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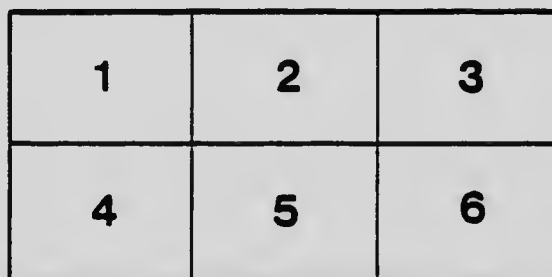
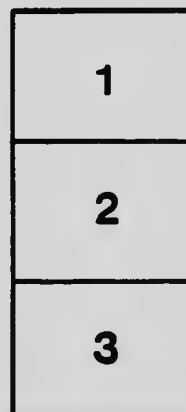
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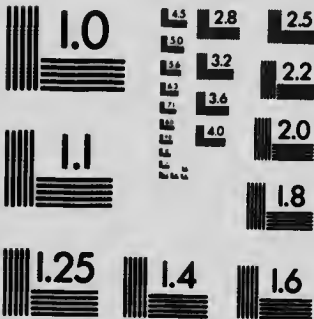
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DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
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DIVISION OF BOTANY

THE BLACK LEG DISEASE OF POTATOES

CAUSED BY *BACILLUS SOLANISAPRUS*, HARRISON.

BY

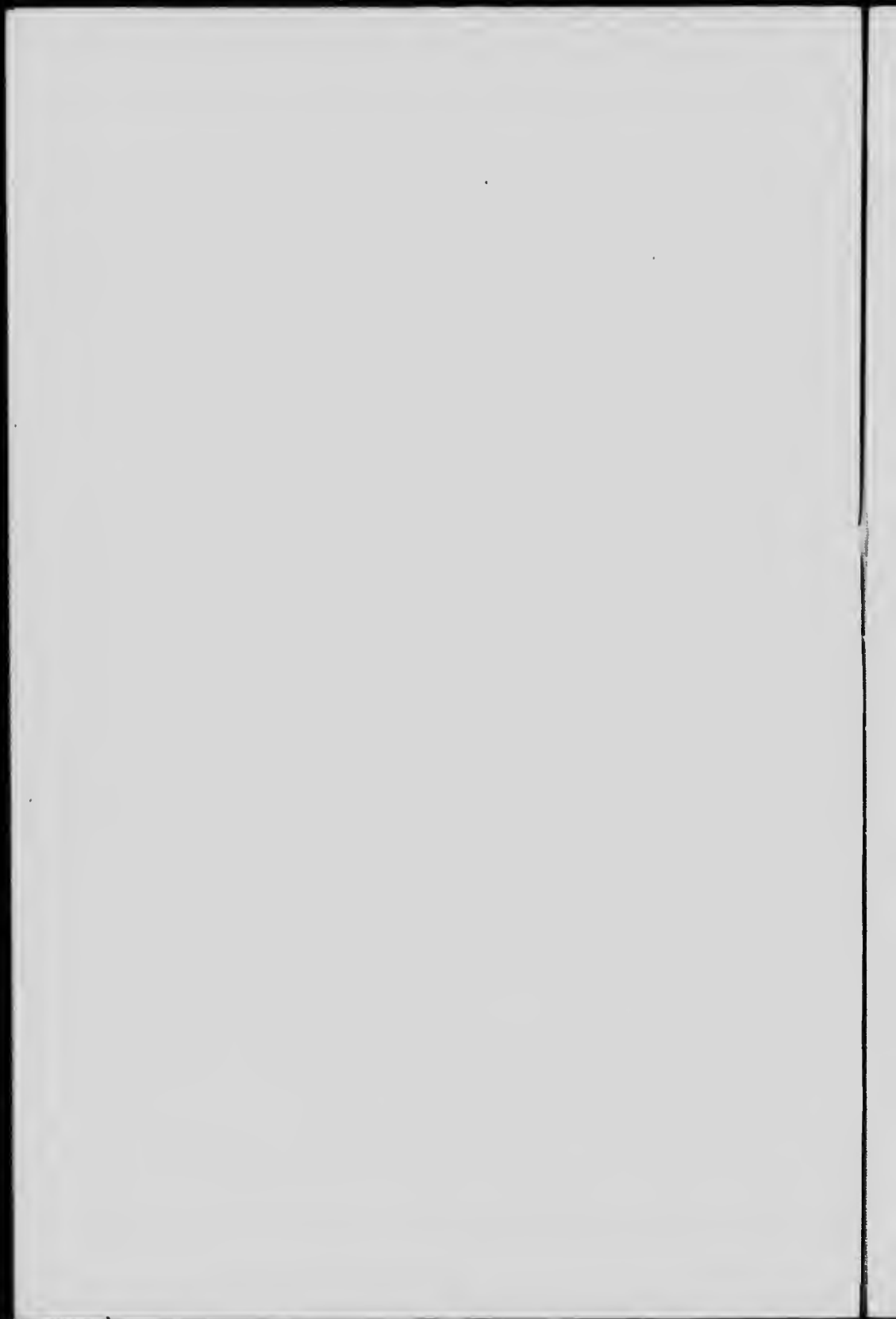
PAUL A. MURPHY, B.A., A.R.C.Sc.I.

