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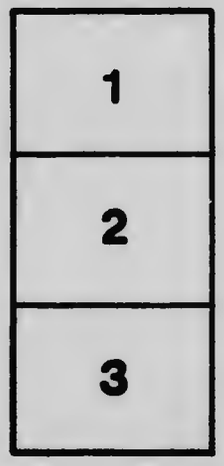

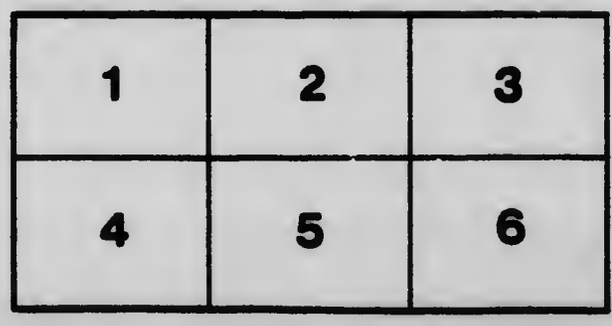

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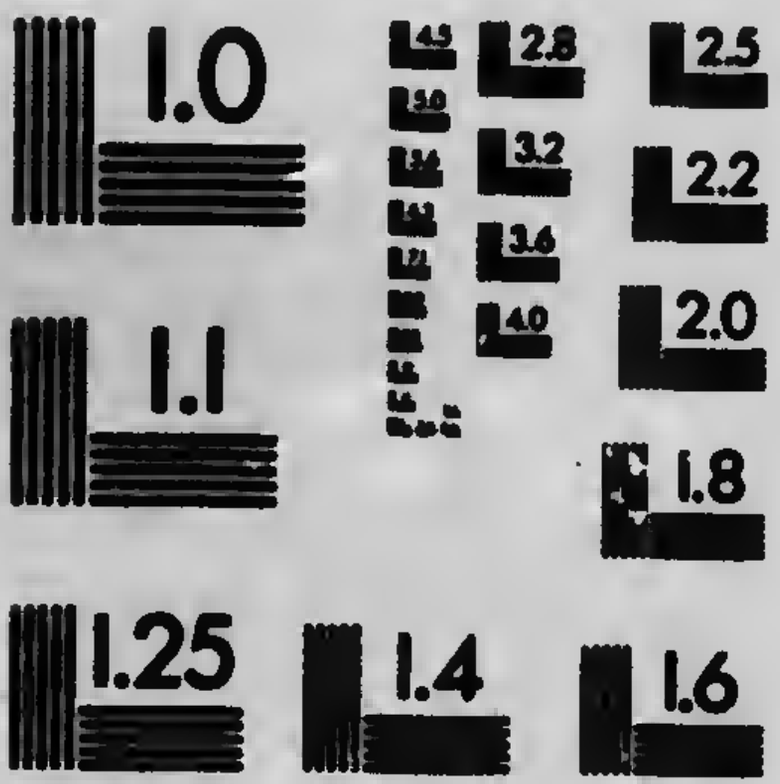

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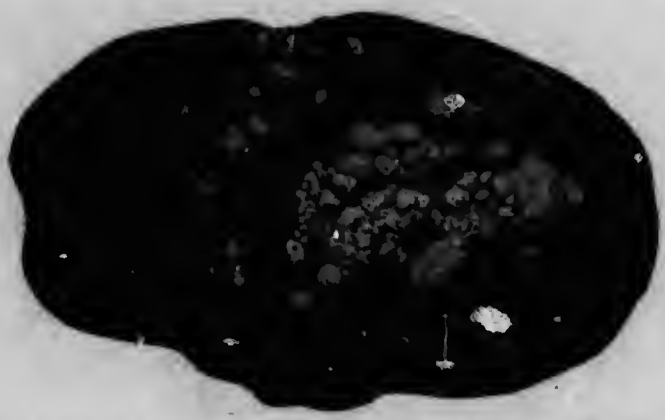
DEPARTMENT OF AGRICULTURE OF THE PROVINCE OF QUEBEC
HORTICULTURAL SERVICE — SECTION OF ENTOMOLOGY

BULLETIN No. 64

SEED TREAMENT

— BY —

GEORGES MAHEUX
Provincial entomologist



Dry rot of potatoes: a common disease of stored tubers. (After Gussow).

