crop C-O-C-S; Tennessee Brand Tri-Basic Copper Sulfate
*cymoxanil	Curzate M-8
*dimethomorph	Acrobat
*propamocarb hydroxide	Tattoo C
*Received Section 18 Emergency Exemptions for use in Washington in 1995	

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Warning. Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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