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Late Blight of Potatoes and Its Control

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Late blight is one of the most widespread diseases affecting potatoes, and when the weather is favorable for its development, it is the most destructive. It is usually less prevalent and destructive in moderately dry regions than in more humid ones, and in dry seasons than in wet ones. No commercial varieties are resistant to the blight. But with the development of modern and efficient methods of combating the disease, severe losses from it can be prevented.

Symptoms

Late blight is usually most severe and causes the greatest damage late in the growing season. It is called late blight because it generally makes its first appearance later than early blight,¹ also known as leaf spot. The late blight fungus² attacks the potato leaves, stems, and tubers. If wet or damp weather continues after infection, the entire plant quickly decays, giving off the somewhat musty odor characteristic of dying potato vines. At first the attack is insignificant, only affecting a leaf or stem here and there, and the danger is not immediately realized. But the disease can spread so rapidly that in a matter of hours an apparently healthy field may be severely damaged.

On leaves, dark-brown dead or dying areas usually develop near the edges or tips and spread inwards. The spread is most rapid in warm moist weather. The edges of the brown areas look water-soaked—a symptom that can be readily detected when the leaf is held against the light. A light-green zone around each brown area is a sign that the disease has progressed further. On the under surface of an infected leaf, the characteristic symptom is a grayish mildew, or mold, which produces the spores. The mildew is more conspicuous when the plants are damp with dew or rain, or when the humidity of the air is high.

On stems, the water-soaked appearance is less marked than on the leaves, and the blotches look like blackened strips running along the stem. Spores are also produced on these blotches when moisture conditions are favorable.

On tubers, the disease is a dry rot, which first appears as a purplish-brown discoloration of the skin, particularly at the eyes. If you cut a diseased tuber, you will notice a dry, granular, brownish or reddish rot extending a little

¹ Caused by fungus Alternaria solani (Ell. & Mart.) Jones & Grout

² Phytophthora infestans (Mont.) de Bary



A potato leaf infected with late blight.

beneath the discolored skin. The affected parts of the tubers die and shrink, causing irregular sunken spots over the skin. Other organisms in the soil or in damp surroundings may enter through the diseased areas and cause secondary wet rots, which may then mask the typical symptoms of late blight rot. The dry rot spots may be evident at digging time, but under dry conditions slight infections on the tubers may escape notice. During the early part of the storage period, the infected parts become more evident, especially when the tubers are stored under conditions of high temperature and moisture, and poor ventilation.

Cause

The fungus that causes late blight is one of the downy mildews. It attacks the growing potato plant and its tubers, and is responsible for both late blight and late blight tuber rot.

When a diseased tuber is planted and begins to grow, the fungus within it also begins to grow and invades the new sprouts, causing the dark-brown to black elongated spots on the stems. When the weather turns warm and moist, the fungus produces spores, and the disease continues to spread in the plant and to destroy it.

The spores are spread by rain and wind. If they fall on a potato leaf, and the weather is right, they germinate and start new infections. In a matter of hours, the mildew appears on the lower surface of the leaf and produces spores. Under favorable conditions, the disease spreads from plant to plant quickly. A potato field unprotected by a fungicide can be entirely killed in a few days.

Spores are also washed down by rain into the soil. When they come in contact with the tubers, they may penetrate the skin and cause the late blight tuber rot. The fungus overwinters in slightly affected tubers, which, if planted the next spring, will start the disease in the resulting crop. It does not overwinter in the soil.

Control

The only way to control the disease is to prevent plants from becoming infected. The fungus spends most of its life inside the plants and tubers, where chemicals cannot reach it. It is vulnerable only in the spore stage. If the plants are sprayed or dusted with an approved fungicide before infection takes place, the spores that fall on the plants are killed when they come in contact with the chemical, and infection is prevented.

Sanitation

Do not plant tubers showing signs of rot. They may contain fungus that will develop inside the growing plants, and in favorable weather produce spores. Wind and rain will spread them to other potato plants, and the disease will become established. Late blight can also develop on sprouts from diseased tubers discarded in the spring, and spread from there to nearby potato fields. The earliest late blight infections observed in potato fields have been traced to these sources.

