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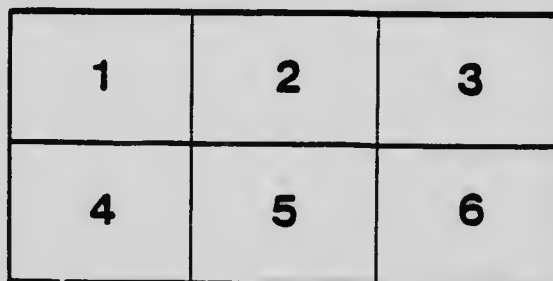
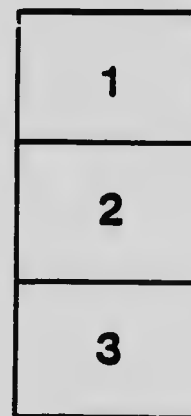
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CIRCULAR No. 7.

## PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE (HORTICULTURAL BRANCH).

## FUNGOUS DISEASES OF ORCHARD AND GARDEN.

BY W. H. BRITAIN, B.S.A., PATHOLOGIST AND ENTOMOLOGIST.

## PLANT-DISEASES.

BY the term "disease in plants" we understand any change in a plant in the direction of a reduced vigour or vitality of that plant, or, in other words, any deviation from the normal behaviour or form of the plant.

Plant-diseases are of several kinds:—

- (1.) Those caused by flowerless parasitic plants—viz., fungi, bacteria, and slime moulds;
- (2.) Those caused by flowering parasitic plants;
- (3.) Those due to insects and other animal parasites;
- (4.) Those due to unfavourable conditions of temperature, soil, etc.;
- (5.) Physiological disturbances, under which are considered troubles of a non-parasitic origin, the cause of which is not very well understood.

This article deals with the diseases belonging to the first group.

The fungi are plants, just as apple, plum, and cherry trees are plants; they are, however, much simpler in structure than are the ordinary plants we see about us. Fungi have neither root, stem, nor leaf, the place of these organs being taken by a mass of fine threads which penetrate the substance upon which the fungus grows and do the necessary work of obtaining food. These threads compose what is known as the *mycelium* of the fungus.

Corresponding to the seeds of the higher plants, fungi produce bodies known as spores, of which there are several kinds, and by means of which the species is perpetuated.

Fungi possess no green colouring matter. By means of their green colouring matter the higher plants are enabled to manufacture their own food, from materials taken in from the soil and air; but fungi must obtain their food already prepared from living or dead animals or plants—if from a living plant they are called parasites, and if from a dead one, saprophytes. The plant or animal upon which a parasite feeds is called the host, however unwilling the relationship may be.

For the purpose of treatment, fungi may be divided into two main groups: (1) External parasites; (2) Internal parasites. In fungi belonging to the first group the mycelium is quite superficial and the parasite feeds near the surface. In those belonging to the second group the mycelium penetrates directly into the tissues of the host, and the appearance of the fungus upon

the surface is usually the last stage of the disease. Because of this, external parasites may be controlled by spraying with fungicides when they appear, while for internal parasites we must adopt preventive spray or, in some cases, cutting out.

### BACTERIA.

Bacteria are colourless plants like the fungi. In fact, botanists regard them as degenerate descendants of the fungi. They are, however, much simpler in structure than most other fungi, each plant-body being composed of a single cell only. Though spores are formed in some cases, these are not for purposes of reproduction, but simply to tide the organism through unfavourable conditions, each bacterium forming but a single spore. Bacteria are exceedingly small and cannot be seen without the aid of a 'powerful' microscope. They enter their host-plant through wounds, breathing-pores, water-pores, and, as is sometimes the case in the fire-blight, through the nectaries of the flowers. They invade the tissues of the plant and injure it by blocking the sap-tubes, by robbing it of food materials, and in other ways.

Two common examples of bacterial plant-diseases are the fire-blight and the crown-gall.

### PREVENTION OF PLANT-DISEASES.

In considering the methods for the control of plant-diseases, emphasis should be laid upon preventive measures. Too frequently when the grower is aroused to the seriousness of a disease the damage is already done. He should therefore so regulate his farm practice as to prevent as far as possible any disease from gaining a foothold in his orchard or field.