Published by order of the Hon. Jos.-Ed. Caron, Minister of Agriculture of the Province of Quebec
May 1919

Let us have specimens of insects or diseases injurious to your crops. Living insects are preferable for study; give them sufficiently of their ordinary food to allow them to eat *en route*. As soon as you notice a serious invasion of your crops by such enemies, advise us immediately.

Your letters or parcels should be mailed to:

The Entomologist,

Department of Agriculture, Quebec.

SEED TREATMENT

Why Treat Seeds ?

Thanks to the transportation facilities that have multiplied commercial exchanges, the enemies of cereals and potatoes have increased considerably, both in number and violence. The zone infested by diseases grows larger as the cultivated area extends. Any farmer impressed with his own interest must fully realize that he has a difficult problem to solve, and a problem particularly difficult because its complete solution depends on the harmony with which all interested will fight these parasites. Besides, there is not a single farmer in this province who is not aware of the havoc worked by these diseases, and of the losses in money they entail. At any cost, our fields must be cleared from of these pests that make our crops yield continually less and less and, by the fact, deprive the farmer of well-deserved revenues. The fight against them has now become rather easy because very simple, yet efficient means, have been discovered by scientists to control these diseases. Amongst the protective means that are within the reach of all, the most important is without saying the selection of seed grains and turbers. Still, other preventive means are existing that add to the value of the former and complete same wonderfully. These are the means we are anxious to vulgarize among the agricultural community.

Our aim, in having this bulletin printed is first to acquaint farmers in the Province of Quebec with the diseases injuring their cereal and potato crops and to give them, afterwards, in a clear and concise way, the safest methods to check their ravages. Treatments the use of which is advised herein have given proofs of their efficiency and should be immediately adopted by our farmers. It will cost very little to put them to execution and it should bring them bountiful crops and large returns.

I—DISEASES OF CEREALS

Our intention is not to treat, under this little, of all diseases injuring cereals, but only of the most common ones, of those that are known to everybody and that are liable to be preventively treated Seen in this light, the most important are, without saying, the *smuts* which levy such an exorbitant tithe on our wheat, barley and oat crops every year.

1—DISEASES OF WHEAT

Stinking smut (Tilletia Tritici).

The most indispensable of all cereals is the victim of two quite common and always ruinous diseases : stinking smut and loose smut. What is stinking smut ?

This is a disease caused by the disaggregating action of a minute parasitic fungus called Tilletia tritici Bjrk. The infection of the plantule of wheat takes place at the time of germination through spores that have remained on the envelope of seed grains. The development of the disease can hardly be noticed, but its effects are evident at harvest time. The injured grains resemble a greyish bag ; they are shorter and coarser than normal grains. When one of these bags is opened, one finds the interior filled with a yellowish dust emanating a penetrating and disagreeable odor much like that of rotten fish : whence the name of "herring disease", sometimes given to stinking smut.

STINKING SMUT.—1, diseased head ; 2, spore ; 3 and 4, spores that have garminated and carrying secondary spores at their extremity ; 5, two secondary spores united. Figs 2 to 5, highly magnified. (After Brefeld).

It is equally to be noticed that smutted heads remain strong, erect, not bending like sound heads. Their colour is a somewhat bluish green, of a darker hue than usual, and they retain this colour for a longer time than healthy heads. The threshing of smutted grain infects healthy grain, because smut masses tear and consequently free the germs of the disease. These germs, finding lodgment upon the surface of wheat grain, contaminate the next crop. It is then most important, seeing that one can never say that seed grain is free of these parasites, to destroy smut spores immediately before sowing. The treatment recommended in this case is a formalin bath which is described further on under the heading : Treatment of cereals, (see page 9).

Loose smut (Ustilago tritici).

This disease is caused by another microscopic fungus, Ustilago tritici Rostr. In certain districts it is more common than stinking smut ; its effects, which are more obvious than in the case of the latter disease, make that it is often better known. At the time when spikes form, the latter, under the influence of the loose smut fungus, are transformed into unevenly indented stems and are completely covered with a bla k dust resembling soot. When ripe, this dust falls down at the least shock and soon there does not remain but the axis of the head without any grain being produced.