Assistant in charge of Plant Pathological Field Station for P.E.I.

CIRCULAR No. 11

Published by direction of Hon. MARTIN BURRELL, Minister of Agriculture, Ottawa, Ont.

FEBRUARY, 1916



OTTAWA, March 7, 1916.

The Honourable
The Minister of Agriculture,
Ottawa.

Sir:—I have the honour to submit herewith for your approval, Circular No. 11, entitled "The Black Leg Disease of Potatoes," and prepared by Mr. Paul A. Murphy, Assistant in charge of the Plant Pathological Field Station for Prince Edward Island.

The losses occasioned by this disease, while still large, have in recent years been appreciably reduced as a result of the close study and persistent effort of our plant pathologists, and it is with a view to making known to our farmers the means of control found to be most efficacious that this circular has been prepared.

I would recommend that it be given a wide distribution, especially in the Maritime Provinces.

I have the honour to be, sir,
Your obedient servant.

J. H. GRISDALE,
Director, Dominion Experimental Farms.

DIVISION OF BOTANY,

OTTAWA, February 18, 1916.

J. H. GRISDALE, Esq., B. Agr.,
Director, Experimental Farms,
Ottawa.

SIR:—I have the honour to transmit herewith a manuscript entitled "The Black Leg Disease of Potatoes caused by *Bacillus solanisaprus*, Harrison," prepared at my request by Mr. Paul A. Murphy, B.A., A.R.C.Sc.I., assistant in charge of the plant pathological Field Laboratory for Prince Edward Island.

The study of the losses with which the potato growers universally have to contend has revealed that, while low yields may be due to unfavourable cultural, climatic, or soil conditions, yet various diseases are far more largely responsible for these often considerable losses. It is quite natural, therefore, that the study of these diseases should receive special attention from the officers of this division, and this activity has already resulted in the reduction of a large proportion of loss. Yet it is essential for the profitable raising of potatoes that there should be placed at the disposal of farmers, short, concise and reliable information regarding the control of those diseases which are most important from an economic standpoint.

Hence, the special treatise on "Late Blight and Potato Rot" submitted to you recently is now followed by one on Black Leg. This disease is readily recognized and moreover easy of control.

The losses due to this disease, now calculated by Mr. Murphy to amount to the still large sum of \$696,255 for the three Maritime Provinces, were, speaking from my personal experience, considerably higher a few years ago. This disease is being reduced every year through our instructions and the special efforts of the farmers, and it is hoped that Mr. Murphy's treatise will assist in further reducing or, preferably, eliminating it altogether from our long list of important plant diseases.

I would respectfully recommend the publication of this manuscript as Circular No. 11.

I have the honour to be, sir,

Your obedient servant,

H. T. GÜSSOW,
Dominion Botanist.

THE BLACK LEG DISEASE OF POTATOES

caused by *Bacillus solanisaprus*.

BY

PAUL A. MURPHY, B.A., A.R.C.Sc.I.

Assistant in charge of Plant Pathological Field Station for P.E.I.

Black Leg is a destructive disease of the potato causing the plants to die prematurely with the production of little or no crop.

SYMPTOMS.

Affected plants are prominent in July, as a rule before any other disease makes its appearance. They are characterized by pale green or yellowish foliage and the leaves have a tendency to roll up. They cease to grow and generally appear somewhat smaller than healthy plants. The branches look stiffer and more upright than normal, and the whole plant is unthrifty and soon dies. (Fig. A.) The symptoms are very well marked and constant, and, once recognized, cannot easily be mistaken.