To do this the following rules should be followed:—

- (1.) Maintain plants in as vigorous a condition as possible by proper cultivation, etc.:
- (2.) Follow clean cultural methods:
- (3.) Start with sound stock and healthy seed:
- (4.) Practise crop-rotation where possible:
- (5.) Practise timely and thorough weeding:
- (6.) Report and submit samples of any disease with which you are not familiar.

(1.) He should study to keep his plants as healthy as possible, for it is a well-known fact that most diseases cannot gain a foothold and maintain themselves as readily in a vigorous plant as in one with impaired vitality.

(2.) Do not leave lying about remnants of crops, prunings, etc., but gather and destroy by fire. Remove dead branches from your trees, scrape off the rough patches of bark, cut out and paint over all cankered areas.

(3.) In setting out young trees or in planting seed or potato-tubers, always be sure that they are absolutely free from disease. Just as a corrupt tree will not bring forth good fruit, so it is impossible for diseased stock or infected seed to produce a strong healthy plant.

(5.) Make spraying part of the regular orchard practice. Spraying at any time or in any manner will not produce clean fruit. To be of any value it must be done at the proper time, in the right manner, and with appropriate materials. To do this the grower must know for what he is spraying and have some knowledge of the disease in question, in order to determine when it can most readily be reached. The spray should be applied, if possible, ahead of the infection period of the fungus.

Again, to be of any value spraying must be done thoroughly. For the spring spray on the dormant wood a coarser spray can be used than that employed in summer spraying, for then the object is only to form a coating over the wood. In summer spraying the object is to thoroughly cover each and every portion of the plant with a fine mist of the spray. Do not drench the plant necessarily, but let every portion be covered with the tiny droplets of the spray.

(d.) Lastly, promptly report and send in for diagnosis any disease with which you are not familiar. Do not wait until it has gained such a foothold that its eradication may prove difficult, if not impossible.

The following are some of the most important diseases of orchard and garden:—

#### APPLE AND PEAR SCAB.

Though apple and pear scab are considered separate species botanically, for our purpose they may be taken together. This is the most widespread and best-known apple-disease. It is especially bad in moist climates; and wet weather at the time the blossoms are bursting, and for some time after, is especially favourable to its development. Some varieties are very much more susceptible than others.

Though best known as a disease of the fruit, leaves, blossoms, and twigs may also be attacked. Upon the fruit small, circular, dark olive-green spots first appear. Later the spots become black in colour, and the outer skin breaks, revealing the fungus beneath. In severe cases the tissues may be puckered to such an extent that the fruit cracks open.

Upon the leaves the fungus is more abundant on the lower surface, where it forms velvety, olive-coloured or black patches, at first circular in outline, but later becoming irregular in shape. The disease may winter over on the dead, fallen leaves. Growing upon the young stems of the fruit, the fungus sometimes causes it to drop prematurely.

#### CONTROL.

Details of control will depend largely upon climate and season. The regular spring or winter spraying of commercial lime-sulphur, diluted 1-0, is of help in controlling the scab. Another should be given just before the blossoms open, with lime-sulphur 1-30, and still a third may be necessary just after the blossoms have fallen.

Prune the trees to admit light and air. When practicable, destroying the old leaves by burning or ploughing under is of value. Orchards with a good air-circulation are less liable to attack.

#### BLACK-SPOT CANKER.

(See Bulletin 34.)

This disease has received various names in different localities, black-spot canker, apple-tree anthracnose, and Pacific Coast anthracnose being the most common. It is a disease peculiar to moist climates, and therefore particularly severe in the Coast districts, though found to a slight extent in the Dry Belt.

Most commonly it makes its appearance in very late fall, but in wet seasons may appear somewhat earlier. A slight darkening of the bark may appear, which later develops into a slightly sunken, dark-coloured circular spot, the bark beneath being soft and spongy. With the coming of the growing season in the spring, the cankered area is rapidly extended, and becomes

almost oblong in shape. The diseased portion of the bark then becomes dry and brittle, and a sharp line of demarcation is formed between the healthy and diseased tissue. Upon the surface of the canker numerous pustules, containing the spores of the fungus, appear. During the next year the cankered area may drop out, leaving the wood beneath bare and exposed. The canker is an annual, and re-infection by means of spores must take place in order to again produce the disease.

A rot of the fruit in storage is also caused by this fungus, which, in favourable seasons, may also be found upon the apples on tree.