As in the case of stinking smut, the loose smut of wheat does not gain other cereals, though it be a close relative to the smut of barley. The disease is propagated by the flower of the wheat and the fine dust carried by the wind finds its way into the flowering organ and afterwards contaminates the entire head. The first heads turn into dust, whereas those appearing later may ripen, but their grains contain the germ of the disease. The plant grown from such a grain will soon be infected and will propagate the disease amongst its neighbours.

As the spores are not attached to the glumes, treating with formalin would not be of the same avail as in the case on stinking smut. The germ residing inside the grain may be destroyed only when submitted to a high temperature, progressively reached by successive immersions. Hot water employed at the required degree does not affect the germinative power of the grain but should surely destroy the germ of loose smut. The hot-water treatment is described on page 10.

2—DISEASES OF BARLEY

C ed smut (Ustilago Hordei).

Two kinds of smuts injure barley : one caused by the Ustilago Hordei K. & S. gives the covered smut, the other ,occasioned by the Ustilago nuda produces the loose smut. The heads attacked by the covered smut are much smaller than the healthy heads, which can be easily ascertained once the grain is cut down. Smutted heads contain no seed, but bags of germs whose thin and whitish envelope is easily destroyed when touched. When threshing, the spores scatter and communicate to sound grain with which they germinate into the soil, and penetrate into it in the same manner as the spores of the stinking smut of wheat. In order to destroy those germs adhering to the outside envelope of the grain, one shall resort to the formalin treatment, (page 9).

Loose smut (Ustilago nuda).

The loose smut of barley operates in the same manner as the loose smut of wheat. It destroys the grain completely and the germs appear in the way of dust at flowering time of barley. Soon afterwards, there remains nothing but

COVERED SMUT OF BARLEY.– Dark spots show the points injured by the fungus. (After Massee).

the center stalk of the head ; the envelopes of spores burst before the harvest and the scattering is made by the wind and other agents. The infection is inside the grain and cannot be controlled otherwise than by the hot-water treatment (page 10), without neglecting the selection.

2—b. SMUTS OF OATS

They are the most common and also those that entail the greatest losses of money. One distinguishes the loose smut and the covered smut. In both cases, spores adhere to the outside of the grain and it is then rather easy to destroy them : one only has to disinfect the seed thoroughly before putting same into the

ground. The formalin treatment (page 9), very simple of execution, should be in favour with all those who grow oats. This is the most efficient means to harvest healthy crops and to destroy fungi in a short time. In order to achieve this end, it is imperative that the use of formalin, this excellent germicide, becomes general throughout the Province.

Healthy panicle of oats. Its graceful spreaded shape should be particularly noticed.

Smutted panicle of oats. The grain is destroyed, the head blackened, ill-shaped and does not open.

Loose smut (Ustilago Avenae).

This smut betrays its destructive action by the presence of an almost black dust and the malformation of heads. One knows that the healthy panicle is widely spread, whilst the sick head does not open ; the grains containing the spores being held fast by the stalk. Ill-shaped, stunted heads, constitute a first symptom of the presence of the disease. The scattering of spores takes place before the harvest ; the wind is their carrier and sets them on healthy heads. A field strongly infested, presents a much darker colour than usual ; because of

the presence of numerous heads blackened by the smut. While threshing, the germs are carried here and there and stick to the grain. Contaminated seed will yield a smutted crop. One should treat with formalin (page 9).

SMUTTED HEAD : 1, its appearance when the infection started ; 2, spores ; 3, spores in various stages of development ; 4, secondary spores united. Figs 2 to 4, highly magnified (after Massee).

Covered smut (Ustilago levis).

Much resembling the precedent, the covered smut however differs a little in this way that it is only propagated by threshing and not before the harvest. Injured heads look very much like those that are healthy at ripening time. On carefully examining oat plants, after cutting, one may find that the smutted grains have a whitish envelope though which one may see the masses of spores taking the place of the grain. Spores adhering to the grain are destroyed by formalin (page 9).

