DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF BOTANY

REPORT OF THE DOMINION BOTANIST

H. T. GÜSSOW

FOR THE YEAR 1924

New Botanical Building and Greenhouses in the Arboretum, Ottawa. (Photo. H. T. Güssow)

Printed by authority of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, 1925

DIVISION OF BOTANY

REPORT OF THE DOMINION BOTANIST, H. T. GÜSSOW

NEW BOTANICAL AND PLANT PATHOLOGICAL LABORATORY BUILDING

A new two and a half story building, situated on the grounds of the Arboretum at the Central Farm, was occupied by the division in October, 1924. After years of cramped quarters the new offices and laboratories are much appreciated. The building contains twelve rooms, including offices, herbaria, laboratories and library. The attic with its large photographic and museum rooms, as well as the finished basement, allow ample room for some years. In close proximity to the main building are situated two new botanical greenhouses.

There may be recorded further progress in our work by the provision of a special vote by Parliament to be devoted to the study of grain rust and cereal diseases generally. The solution of the problem of wheat rust is very urgently required, and the work so far carried on by this division is largely amplified by the interest taken in this project by the National Research Council. In co-operation with the Council and the western universities and colleges, it is hoped that considerably more progress will be possible. There is to be erected a rust research laboratory, as well as a series of greenhouses, with up-to-date equipment, on grounds placed at the disposal of the Dominion Government by the Manitoba Agricultural College, Winnipeg, Man. These two items are worthy of special notice; and it is hoped that the increased facilities thus placed at our disposal, together with the advantages to be derived from such close co-operation between all parties interested in plant pathological research, will yield the good results to be expected.

THE MYCOLOGICAL HERBARIUM

The new building has enabled us to accommodate the mycological collections of the division far more adequately than has hitherto been possible. By purchase, personal collections, general contributions, and the generosity especially of the Director and of Dr. M. O. Malte, Chief Botanist, both of the Victoria Memorial Museum—to whom we desire here to record our great indebtedness—our mycological herbarium and collections are now quite extensive. It is hoped that our mycological friends will continue, and, if possible, increase their contributions to our herbarium. The deposit of type specimens in our collections, which are open to any student of mycology or any investigator desirous of consulting them, would especially be welcomed. Our collections include, among many good and well-known exsiccati, a complete set of the Fungi Columbiani, West American Fungi of D. Griffith, Mycotheca Italica of Saccardo, Shear's New York Fungi, Seymour and Earle's Economic Fungi, Möller's Swedish exsiccati, etc., etc. On the whole, our collections are well on to 20,000 specimens. We shall be very pleased at any time to receive contributions, especially of Canadian fungi, in order to make them as complete as possible. All collections should give the locality, date, name of collector, and the name of the host plant.

FOREST PATHOLOGY

WHITE PINE BLISTER RUST

In Eastern Canada.—As far as the East is concerned the most interesting condition in regard to blister rust obtains in that part of Ontario bordering on the Ottawa river where rust has occurred upon cultivated *Ribes* each year since 1919 at least, but where, as yet, no infected pines have been found. For the past three years now in this district many young pines growing in proximity to infected *Ribes* have been carefully examined but no diseased trees have ever been found. This year there were 600 trees inspected at Renfrew, 1,800 at Pembroke, and 1,000 at Petawawa, but, as in previous years, no positive results were obtained. This area has in the past borne some of the finest white pine to be found anywhere and the reproduction is largely composed of this species. Should the young crop become infected to any extent with rust, therefore, it would be a serious matter. While there appear to be some grounds for believing that the pines will never be seriously affected by rust here, yet on account of the value of the young timber it will be necessary to maintain a close check upon the disease. As yet the reason—or reasons—why the rust has not appeared on the pines is not apparent.

In British Columbia.—By the end of last year currant rust was general throughout the Dry Belt, in the area south of the main line of the Canadian Pacific Railway to the international boundary, and extending to Grand Forks on the east. In the interior Wet Belt infection was widespread along the same railroad from Notch Hill to beyond Revelstoke, and south to Renata and Nelson. During the present year most of the same localities where rust had been found in 1923 were reinspected and the survey extended as much as possible. For the purposes of this work inspection was confined to cultivated black currants, as it is generally admitted that this species is the best indicator of the presence or absence of the disease. Although a larger area was covered this year by the inspectors, very much less rust was found. With the exception of Canoe, Revelstoke, and Beaton, where pine infection is known to exist, rust was found only at Mabel Lake, Kamloops, and Ashcroft, the latter two points being in the Dry Belt. The present year has been a most unfavourable one for the dissemination of the rust; observations at Canoe and Revelstoke indicate that, up to the end of September, æcial spread was confined to currants within a radius of three miles, and uredinial spread has been similarly restricted.