#### CONTROL.

Preventive sprays must be used, as, after it has once established itself, spraying will not reach the seat of the trouble. Bordeaux mixture has proved most satisfactory for the canker, and for this purpose should be used in double strength (8 lb. stone-lime, 8 lb. copper-sulphate, and 40 gallons of water). It must be applied before the fall rains begin. In districts where the disease is bad this should be followed by another about a week later. Winter varieties of apples are not recommended for these districts, because after the fruit is picked it is too late to obtain the best result from sprays.

Lime-sulphur is recommended as a spray where the disease is present, but not serious. Proper pruning is desirable to allow entrance of light and air, and bad crotches are particularly to be avoided, as such places furnish a favourable place for spores to lodge. Avoid injuries to the bark from careless cultivation, and keep down other fungous diseases and insect pests. Destroy fallen fruit by burning or feeding to stock. Endeavour to keep a thrifty condition by proper cultivation.

#### APPLE-MILDEW.

The apple-mildew is pretty widely distributed, but only rarely proves of much importance. It is most serious as a disease of nursery stock, and to these it is sometimes found doing appreciable damage.

It appears on stem as dense, persistent, greyish-white patches. On the leaves it covers both sides, and is most common on those at the tips of the branches.

#### CONTROL.

Bordeaux or lime-sulphur sprays are effective.

#### SILVER-LEAF.

This disease has been observed in British Columbia upon apple, plum, peach, and pear trees, and has also been reported on our cherries. In Europe it is said to be most severe on plum-trees, but here the apple seems to suffer most. Plums are commonly attacked, but pears and peaches only rarely.

The characteristic symptom of the disease is the silvery appearance of the leaves, the upper surfaces of which lose their green colour, and take on the silvery gloss which gives the disease its name. Closer observation reveals the fact that the upper epidermis is more brittle than normal, and a cross-section shows it to be broken away from the underlying tissue. Air-cavities are thus formed beneath the cuticle, and this is probably responsible for the silvery appearance of the leaf. Sometimes only a single limb will be attacked, sometimes the whole tree.

Recent investigations connect the disease with a fungus (*Stereum purpureum*), the mycelium of which lives perennially in the tissues, and only comes to the surface to fruit upon the dead wood, where the tree, or some portion of it, has been killed.

No control measures have been properly worked out as yet, but the fact that the fruiting-bodies of the fungus only appear upon the dead wood suggests that, at least, the grower should be careful to remove all dead wood from affected trees.

Fruit-growers and others who have observed this disease in British Columbia are of the opinion that only trees weakened by winter injury or other cause are subject to the disease. Apparently sound trees, however, may sometimes be attacked. In any case, it is advisable to keep the trees as strong and healthy as possible. A special effort should be made to mature the trees in the fall, by avoiding too late or excessive irrigation and cultivation, and by planting cover crops.

This disease is at present under careful observation by several investigators, and further and more definite information will be available in the near future.

#### FRUIT-PIT OR BALDWIN SPOT.

This disease is so well known to all those engaged in fruit-growing that a description seems hardly necessary. Dark-coloured sunken spots, visible at first beneath the skin, appear upon the surface of the apple, being more numerous at the blossom end. Dead brown, spongy areas of tissue, sometimes found when the outside of the apple appears quite normal, extend inward from the spots, sometimes almost to the core. Several forms of the disease occur, but all injure the appearance and saleability of the fruit, and may render it unfit even for cooking. The spot may occur upon apples on the tree, but very frequently the fruit appears quite healthy until stored for some time.

The disease is found in all districts, irrigated and unirrigated, though, as a general rule, is more destructive in the irrigated sections. It is to be found on all types of soils, and no variety seems to be altogether immune from attack, though there is a great difference in the degree of susceptibility of the different varieties. Nearly all the fruit on a tree may be affected, or only that on a single limb. One tree may have its fruit badly spotted, while another of the same variety, grown under apparently identical conditions, will be comparatively immune.

Several theories have been advanced to explain the cause of fruit-pit. One is that too rapid transpiration of water from the cells of the fruit tubercles brings about too great a concentration of the sap in these tubercles as a result.

Another attributes the trouble to the rapid change in temperature from warm days to cold nights. During the day rapid transpiration of water from the fruit will occur. At night this will be rapidly checked, and as respiration still remains active, owing to the warmth of the soil, water will still be carried to the fruit and accumulate there to such an extent that an actual bursting of the cells will occur.