If an affected plant be pulled up one finds that it leaves the ground easily. A suspicious looking plant may be tested in this way, for if it be gently pulled it will come away readily if it has the Black Leg. The part of the stalk which was in the soil will be found to be black and rotten, and this is a certain symptom of the disease. (Fig. B). The set will be found to be rotten also, and if the connection can be traced it will be seen in almost every case that the rot in stalk and set is continuous. Since the disease comes from the set it almost invariably happens that if one stalk in a hill shows the disease the others will sooner or later show it too. This can be easily verified by pulling them up, when it may be seen that no matter how healthy they appear the rot is working its way through the lowest parts of the stem, soon to make its presence visible in the foliage. *In removing diseased plants, therefore, the whole hill should be taken out.*

If any new tubers are formed, the infection spreads to them also along the "rhizome" or stem on which they are borne. One can often see cases in which the rot has progressed part of the way along the rhizome towards the new potato.

The disease manifests itself in the tuber as a rapid soft rot, which always starts from the stem end. (Figs. C, D). On the outside, the rotting tuber is soft and moist looking, and a blackish line under the skin shows the boundary of diseased and healthy tissue. Such a tuber when cut open has characteristically a black cavity in the centre (Figs. E, F) while the remainder of the flesh is soft but not much discoloured. Sometimes the whole of the interior is filled with a white slime. Once the disease gets into a tuber it rots almost at once, and under normal circumstances affected tubers never live over winter, most of them rotting in the field.

LIFE HISTORY OF THE CAUSAL ORGANISM.

The disease is caused by one of the most minute of organisms, known as bacteria—the name of which is *Bacillus solanisaprus*, Harrison. This organism was first described by Professor Harrison of Macdonald College. Various other almost identical

parasites have been described in other countries under different names. The organism is carried by the seed exclusively, and it does not live over in the soil as far as is known. When a set which carries the infection is planted, the parasite, under the influence of the moisture and favourable temperature of the soil, sets up a soft rot in it. This is transmitted more or less quickly to the sprouts. If it reaches them before they come to the surface of the ground, cutting off their supply of food before there has been time to develop much of a root system, no plant results. It more often happens, however, that the plant is six inches or a foot high before it shows symptoms of the disease by the rolling of its leaves and by its light green colour. These are invariable signs of the water supply being short, and that is the proximate cause of the symptoms in this case also. In consequence of the disease having taken longer to travel from the set into the base of the shoot, the plant has had time to develop a large root system. Thus, unlike the case of the shoot which was killed as soon as its connection with the set was cut off, the plant is able to live and thrive by drawing on its own roots which are developed above that part of the stalk in which the parasite is. Gradually, however, the rot works upwards, killing off root after root, and slowly starving the plant. The rot travels up as far as the ground level, and sometimes a little above it, and thus cuts off the last root and finally kills the plant.

If death has not resulted before some tubers have been formed the disease is likely to invade them also along the rhizomes. If it does, they generally rot entirely away. Such tubers are not at all likely to be used for seed, but there are other apparently healthy ones which contract the infection from them, or in some other way not well understood, and carry it into storage with them. It is probable that they do so in cuts and bruises which have healed up and in which soil contaminated by tubers rotted by the Black Leg organism has lodged. At the same time the possibility has not been eliminated that, for some reason, the parasite may cease to develop in a tuber and may lie there in a dormant condition until the following spring, although it is usually so virulent that, when it comes into direct contact with the flesh of a potato, it rots it entirely away. The success of the formalin treatment in preventing the disease, even though it must be combined with selection, would seem to indicate that the infection must be carried to a considerable extent externally. It is probable that the parasite does not persist on the unbroken surface of the tuber because it is very easily killed by direct sunlight and drying.

However the details may be, it is certain that infection is carried by the seed. All the sets cut from a tuber which harbours the disease will be almost sure to be infected by the knife, and a large number of the succeeding ones will be contaminated also. The infection thus imparted to a comparatively small number of sets may be spread almost indefinitely, if the cut seed is allowed to stand in bulk and heat even to a slight extent. Such conditions are the most favourable possible for the disease, and it has been shown by experiment that keeping cut seed in barrels for two or three days caused the diseased plants to increase from 15 to 20 plants per acre to 325 plants per acre.*

AMOUNT OF LOSS OCCASIONED.