The situation as regards diseased pines remains unchanged. Canoe, Revelstoke, and Beaton are still the only known centres of pine infection. It is suspected, however, that pine infection exists near the south end of Mabel Lake. Last year 73 cankers were found in these three centres, and this year over 10,000 have been located and destroyed. Since then, however, hundreds of incipient cankers have appeared, and the utility of attempting to check the development of rust in this way is very doubtful. No cankers have been found on growth older than 1916.

As in previous years, the provincial Forest Branch co-operated with our field staff and rendered valuable assistance. During the course of the season a good deal of educational work was done through the medium of the press, by circularizing owners of black currants, and by personal visits to such owners. Exhibits of blister rust were also prepared for several of the fall fairs, and the United States Office of Blister Rust Control kindly loaned us a blister rust film.

INVESTIGATIONS ON DECAYS OF BALSAM FIR *(Abies balsamea)*

A further systematic study of decay in balsam fir, similar to that carried on last year, was undertaken. This work was again done in co-operation with

Price Brothers & Company, and upon their limits. This year an altogether different region was selected for the field work since it is to be expected that the findings in regard to decay will vary from district to district as conditions change.

The area chosen was situated in the Metis Seigneurie on Metis Lake which is on the south shore of the St. Lawrence. The stand was similar to that worked in the previous year, i.e., of the balsam-birch type. In addition some cedar is found along the shores of the lake. What little cutting has been done has been restricted to cedar and large spruce.

As before, the principal objects of the study were to determine the extent of decay in the stand, and at what age decay becomes of economic importance. To this end 635 trees of all ages and conditions were felled and analyzed, complete notes being taken both on the individual trees and on the conditions under which they were growing. As in the former study it was found that red heart rot and feather rot were the important types of decay, although, in addition, decay caused by *Coriolus balsameus* was of frequent occurrence. As yet the interpretation of the field data has not progressed far enough to permit of a synopsis of the results being given.

(A. W. McC.)

CULTURAL STUDIES OF WOOD-DESTROYING FUNGI

In dealing with the diseases of forest trees a knowledge of the type of decay caused by an organism, of its prevalence, of its hosts and their relative susceptibility, and of the relation of the age of host to immunity from attack may be obtained entirely from data collected in the field. But to this should be added a knowledge of the cultural characters of the organism under controlled conditions,—characters which serve as criteria for the definite identification of the organism; a knowledge of the conditions governing spore germination, mycelial development, and sporophore production; and experimental inoculations, which finally and completely prove that an organism is responsible for the decay with which it is usually associated. Such information is only obtained from laboratory experiments, which must therefore form a necessary supplement to field work, if effective measures for the control of fungous diseases of forest trees are to be formulated.

For this reason Miss Irene Mounce devoted her time to cultural studies of a number of wood-destroying fungi. The first form to be studied was *Fomes pinicola* Fr. This fungus is one of the common wood-destroying fungi both in America and Europe. Its large sporophores with conspicuous vari-coloured upper surface and white hymenium are usually found on the trunks of trees which have been killed by some other agency, or on fallen timber. It is responsible for a vast amount of damage because of the rapid and complete destruction of wood which it brings about, and because of its ability to attack so many different kinds of wood. It has been reported as occurring on no less than eighty-two species of coniferous and deciduous hosts.

The decay caused by *Fomes pinicola* is typical and readily recognizable At first it is characterized by a darkening of the wood, due to the removal of cellulose, and by the appearance of numerous horizontal and longitudinal cracks, due to shrinkage. Gradually these spaces are filled up with masses of white mycelium, and in the final stages the wood is reduced to a very friable mass. This mass is held together by mycelial felts, consisting of closely intertwined hyphae, similar to the mats formed on agar cultures. Badly decayed wood gives the characteristic lignin reaction with phloroglucin and hydrochloric acid, but remains unchanged in chlorzinc iodine solution, indicating the absence of cellulose.