II—TREATMENT OF CEREALS

As a general ru'e, all seed wheat, oats and barley must be disinfected so as to kill the germs it may contain or carry and that would, without such precaution, contaminate the future crop. It is better not to take any risk ; there is not a

single farmer who can state that the grain he is about to put into the ground contains no fungus. As we have just seen, it is not indifferent that the seed be treated with formalin or hot water. It all depends of the diseases to be treated, and this is particularly important for wheat. In most of cases, formalin might be used because it succeeds in controlling most of the smut diseases. The farmer shall have to ascertain the presence of such or such disease and apply the proper treatment. However, it is obvious that formalin employed for all cereals is of much more avail than no treatment at all.

Formalin treatment.

This is the treatment recommended for the stinking smut of wheat, the covered smut of barley, the loose smut and the covered smut of oats. Formalin has the required strength to destroy them. It is a liquid chemical, almost colourless ; it is inexpensive and easily obtained at drug stores and from seed or insecticide or fungicide merchants. It is also called formaldehyde, formalin being formaldehyde 60% strong. The treatment is easily applied, and in a short time, in two different manners, as desired.

Dipping process. First, in a wooden barrel, a solution of formalin is prepared as follows : 40 gallons of water and one pound (or one pint) of formalin, or formaldehyde 40% strong. For more convenience, half of the solution thus prepared may be poured into another barrel, so that the work may proceed rapidly. A bag of grain is then dipped into each barrel ; same will undergo an up and down movement so as to expel the air. The bath should not last more than five minutes. but one should see that the bag is thoroughly immersed. The grain is afterwards emptied on boards without delay and left to dry. The operation is repeated as often as there are bags to immerse One should not forget that the grain must drain immediately and thoroughly before sowing.

Sprinkling process. This method consists in heaping the grain on a good floor. A person moistens the grain with a sprinkler (a pressure sprayer preferably), whilst another person turns it over with a shovel so as to allow formalin to penetrate the whole heap and reach each grain. When all grains are moist, they are covered with cloths or blankets for three or four hours : this is intended to prevent the too prompt evaporation of formalin. Then the blankets are removed and the grain is allowed to drain, after which there only remains to sow. The grain should be treated at the eve of sowing only. As its bulk lightly increases, the seeder should be set as if you are sowing ½ bushel more per acre. Forty gallons of solution are usually enough to treat 50 bushels of grain and the cost of treating should not exceed one cent per bushel. One holds that formalin lessens the germinative power of grain : repeated experiments have shown that if the treatment is applied under the conditions we have just mentioned, there is no

danger of this nature. Follow scrupulously the directions regarding the strength of the solution and the length of the bath.

Hot-water treatment.

Hot water should only be used when one is certain that wheat or barley are infected by loose smut. This treatment is more complicated than the former and requires more time. It is aimed to destroy germs or disease threads contained in the grain. For this purpose, the grain is raised, through three successive baths, to a high determined temperature.

1.—Take hot water, when about to boil, pour into a barrel, add cold water, and stir until the thermometer shows exactly 86 degrees. Bags of grain, three-quarter full, are placed to soak into this water for four hours ; this is the soaking or preliminary treatment.

2.—For the second immersion, one should have in another barrel, water heated to 112 degrees exactly, then take the bags out of the first barrel and plunge them immediately into the second one, during 15 or 20 minutes.

3.—Finally, plunge these same bags in another hot-water bath, at 129 degrees exactly, during 10 minutes. Then put the grain to dry spreading it in thin layers, exposed to the sun or air and turn often ; sow before it is completely dry. Through these three successive immersions, the germ of the loose smut is destroyed and the grain is not damaged.

III—DISEASES OF POTATOES

Powdery scab (Spongospora subterranea).

One of the most terrible pests the farmer has to fight. The skin of the tuber is first swollen by spots or pimples, then it dries up, breaks easily, allowing a

Powdery scab.—Pimples appear on the surface of the tuber. (After Gussow).

brownish dust to come out (germs of the disease). These germs, scattered into the soil, may contaminate the following crop if care is not taken to change field. It is obvious that one should never use tubers from a scabby crop for seed purposes. One should always plant, moreover, only first class seed ;
and to avoid all accidents, treat potato sets with formalin. In this way, germs of diseases that may adhere will be destroyed by this preventive means only.

POWDERY SCAB.—Advanced stage of the disease. The tuber is drying. Brown spots contain a brownish dust or germs of the disease. (After Gussow).