Others believe that in dry seasons insufficient mineral matter can reach the fruit, owing to the premature dryness of the soil, and that consequently certain groups of cells will die of starvation.

Lately experimental evidence has been brought forward to show that the spotting of the fruit is, strictly speaking, not a disease at all, but a symptom



of local poisoning. All investigators agree that it is not due to a fungous or other parasite.

The disease has been under observation for a number of years, and these and other theories have been put forward by different investigators to explain its cause. None, however, have been universally accepted, and no certain control measures have been so far discovered.

The following suggestions, however, have been put forward, and if followed can only result in benefit to the orchard and a saving of money to the grower: Endeavour, in so far as possible, to maintain an even moisture-supply throughout the season. Discourage heavy wood-growth and light yields of large sappy fruit. Late and excessive irrigation and clean cultivation should be avoided. Cover crops should be grown, and in extreme cases it may even be necessary to put the orchard in sod for a time. Do not give trees a too heavy winter pruning, and see that the orchard is given proper drainage.

#### WATER-CORE.

Water-core thrives in those districts where the fruit-pit is most prevalent. Like the fruit-pit, this disease is not due to any organism. Many varieties are affected, Hyslop Crab, Ribston Pippin, King of Tompkins County, and Wagener being among the worst.

Hard, watery areas appear in the flesh of affected apples at the core and extending outward from it. Small areas of this watery tissue may be scattered throughout the fruit, sometimes near enough to the outside to be visible at the surface. The seed-cavities usually contain liquid, and the intercellular spaces, instead of containing air, are filled with a watery fluid. Water-cored apples may appear perfectly normal when picked, the trouble only appearing after the fruit has been in storage for some time, when the affected areas will turn brown and the fruit rapidly break down.

The same remedies suggested for the control of the fruit-pit are also recommended for this disease.

#### FIRE-BLIGHT.

(See Circular 23.)

This has been known for some years as a serious disease of pears, apples, and quinces. In British Columbia it has so far been most serious as a disease of apple-trees.

Blossoms, young fruit, twigs, limbs, and trunk may be attacked. The disease appears at blossoming-time as a "blossom-blight." The germ of the blight, carried to the blossoms by bees or other insects, multiplies rapidly in the nectaries of the flowers, and may later spread down into adjoining twigs. Tips, blossoms, and leaves will be seen to wilt, becoming dark brown or black, and finally shrivel up, presenting a scorched appearance. The bark at first has a water-soaked appearance, but later becomes hard and dry. Young, rapidly growing shoots are specially affected, aphides and other sucking-insects being among the agents which carry the disease to the twigs. Where the disease is active, blisters will appear on the bark, through which a thick, gummy substance will ooze, at first light yellow in colour, but later becoming dark red or brown. The disease may enter the main limbs or trunk by passing down a twig or water-sprout. There it may form a canker of limited extent around the base of the shoot. In this case there is usually a clear line of demarcation between the healthy and diseased tissue, and when the disease

has ceased to become active a crack will usually be formed around the affected part. In the seemingly healthy tissue just outside of this area a few germs may lurk to carry on the disease for another year. Sometimes the disease goes on spreading down the main limbs and trunk, extensive cankered areas being developed, from which the yellowish gum may often drip abundantly. In severe cases the tree may be girdled and killed in a single season.

#### CONTROL.

- (1.) Cut out diseased spots as soon as the disease appears, at least a foot below the affected part.
- (2.) Cut out cankers at the base of shoots at least 4 or 5 inches below diseased part.
- (3.) Carefully disinfect the tools after each cut, with corrosive sublimate, 1-1,000, or formula, 1 pint to 3 gallons.
- (4.) Carefully examine trees again, and cut out cankers after the leaves have fallen.
- (5.) Gather and burn all prunings from diseased trees.
- (6.) Keep aphides and other insects in control.
- (7.) Discourage too rapid growth of trees by lessening amount of irrigation and cultivation, and by growing cover crops, or put orchard in sod for a time.

#### BROWN-ROT OF STONE-FRUITS.

The brown-rot of plums, peaches, and other stone-fruits is well known, and commonly destructive wherever these trees are grown. Warm, moist weather is particularly favourable to the growth of the fungus that causes the disease. Cloudy weather, with frequent showers, in midsummer, enables the fungus to most readily infect and establish itself upon the plant.