Destroy all cull potatoes. Several methods are satisfactory. Tubers that are being discarded during the winter may be scattered in thin layers outdoors, where frost will destroy them. Small lots of cull potatoes may be satisfactorily disposed of in the spring by deep burial or by baking them. To bake them place them in thin layers in combustible material and set the pile on fire.

Use an approved weed killer if tubers in refuse heaps have sprouted. Herbicides usually kill the eyes also, and prevent any further sprouting. But when the cull pile is deep, more than one application may be needed to kill the buried sprouts. The important point to remember is to treat the cull piles early and effectively, and examine them from time to time for new sprouts. If any appear, spray the pile again.

Use of Fungicides

Spraying or dusting with an approved fungicide is the most important practice in blight control. Thoroughness and timeliness of application are essential for success. Even if all the potatoes planted on your farm are free from blight, you must treat them because the disease may be brought into the fields by windblown spores from a neighboring farm. Late blight is prevalent in the southern United States, where potatoes are grown during the winter, and, as the season advances, the disease spreads northward by windborne spores from potato field to potato field.

Bordeaux mixture is the oldest fungicide used in the control of late blight. A 100-gallon tank of the spray mixture is prepared in the following way. While the tank is being filled with water, keep the agitators turning, and sift in 10 pounds of pulverized or "instant" copper sulfate. Then, when the tank is nearly full, sift in 5 pounds of hydrated lime. Add enough water to make up the full 100 gallons, keeping the agitators running during the whole mixing operation.

Bordeaux mixture had no real competition until about 1930, when the "insoluble" or "fixed" coppers—basic sulfates, basic chlorides, carbonates, oxides—were introduced. These prepared copper fungicides apparently did not improve the control of late blight. Most of them did not adhere and persist so well as Bordeaux and consequently they were, in general, somewhat less effective. Their great advantage was that they reduced the labor and time of preparing spray mixtures.

In the 1930's research was directed towards the development of organic fungicides. The salts of dithiocarbamic acid, for example, were patented in 1937. After that, the search for new and better fungicides became keen, and today many efficient products are available.

Organic fungicides that are now recommended include maneb, mancozeb, metiram, and Difolatan. If you prefer a copper fungicide, use one that contains either tribasic copper sulfate or copper oxychloride sulfate. Because new fungicides are continually being introduced, be sure to keep up-to-date on recommendations. From time to time you should find out what fungicides are recommended for your locality. The information may be obtained from your nearest extension department, research establishment, or agricultural college. Some provinces issue printed calendars of recommendations every year.

Spraying. Spraying is more important in some regions than in others. In some places, particularly near the sea, a full-season spray program consisting of five to nine applications is needed. In other areas that are not so subject to frequent rains or fogs, fewer spray applications may suffice. In any case, it is best to ask your nearest extension officer about the time to apply fungicide. In some regions, the press and radio provide information on the occurrence and probable spread of late blight. Advice on the timing of spray applications is based on the severity of the disease and the weather likely to favor its spread.

For your spraying program to be successful, follow closely the suggestions given below.

• Apply the first spray when the plants are not more than a foot high, to ensure that the lower leaves are well covered with the fungicide.

• Spray every 10 days, and if blight is developing rapidly and moist weather prevails, reduce the interval to 7 or even 5 days.

• Because blight develops rapidly during wet weather, apply the sprays, if at all possible, before rains. But do not spray the plants when it is raining or when they are wet.

• Do not neglect to spray during fine weather or during the haying period. Maintain the spray schedule until the end of the season. It is a common practice for growers to spray thoroughly and frequently early in the season, but later when the spray material applied in the early season has been largely washed off and the blight begins to spread, they neglect to spray and heavy losses result. Spraying is a preventive measure and should be carried out all season.

• Pay strict attention to the performance of the sprayer. Clogged nozzles, low and uneven pressure, or other defects result in poor coverage. Renew nozzle disks as soon as they begin to show wear.

• Follow carefully the directions for preparing the spray material.