Microtome sections of diseased wood show evidence of the work of the fungus by the presence of bore-holes, enlarged pits, splitting of the cell wall due to shrinkage, and tracheids containing typical hyaline hyphae with clamp-connections, or completely filled with much-branched densely interwoven hyphae.

Sterilised wood blocks inoculated with small squares of mycelium-covered agar from cultures of *Fomes pinicola* developed a rot which was similar in every way, both macroscopically and microscopically, to that which has just been described.

Such aspects of the problem as the conditions governing spore germination and sporophore production in artificial culture; the effects of light, temperature, and the composition and acidity of the medium upon mycelial development; the rate of growth, texture and colour of the mycelial mat, and the size, shape, septation, and branching of the hyphae were studied.

Sporophores of *Fomes pinicola* have been obtained on malt, prune, and Czapek's synthetic agars; on prune decoction and on Czapek's synthetic liquid medium containing various substances as a source of carbon; and on the wood of eleven different coniferous and deciduous trees.

Recently a study of monosporous mycelia has led to the conclusion that this large wood-destroying fungus is *heterothallic*. Such monosporous mycelia as have been studied are either sterile or produce only a typical fruiting-bodies from which no spore deposit has, so far, ever been obtained.

As soon as laboratory conditions permit, a comparative study will be made of the cultural characters of some fifty cultures of *Fomes pinicola* obtained from the sporophores and wood of various hosts from different localities.

A series of cultures of wood-destroying fungi is gradually being collected. These will be used for purposes of comparison, and for the identification, from cultural criteria, of unknown organisms causing wood decay. This year a number of new cultures have been added to the collection, particularly cultures of some of the fleshy fungi which are wood destroyers.

STUDIES IN POTATO DISEASES

THE TESTING OF SEED POTATOES

The question is often asked, "How can we raise a seed plot absolutely free from leaf roll or mosaic disease?" Many attempts were made by careful and painstaking growers, eager to produce a strain worthy of use for seed, in which the principal diseases—leaf roll and mosaic—should be eliminated. Since neither of these diseases can be recognized in the seed tuber, and since these diseases are principally established by the use of tubers so affected, attempts have recently been made to eliminate the diseases by the method of tuber units. Each tuber was cut into quarters—lengthwise—and the four sets were planted in a row; then came a space, and the second tuber was planted; and so forth. This method gave fairly accurate indications of the presence of these diseases in each tuber planted, and the whole four sets were removed as soon as signs of these diseases showed up. The plots were most carefully "rogued" several times a season, and at the end the field looked to all intents and purposes, free from these diseases. This method, while giving assurance of the removal of each of the four sets cut from one tuber, and in itself being preferable to the usual method of cutting sets and then planting them where they dropped, thus dispersing the disease all over the field, still has one serious drawback—one is able to remove what shows up diseased, but one has no assurance that the virus of the two diseases may not have been spread to nearby hills by means of aphids. Supposing that, from the time an expert is able to recognize the diseases and throws out plants so affected,

aphids had been at work on them, the disease may by then have been transferred to neighbouring hills without showing any signs. Yet the infection is present, and experience has shown that the tuber unit method is not altogether satisfactory.

We have often supervised the rogueing of such fields and performed the task ourselves as well as we believed it could possibly be done, and yet, when the remaining tubers were planted in the following year, it was found that the diseases had not been eliminated, especially mosaic. This result, of course, proved most disappointing, and many a grower expressed lack of confidence in the suggested control measures. It is well known that rogueing is better than not rogueing, and these diseases are certainly very considerably reduced in the progeny of crops carefully rogued. But the fact remains that we must still make allowance for a small percentage of these diseases in our inspection standards.

Finally we resorted to testing of seed potatoes. Originally this method was commenced in order to provide us with absolutely guaranteed tubers that would reproduce leaf roll and mosaic, which tubers were essential for research purposes. A number of suspected tubers, harvested from hills staked in our experimental plots as showing the diseases, were numbered from one to fifty. A wax pencil, or pencil used for marking china, answers well for this purpose. Then we used a punch—an open brass tube of five-eighths of an inch internal diameter, one edge of which was filed to a chisel edge—and one or two eyes were punched out of the individual tuber. This gave us a cylinder of potato, the upper end of which bore the eye. These eyes were numbered correspondingly with the number of each tuber, and were then potted in small pots into ordinary good greenhouse soil. Kept in a greenhouse, they soon rooted and developed a good growth. Almost from the start we could determine which tubers were sound and which produced disease. Thus we had a means to select one hundred per cent diseased plants and, incidentally, one hundred per cent absolutely sound plants, merely by using for planting the rest of the tubers from which the eyes were punched.