It is most destructive as a rot of the fruit, though occurring on blossoms and leaves. Green fruit may be attacked, but not often until over half-grown. The susceptibility of the fruit increases with the degree of ripeness. Small, dark-coloured circular spots appear on the surface, which spread until the whole fruit is affected. During warm, moist weather a whole fruit may become decayed in three days. Upon the surface of decaying fruits mould-like tufts appear, bearing the summer spores of the fungus. The diseased fruit may either fall to the ground or it may shrivel up, forming the so-called "mummied plums," and remain clinging to the tree throughout the season.

Fruit in transit or in storage may be seriously affected by the brown-rot.

#### CONTROL.

Spray well with lime-sulphur, dormant strength, just before the buds open. Follow with another of lime-sulphur 1-50 (or self-cooked) just after the blossoms have fallen, and with still another as late as is safe without injuring the fruit.

Prune out trees to admit air and sunlight, and thin the fruit so that no two touch.

In picking, exercise extreme care to avoid bruising or otherwise injuring the fruit. Pack no fruit that is bruised in the slightest degree. Allow the fruit to stand in a cool place overnight before packing. Collect and destroy all mummied fruit.

### PLUM-LEAF SPOT OR SHOT-HOLE FUNGUS.

This is a common disease of the cherry and plum, causing dead brown spots to appear on the leaf, which very often drop out, producing the shot-hole effect.

To control, spray with lime-sulphur, winter strength, just before the buds burst. Follow this with another of lime-sulphur 1-55 (or use the self-cooked, 8-8-40 formula). This is usually quite sufficient to control the disease, but in extreme cases another, after the fruit is picked, may be necessary.

### PEACH AND PLUM SCAB.

This disease causes small, circular, dark-coloured spots to appear upon the surface of the fruit. In bad cases one side of the fruit may be almost completely covered by the spots, and in such cases is apt to shrivel and crack open. Leaves and twigs may also be attacked.

The disease may be successfully controlled by the use of self-bolled lime-sulphur, 8-8-40 formula. The commercial mixture, diluted 1-50, may also be used.

### PEACH-MILDEW.

Peach-mildew occurs on the leaves and young shoots as a dense white mass of threads. It may also occur on the fruit itself. The disease causes an arching and curling of the leaves, and the deformation of the young, rapidly growing shoots.

In controlling this disease, self-bolled lime-sulphur has given fair results. Sulphur as a dry dust spray and ammoniacal copper-carbonate have also been used.

### PEACH-LEAF CURL.

Peach-leaf curl is first noticed on the unfolding leaves. It makes its appearance as an arching, curling, and thickening of the leaf, accompanied by a general heightening in colour. When only small areas are affected, these appear as reddish arched spots upon the leaf. Badly attacked leaves become brown and drop off, forcing the tree to put out a new set. Young twigs affected with the disease are thicker than normal and pale in colour. A gummy exudate may sometimes be seen oozing from the bark of such shoots.

When the leaves are severely attacked, the fruit may become dwarfed or even drop off. Trees suffering from the disease are apt to go into winter quarters improperly matured, rendering them more liable to frost-injury.

Peach-leaf curl is particularly destructive in seasons when cold, damp weather prevails, when the trees are leafing out, and consequently moist climates are more subject to serious infestations than dry ones. The disease gains entrance to the plant by the buds as they unfold, and control measures consist in giving the buds a thorough coating of spray before this time, to prevent the germination of the spores of the fungus.

Lime-sulphur, winter strength, or Bordeaux mixture, are both suitable for this purpose.

### RASPBERRY-CANE BLIGHT.

This frequently proves a serious disease of raspberries, particularly the black-cap varieties, causing a blight of leaves and cane. Sometimes the whole cane may be affected, sometimes only a single branch. Frequently the bark

and wood on one side of the cane will be blackened and discoloured by the disease, while the other will remain healthy.

Spraying has not proved altogether successful in treating the disease. Systematic cutting-out of old canes must be practised, and care taken to obtain only healthy plants at the outset.

#### RASPBERRY ANTHRACNOSE.

This affects both blackberries and raspberries, injuring the canes, leaf-stalks, and leaves. Light-coloured sunken spots appear on the canes, giving them the so-called "bird's-eye" effect.