Ordinary scab (Oospora scabies).

Also called scab of Irish potato or disease of heavy lands. This disease is very common in our country, particularly in some heavy lands. It differs from the former because the pimples or spots are not rugous and contain no dust, one can break the surface without setting free any dust of germs. Selection of seed, of the ground and formalin treatment.

Rhizoctonia (Corticum vagum).

It is also called scurf (disease to which is connected the infection known by the name of "little potato" or stem rot). This disease, less common than the

ORDINARY SCAB.—Outside aspect. (After Gussow).

former is often an ally of the common scab. It attacks the underground part of plants ; hypertrophies are formed on the surface of the tubers but does not seem to penetrate the flesh, although they probably carry the spores of the fungus. Treat with formalin.

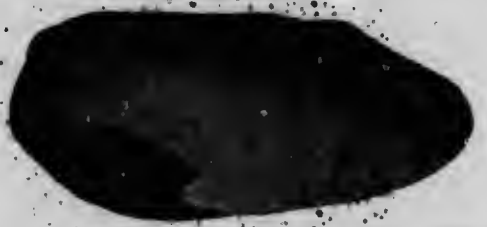
Early blight (Alternaria solani).

The early blight is noticed in July as it produces on leaves, dry brown spots, marked with concentric circles. One cannot control its injuries otherwise than with Bordeaux mixture. The first spray should be given when the young plants are about three or four inches high and the operation must be repeated at least five times during the season.

Little Potato.—Note the characteristics of the disease on the surface of tuber. (After Gussow).

Late blight (Phytophthora infestans).

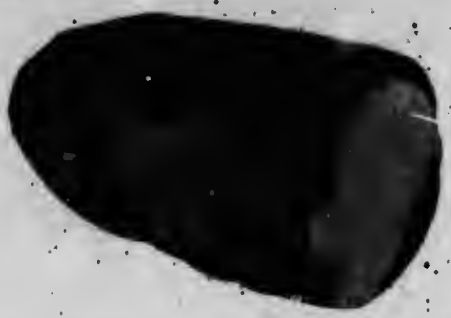
It is the potato rot. Also known under the name of downy mildew, this disease only appears in August, but its work of destruction is started much before its results are seen. The lower leaves are the first injured ; dark brown or purple-black spots appear and they seem swelled with water. These spots harden in dry weather ; when it is wet, they widen and soon cover the whole plant causing



Mildew.—Shaded parts are of a dark brown colour. (After Gussow).

it to fall in a short time. From the stalks, the disease gains the roots and the tubers. The injured potatoes have a hard skin marked with livid spots. Underneath, the flesh shows brown surfaces that grow in size under favorable conditions

of moisture. The rot thus occasioned is dry and one very seldom sees potatoes injured by this disease keep throughout the winter. This disease is the most expensive to us. It is however easy to control same by spraying, as in the former case, at least five times during the summer with Bordeaux mixture, and in selecting for seed purposes only the tubers that are perfectly healthy and which one will treat with formalin.



MILDEW.—Inside aspect of a tuber injured by the mildew. One can notice on the flesh, brownish spots corresponding to those on the surface. (After Gussow).

Black leg (Bacillus solanisaprus).

Appears very early in July, usually before any other disease. The leaves turn yellow and are inclined to curl. All plants attacked stop growing, remain stunted and small. Within a longer or shorter time, according to the violence of the injury, the plant dies ; that part of the plant lying underground rots and turns black (whence the name of black leg). The tubers from these plants carry the germs of the sidease ; they are soft, wet, the center is hollow and black, whilst the remainder of the flesh softens and loses its colour. When a potato is much injured, the rot is quick. Treat germs or sets with formalin.

Potato canker (Chrysophlyctis endobiotica).

Although it has not yet been discovered in our Province, this very serious disease may take ground without our knowing it. The law regarding "the protection of plants" has classed this disease amongst the destructive pests because one must prevent its invading our country at all costs. Those who might find in their field tubers attacked by the potato canker are legally obliged to inform the Minister of Agrieulture of the fact ; for they are liable to a fine of $100.00 on failing to do so. The caracteristics of this disesae are given hereafter for the information of farmers. Tubers injured by the canker are covered, partly or entirely, by swollen excrescences sometimes as big as the injured, a kind of black warts of irregular formation. The flesh of the potato is reduced by the canker

to a black or brownish mass, of soft consistency and fetid odor (caused by putrefaction). The germs of the disease may remain in the ground for a long time. Treatment : destroy all tubers by cooking or burning. It is also important o keep an eye on the quality of the seed.