We quite understand that this method is only applicable when a greenhouse is available, but no doubt individuals who do not possess such facilities may overcome the difficulties by growing or testing their seed potatoes under any other suitable condition, where light and warmth are available. It is, however, a method that is strongly recommended to the seed grower who possesses a good strain of seed, and who wishes to keep for his own use a seed plot free from these constitutional diseases. It must be pointed out that such seed plot should be kept separate from any other potato field, so that chance infections are precluded. There are a number of strains, which are in the possession of growers, that are valuable because of their high qualities. It would certainly pay such growers to practise seed testing of their tubers and thus eliminate these troublesome diseases. This work may be done early in January, and some five to six weeks are ample to make a thorough test. Naturally, one must be able to recognize the diseases without fail.

Incidentally to trying this method, we desired to ascertain whether mosaic disease would in any way be influenced by growing such diseased cylinders, after rooting, in so-called water cultures, i.e. in jars containing a nutrient solution in liquid form. In our work we commenced with the following solution:

To 1000 cc. of water add 100 cc. of a solution made up as follows:—

1200 cc. water (tap or distilled)
2.46 grams Magnesium sulfate ($Mg\ SO_4 + 7\ H_2O$).
2.98 " Pot. chloride ($K\ Cl$).
6.56 " Calcium nitrate ($Ca\ N_2\ O_6$).
2.20 " Pot. biphosphate ($KH_2\ PO_4$).

Iron was added—a few drops of a solution of chloride of iron. The jars were wrapped to keep roots in the dark, and the plants grew almost as well as those in pots. There is no doubt that staling of culture solution and lack of iron had as disastrous an effect on the development of the plants as renewing of solution and supply of iron showed a beneficial effect. At one time the mottling due to mosaic had almost entirely disappeared, to reappear again later. The plants flowered and produced tubers immediately above the surface of the solution, ranging from the size of a pea to a walnut. This is interesting as indicating that the law of heredity appears stronger than the influence of environment. The tubers produced in these solutions were harvested and are now growing, planted in soil in our experimental greenhouses.

We were also interested to know how the single eyes would behave, when planted in the open. Perhaps this method, judging from limited observations, may yet be applicable to the selection of more prolific strains. The individual sets, weighing accurately about half an ounce each, produced yields ranging from two pounds six ounces to eight pounds two ounces per bill—the latter truly a remarkable yield, multiplying by two hundred and sixty times its own weight!

DISEASES IN RELATION TO JUDGING SEED POTATOES AT FAIRS AND EXHIBITIONS

One would expect that the winning of a first prize at a seed potato fair is equal to a guarantee that the winning sample and the lot from which it was taken are of a superior type and quality. The awarding of a prize is—or should be—the highest degree of recognition that can be given for a really first-class seed potato. While it may sometimes prove a difficult matter for the judge to do justice in making his award, generally speaking, a decision is made on a variety being true to name, true to type, uniform, and sound to all appearances.

On the point of being sound to all appearances we wish to say a few words. While there are a number of diseases easily recognized by the appearance of the tuber, such as scab of any kind, late blight rot, and rhizoctonia, there are others, for instance, the wilts, necrosis, etc., that can only be discovered on cutting into the tuber. All these the judge is familiar with, and he is able to determine the freedom from such troubles quite readily. The case, however, is quite different in diseases conveyed by seed potatoes that cannot be detected by any external sign, not even by the most experienced specialist. We refer to such troubles as leaf roll, mosaic, spindling sprout, etc. We have known cases where a first prize had been awarded to potatoes fully eighty per cent of which were affected with leaf roll, and others with fully as much mosaic. The accompanying photograph (Fig. 1) illustrates one case in point. These two tubers were taken from a prize-winning lot of Early Peachblows exhibited at the Saskatoon fair. On testing them in our laboratories it was found that the sample contained a considerable percentage of tubers affected with "spindling sprout." An examination of the photograph taken by my colleague, R. R. Hurst, will at once reveal the importance of the argument.