• Maintain the pressure recommended for the sprayer you are using, not only in the main part of the field, but also at the ends of the rows.

• In districts where late blight is generally severe, spray the rows in both directions to ensure complete coverage.

Dusting. Many potato growers use dusts instead of liquid fungicide mixtures because of the lower labor costs, reduced depreciation of machinery, ease of operation, and speed of application. Studies at Charlottetown have shown that dusting is just as good as liquid spraying, except in years when blight in severe. In these years, dusts have not been satisfactory. In regions where blight is of minor importance, dusts usually provide adequate control.

Apply 20 to 40 pounds of dust per acre, depending on the size of the plants and the severity of the disease in the area. Twenty pounds is enough when the plants are small, but the amount should be gradually increased as the plants grow and fill in the rows.

When you use a dust for blight control, take the following precautions:

• Ensure the maximum discharge by preventing the dust from caking in the bottom of the hopper or in the entrance to the delivery tube. Caking is likely to occur if you completely fill the hopper.

• Apply the dust in the evening, or early in the morning. At these times, strong winds are not likely to occur, and the dew on the plants enables the dust to adhere.

• In driving, turn away from the dust cloud. Begin on the leeward side of the field, and at the end of each row turn out of the cloud of dust that has just been discharged. This precaution will add greatly to your comfort and safety.

Cultivation and Hilling

Weeds in a potato field interfere with the proper dispersal of dusts or sprays and prevent the complete coverage of the plants with fungicide. Adequate and timely cultivation controls small weeds easily. If necessary, use chemicals for controlling weeds in potato fields. Some cf these must be applied only before the potato shoots appear above the ground; others may be applied to the growing crop. As with fungicides, research on herbicides is undergoing rapid development, and recommendations are subject to change. You should consult your local extension or research services when your weed problem suggests that chemical control is desirable.

Keep the rows well hilled up in order to provide a thick soil covering over the tubers throughout the season. Hilling gives the best protection against infection by late blight spores that may be washed down by the rain, and also reduces losses from sunburn and frost.

Potatoes used to be grown in rows close together, so that the hills had to be steep and pointed. The steep slope made most of the rainwater run off, and, during dry weather, the surfaces of the hills dried quickly. This type of hill probably contributed to diminished yields, because the plants were not able to get enough water for their proper development. In modern practice, the rows are usually spaced 36 to 40 inches apart. At this spacing the hills may be made less steeply inclined, with a reasonably broad, slightly concave crown. This type of hill absorbs much of the rain, is less subject to moisture loss through evaporation, and provides the maximum depth of soil covering. In heavy soils that crack when dry, it is almost impossible to grow potatoes free from tuber rot, no matter how well you spray them, as spores are very likely to be washed down into the cracks by rain. Potatoes should be grown only on the lighter soils, at least until resistant varieties are available.

Kill Off Potato Tops to Prevent Tuber Infection

Potato tops must be killed off 2 weeks before digging in order to prevent tuber rot, even though a full spray program has been carried out. Some late blight spores are produced on the potato plants as long as they remain green, in spite of the most careful and thorough spraying, and these spores can infect the tubers. Killing or removing the tops 2 weeks before harvesting ensures that no living spores are present to infect the tubers during digging.



Potatoes infected with late blight tuber rot. Left, external symptoms. Right, internal symptoms.

Use of chemicals. The most practical means of removing the tops is to spray or dust them with a chemical top killer. A number of materials for this purpose are now on the market. A material that has given satisfactory results is sodium arsenite, which is sold as a concentrated solution under several trade names. Although it is a deadly poison and requires the usual safety precautions, it does not affect the potato tubers when it is sprayed on the plants at the recommended strength of 1 gallon per acre.

Bluestone (copper sulfate) solutions have never proved satisfactory because the killing rate is too slow, but this chemical may be used when more effective ones are not available. At least 30 pounds of bluestone, dissolved in enough water to spray 1 acre, should be used. Adding 10 to 15 pounds of common salt improves the killing action of the spray. Other top killers such as diquat are available, and are quite satisfactory when used according to the manufacturers' directions. Here again, research is still in progress and new chemicals for experimental use are constantly being offered to government research agencies. You should therefore consult your local extension or research services to find out what top killers are recommended for your region.