POTATO CANKER.— The canker has already invaded one half of the tuber as shown by the characteristic black warts. (After Gussow).

Mosaic.

Physiological affection whose origin has not yet been well explained. The leaves of the injured plant are poorly developed, shrivelled, dried up and cracked. Its injurious action is felt in the yield : the tubers harvested are practically sound, but one only has two-thirds of the ordinary crop. The selection of seed is the only means of preventing mosaic.

1 2

1—Healthy plant : leaves are wide and complete. 2— Plant injured by mosaic. Leaves are little developed and shrivelled. (After Murphy).

Leaf roll.

Another disease of the same kind as the former. As the name indicates the leaves roll up lengthwise and prevent the plant from completely working out the reserves that permit the formation of potatoes.

LEFT : tubers from a plant dwarfted by the leaf roll. RIGHT : potatoes from a sound plant. In both cases, tubers are looking fine, but on the left one has only one-third of the yield. (After Murphy).

The potatoes harvested are healthy, but they only amount to one-third of the normal yield. It has been calculated that the leaf roll is responsible for the large decreases in yield that have for a long time been attributed to the weariness or degeneracy of varieties. Selecting the seed is the only means of prevention.

IV—TREATMENT OF POTATOES

Formalin Bath.

Preparation. The material required for the preparation of a formalin bath consists of a barrel, formalin and water. One puts 30 gallons of water into the barrel to which one pound or one pint of formalin is added. When the barrel used does not contain 50 gallons, it would be better to use only one-half of the formula, or 15 gallons of water and half a pound of formalin ; otherwise the quantity of potatoes to be soaked would cause the solution to overflow ; what is important is that the barrel contains enough liquid to cover the bag of potatoes completely. If one wants to treat a large quantity of tubers rapidly, it is preferable to prepare three, four or five barrels in advance, as the case may be, so that sowing will not be de ayed.

Execu'ion. Put potatoes in very neat bags so as not to muddle the solution and allow the liquid to reach the tubers rapidly. With the help of a pulley and a rope, plun the filled bag into the barrel ; allow the tubers to soak for about

two hours, lift and allow to drain above the barrel, taking care that the bag rests on small crossed planks.

When this operation is over, empty the potatoes on the grass or planks. It is important that every thing used in connection with the handling of disinfected potatoes be perfectly clean ; to act otherwise would be compromising the success

Characteristic appearance of a plant upon which leaf roll develops. Leaves are drooping and the plant looks tired. (After Murphy).

of the treatment in having them come into contact with articles carrying the germs of the diseases. When the potatoes are dry, one may proceed o the cutting of sprouts or sets. In doing this work, it is necessary that each operator be provided with two or three knives ; while he is using one of them, the others are allowed to bathe in a bottle or vase containing a strong solution of formalin and even pure formalin. If one happens to cut a potato on whose flesh signs of diseases are discovered (spots or surfaces of unusual colour), one should plunge into the formalin solution the blade that is certainly carrying germs of the evil and in exchange, one of the purified knives is used. Needless to say that spotted tubers must be put aside.

The use of formalin is not dangerous, as it is not a violent poison ; its only inconvenience is that it irritates the skin , when tasted, it is plainly acrid.

Remarks.

Only tubers that are perfectly healthy should be used for seeding. Whatever may be the quality of the seeds used, one should never neglect to soak them into a formalin solution.

Never plant potatoes in a soil that has already yielded a contaminated crop ; this would be running to meet a failure.

The selection of potatoes in the field, when carefully done, would avoid many inconveniences.

Finally, formalin prevents only a part of diseases. In order to complete the means of control, it is necessary, when the plants are three or four inches high, to commence spraying with Bordeaux mixture. Five sprays, at least, should be given during the summer. For further information, ask for our bulletin No. 42 on "THE PROTECTION OF PLANTS".

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