The nature of this trouble, similarly to mosaic and leaf roll, is unknown, but it is known that a farmer would experience serious losses were he to plant a large percentage of potatoes with spindling sprouts. Here again testing of seed potatoes comes into its own. It would, however, be quite impossible to test seed potatoes about to be exhibited. There is a suggestion which we wish to make, and that is to dissuade fair directors generally from accepting seed potatoes for exhibit unless such are from crops that have passed field and tuber inspection according to the standards of certified seed potatoes as defined under the Destructive Insect and Pest Act. Field crop competitions and the judging of seed crops from recognized or certified fields have done a very great deal

Iron was added—a few drops of a solution of chloride of iron. The jars were wrapped to keep roots in the dark, and the plants grew almost as well as those in pots. There is no doubt that staling of culture solution and lack of iron had as disastrous an effect on the development of the plants as renewing of solution and supply of iron showed a beneficial effect. At one time the mottling due to mosaic had almost entirely disappeared, to reappear again later. The plants flowered and produced tubers immediately above the surface of the solution, ranging from the size of a pea to a walnut. This is interesting as indicating that the law of heredity appears stronger than the influence of environment. The tubers produced in these solutions were harvested and are now growing, planted in soil in our experimental greenhouses.

We were also interested to know how the single eyes would behave, when planted in the open. Perhaps this method, judging from limited observations, may yet be applicable to the selection of more prolific strains. The individual sets, weighing accurately about half an ounce each, produced yields ranging from two pounds six ounces to eight pounds two ounces per bill—the latter truly a remarkable yield, multiplying by two hundred and sixty times its own weight!

DISEASES IN RELATION TO JUDGING SEED POTATOES AT FAIRS AND EXHIBITIONS

One would expect that the winning of a first prize at a seed potato fair is equal to a guarantee that the winning sample and the lot from which it was taken are of a superior type and quality. The awarding of a prize is—or should be—the highest degree of recognition that can be given for a really first-class seed potato. While it may sometimes prove a difficult matter for the judge to do justice in making his award, generally speaking, a decision is made on a variety being true to name, true to type, uniform, and sound to all appearances.

On the point of being sound to all appearances we wish to say a few words. While there are a number of diseases easily recognized by the appearance of the tuber, such as scab of any kind, late blight rot, and rhizoctonia, there are others, for instance, the wilts, necrosis, etc., that can only be discovered on cutting into the tuber. All these the judge is familiar with, and he is able to determine the freedom from such troubles quite readily. The case, however, is quite different in diseases conveyed by seed potatoes that cannot be detected by any external sign, not even by the most experienced specialist. We refer to such troubles as leaf roll, mosaic, spindling sprout, etc. We have known cases where a first prize had been awarded to potatoes fully eighty per cent of which were affected with leaf roll, and others with fully as much mosaic. The accompanying photograph (Fig. 1) illustrates one case in point. These two tubers were taken from a prize-winning lot of Early Peachblows exhibited at the Saskatoon fair. On testing them in our laboratories it was found that the sample contained a considerable percentage of tubers affected with "spindling sprout." An examination of the photograph taken by my colleague, R. R. Hurst, will at once reveal the importance of the argument.

The nature of this trouble, similarly to mosaic and leaf roll, is unknown, but it is known that a farmer would experience serious losses were he to plant a large percentage of potatoes with spindling sprouts. Here again testing of seed potatoes comes into its own. It would, however, be quite impossible to test seed potatoes about to be exhibited. There is a suggestion which we wish to make, and that is to dissuade fair directors generally from accepting seed potatoes for exhibit unless such are from crops that have passed field and tuber inspection according to the standards of certified seed potatoes as defined under the Destructive Insect and Pest Act. Field crop competitions and the judging of seed crops from recognized or certified fields have done a very great deal

towards the improvement of agricultural seeds generally, although the question of disease freedom is not receiving quite the attention it deserves; but in the case of seed potatoes it is often observed that the awarding of a first prize is misleading an unsuspecting public, unless the competition is limited to growers of certified seed only. Several provinces, notably British Columbia, have made wonderful progress along these lines, and after all it is freedom from disease