Dusting with powdered cyanamid has given moderately good results. The dust has to be applied with a power duster, and two applications of 50 pounds per acre, a few days apart, are necessary. The cyanamid increases the fertility of the soil, as it contains 21 percent nitrogen. It is a very caustic chemical and, if the duster is not cleaned thoroughly immediately after the application, the metal parts will corrode. Sand, free from gravel or rock particles, may be blown through the duster to clean it.

Use of machines. Machines that cut off the tops near ground level and shred them into small pieces are now being manufactured and are becoming popular in some districts. These machines are powered by the tractor takeoff and are drawn behind tractors. But they are expensive, and do not appear to be economical for the small grower. In some localities, their operation on a custom basis may be possible. In small plots, the tops may be pulled by hand.

In using mechanical equipment, some precautions are necessary. The beater destroys the tops completely if it is set to operate at drill level but, in this position, the tubers are likely to be injured, especially if the ground is uneven or if the variety produces its tubers near the surface. In addition, the use of this type of equipment increases the danger of frost injury because it removes some of the protective soil. To avoid these losses, the beaters must be adjusted to operate above drill level. As a consequence, the lower parts of the potato stalks—usually 3 to 5 inches—are left standing in the drills. These stalks can be dangerous at harvest time if late blight has been present in the field, because the discase lesions on them will produce spores that may infect the tubers when they are harvested. If this danger is present, spray the field with bluestone at the rate of about 15 pounds per acre shortly before you begin digging. If the chemical is not available, use sodium arsenite or diquat.

Delayed Digging

Blight spores can survive on the surface of the soil for several days, occasionally as long as 14 days, and if they come in contact with tubers dug at any time during that period, they may infect them. To make matters worse, the tubers may appear to be perfectly healthy when stored, but later may become infected by spores brought in on their skin. Severe losses in storage bins often result from such infection. It is much safer, whenever possible, to leave the crop undug for 14 days after the vines have died, or have been killed by frost or a chemical. During that time, the spores on the dead vines and on the soil will perish; and most of the tubers that became infected



during the season by spores washed into the soil by rain will show the rot and can be discarded. Killing the vines removes most of the danger of infection in storage.

While the tubers are in the ground, they loosen from the stolons and the skin becomes tough. Mature potatoes are less apt to be injured during digging and subsequent handling. Tubers harvested in an immature condition are easily bruised, even by light blows. Injured tubers in storage are likely to be attacked by some other rots.

Blight-resistant Varieties

Very encouraging advances have been made towards a solution of the late blight problem by breeding resistant varieties. This objective will be fully realized when resistant varieties, adapted to each potato-producing region and of the type and quality demanded by the public, have been developed.

Cautions

Several chemicals are used in potato-growing operations. Because their purpose is to kill living organisms—bacteria, plants, insects, fungi—they may have adverse effects on other forms of life, such as birds, fish, farm and wild animals, and humans. To protect these creatures and ourselves, use caution when storing chemicals, opening containers, and disposing of surplus solutions and rinse water from sprayer tanks. Remember that chemicals are potentially dangerous; always take care to avoid the pollution of feeds, pastures, wastelands, and streams. Bury containers as soon as they are empty.

Chemical top killers containing sodium arsenite are particularly dangerous on the farm because, besides being highly poisonous, their salty flavor and sweet odor attract animals. Cattle do not usually eat potato plants, but they are so strongly attracted to fields that have been sprayed with sodium arsenite that they attempt to break through weak sections of a fence in order to feed on the foliage. Make sure your fences are strong, or remove the herd from the area for a few days.

Take particular care when you apply a sodium arsenite top killer to a field next to a pasture. If the wind is blowing towards the pasture, a light drift of the solution may be carried to the grass over the first few yards of the grazing area. The grass then has the salty flavor that attracts the cattle, and they will concentrate their feeding on the contaminated strip. They may become seriously ill, or even die.

A brand name is used in this publication because the chemical name is difficult for general use and there is no official common name for the active ingredient.



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