Spraying with Bordeaux mixture early in the season has given good results. This and cutting out the diseased canes should keep the disease in control.

#### GOOSEBERRY-MILDEW.

This frequently becomes a serious disease of gooseberries, particularly the European varieties. The disease appears as a white powdery growth upon young twigs and leaves. Later the fruit will be affected. As the season advances, the threads of the fungus become dark brown in colour, forming dark blotches upon leaves and fruit. In bad cases there will be a severe drooping of the leaves.

Lime-sulphur is the most satisfactory fungicide for controlling the mildew. Use the dormant strength before the buds burst in the spring. Follow this with another, diluted 1-20, just before the blossoms open, and another, 1-30, just after the fruit sets.

#### LATE BLIGHT OF POTATOES.

The late blight of potatoes has frequently caused heavy loss to potato-growers in many parts of the world. It is a disease peculiarly dependent upon weather conditions for its development. A few days of warm, moist weather in midsummer are sufficient to enable the fungus to spread with singular rapidity over the field.

Dark-coloured spots appear on the leaf, usually beginning at the edge or tip. These spots are soft, of a dark, water-soaked appearance, with sometimes a slight purplish tint, and emit an offensive odour.

A dry-rot of the tubers, sometimes in the field, sometimes in storage, is also produced by the disease. The death of the cells of the tuber, brought about by the fungus, creates favourable conditions for the entrance and growth of various saprophytic moulds and bacteria, which may cause a wet-rot of the potato.

To control the blight, spray the plants with Bordeaux mixture when about 6 inches high, and repeat at intervals of about two weeks, three or even more sprayings being necessary, depending on weather conditions. Plant only sound tubers, and, if possible, practise a rotation of crops.

#### POTATO-SCAB.

This disease, commencing as dark-coloured spots upon the skin, finally develops into corky, scab-like blotches on the surface of the tuber. The trouble is not usually very deep-seated, those tubers that have been attacked while young being worst.

The spores of the fungus may persist in the soil for years, and are able to pass unharmed through the digestive tract of domestic animals, particularly horses.

Control consists in soaking the seed-potatoes for two hours in formalin, 1 pint to 30 gallons, then dry and cut.

Potatoes should not be grown for two successive years where the disease has occurred, and uncooked scabby potatoes should not be fed to horses.

#### STEM-ROT OF POTATOES.

Various names have been applied to this disease, stem-rot, rhizoctonia, potato rosette, little potato, and black-rot being some of these.

The stem of the potato at or below the surface of the ground is attacked, and sometimes completely girdled. Sometimes, but not invariably, small tubers, either singly or in bunches, appear on the stem above the injury, sometimes quite high up on the stem. The leaves of plants affected are usually smaller than normal, and yellowish in colour, in some cases taking on the rosette habit. In bad cases the plants die and the leaves wither up.

Tubers of diseased plants will be covered with small, black or dark-coloured spots, called sclerotia, which are composed of dense masses of the mycelium of the fungus. In this form the disease is carried over the winter, and plants grown from such seed are very apt to develop the disease.

To control this disease, treat as for scab.

#### DRY-ROT AND WILT DISEASE OF POTATOES.

This disease produces a wilt disease of the parts above ground, but is better known as a dry-rot of the tubers. Diseased potatoes may, to all appearances, be perfectly sound, until some time after gathered. They can be detected, however, by cutting the tuber across at the stem end, when a dark ring will be seen just under the surface. The disease may spread rapidly in storage, mould-like growths appearing on the surface, and the potato may shrink away to a fraction of its former size.

To control, reject all diseased tubers for seed purposes; avoid infected ground for planting potatoes, as the fungus lives for a considerable length of time in the soil. Some have reported good results from spraying with Bordeaux mixture for the wilt disease.

#### EARLY BLIGHT OF POTATOES.

This disease commonly occurs on both potatoes and tomatoes. Though able to establish itself on the host-plant as a true parasite under suitable conditions, plants weakened from any cause are particularly susceptible.

Well-defined circular or elliptical spots appear on the leaves and stems. They are brown in colour, concentrically marked, with pale centre and darkest border. The disease may be accompanied by a curling and drying-up of the leaves, thus causing much damage to the crop.

Spraying as for the late blight will control the disease.

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