A conservative estimate of the loss due to Black Leg in 1915 (in which the disease was extraordinarily abundant) in parts of the Maritime Provinces puts the figure at the astounding total of 10 per cent of the entire crop, including diseased plants and misses which could be traced to the disease. *In some cases the percentage of Black Leg plants was very much higher than that, and the total misses were as high as 80 per cent and more.*

These figures are the results of careful counts on more than one hundred farms.

The 10 per cent loss in money estimated above, when applied to the figures of estimated areas and yields of potatoes in the three Maritime Provinces (P.E.I., N.S., N.B.) as given in the November 1915 issue of the "Census and Statistics Monthly" amounts to a grand total of \$696,255, or \$6.65 per acre with an average yield of 133 bushels.

* At the Experiment Station, Orono, Maine.

CONTROL.

Black Leg is one of the most easily controlled of all plant diseases, and, if the directions as to the cheap and simple treatment given below be followed, it can be entirely eradicated in two years. Once it has been banished it is not likely that it will be introduced again unless fresh seed be procured. New seed should be always treated by one of the methods given in article (3), preferably with corrosive sublimate. An ounce of prevention is better than a pound of cure; otherwise one never knows what serious disease may become established on the farm. Although this recommendation is doubly applicable to new seed, no better practice can be followed than to disinfect regularly all seed potatoes. Bigger, cleaner and healthier crops will be the invariable result, that is, assuming that the land is clean and free from those diseases which it has the power of harbouring. If it is not, it should be given a rest from potatoes and put to other crops as long as possible.

RULES FOR THE TREATMENT OF SEED POTATOES.

(1) Do not, if possible, use seed from a field in which there was a large amount of Black Leg, or in which misses were noticeably abundant.

(2) Before cutting potatoes for seed, pick out and discard all decayed, broken, cut, or bruised tubers. It is by these that Black Leg is likely to be carried. No disinfection will be entirely successful unless this is done.

(3) Steep the selected sound potatoes, before cutting, in either:—

(a) a solution of two ounces of corrosive sublimate in 25 gallons of water for three hours. *Corrosive sublimate is a deadly poison.*

or (b) a solution of one pint of formalin in 30 gallons of water for two hours.

(4) Keep a jar of formalin with a spare knife in it at hand when cutting seed and if a tuber which shows traces of rot be met with drop the knife with which it has been cut into the disinfectant and use the other one instead.

(5) Do not plant potatoes in soil which needs draining. A wet soil favours the disease.

NOTES ON THE PREPARATION AND USE OF THE DISINFECTANTS.

Corrosive sublimate is rather insoluble and a small quantity of hot water should be used to dissolve it. Wooden or earthenware vessels only should be used to contain it, as it has a corrosive action on metal ones. The solution loses its strength quickly when a batch of potatoes has been steeped in it, so that it is safer not to use it for a second lot. The solution will, however, keep good for a considerable time before being used. As corrosive sublimate, even in very dilute solutions, is a deadly poison, the greatest care must be taken with it and with the vessel and potatoes with which it comes in contact. On no account should the potatoes be used for food for man or beast, and the containers should be carefully washed before being used for any other purpose. It is, however, one of the best disinfectants known and certainly the most effective known for potatoes. Its cheapness is another point in its favour, an ounce costing about 20 cents.

On the other hand, formalin possesses none of these disadvantages, but it is unfortunately not so effective for all potato diseases as the other. It is equally good for Black Leg, Common scab and possibly some others, but not so good for *Rhizoctonia* nor probably for Powdery Scab. It is very easily prepared and is non-poisonous, and treated potatoes may be used for food. It may be used more than once on the same day as it is made up, but not afterwards because the formalin evaporates. It can be sold at a profit for 25 cents a pint but 50 cents is usually demanded for it.

For further information apply to the Dominion Botanist, Central Experimental Farm, Ottawa.

Read also—

Potato Diseases transmitted by the use of unsound Seed.
The control of Potato Diseases.

Potato Scab.

Powdery Scab of Potatoes.

Free on request, Central Experimental Farm, Ottawa.



"Black Leg of Potatoes" (after Orton).
Explanation of figures in text.

J. L.