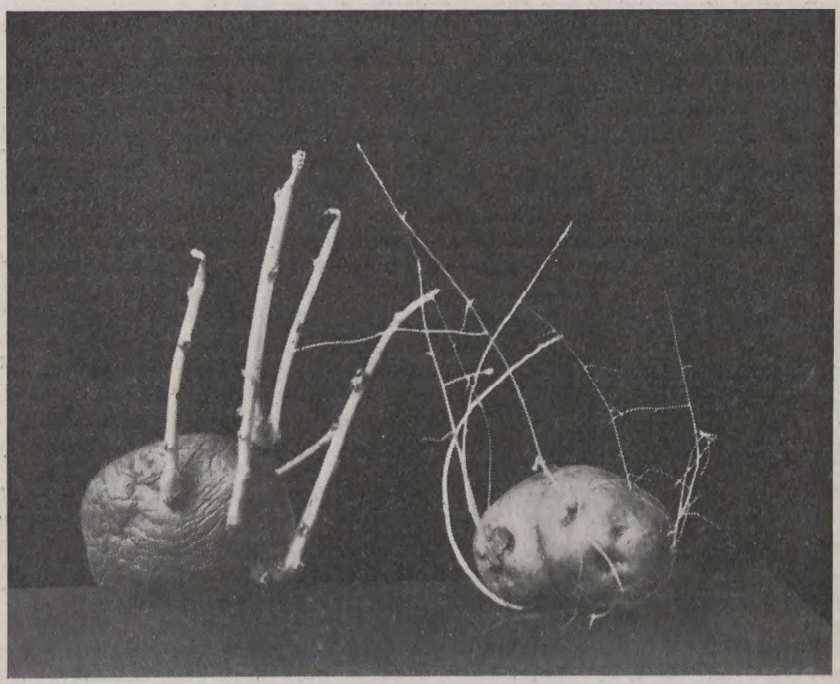

Fig. 1.—Showing the contrast between the sprouts of a healthy tuber (left), and a "spindling sprout" tuber (right). These tubers were taken from a prize-winning lot of Early Peachblows at a provincial fair in the West.

that makes a crop profitable, however good and pure the pedigree may be. Every lot of certified seed exhibited should have attached to it a copy of the certificate, together with a precise and accurate statement of disease found in field or bin. Such procedure would do an immense amount of good in eliminating the distribution of prize-winning potatoes that are only fit for the table or feed.

SOLANIN, A POISONOUS ALKALOID IN POTATOES

It is a well-known fact that any kind of human food may spoil and constitute a serious menace to health when partaken of in such condition. May we only remind our readers of the many fatalities due to what is commonly referred to as ptomaine poisoning, with which latterly a specific organism, viz., *Bacillus botulinus*, has been found to be associated.

On several occasions we have personally met with the unpleasant results due to eating potatoes which contained an accumulation of a poisonous alkaloid known as solanin. Solanin is a specific alkaloid (really an alkaloidal glucoside) of the genus *Solanum*. It is obtained from numerous species of the genus *Solanum*, which includes our common potato (*S. tuberosum*). It has a disagreeable taste, resembling tincture of Hyoscyamus; it is bitter, acrid, and unpleasantly persistent in its sensation upon one's tongue. It is slightly soluble in

water; saponaceous when shaken in it. It is insoluble in ether and chloroform, and slowly in alcohol, but readily so when heated in it. In the potato it is present in the inner epidermal tissues and around the buds or eyes. In sprouting tubers its quantity is slightly increased, and some observers regard greened tubers as containing specially large quantities. Microchemically the presence of solanin may be demonstrated by the action of concentrated HNO_3 or H_2SO_4, when a fairly pronounced red colour reaction takes place.

Undoubtedly solanin is present in all potatoes, normally to such small extent as to cause no trouble whatsoever. Neither can there be much doubt that the solanin content increases under certain conditions, notably towards the process of sprouting. Normally one finds solanin present within a short distance of the eyes, and when sprouting takes place, this alkaloid travels a considerable distance up the sprouts. Hence, the breaking off of the sprouts, which is done, of course, before potatoes are used, is one fairly safe method to prevent ill effects from solanin.

Our observations lead us to believe that the solanin content, however, is also influenced by storage conditions, especially in households. We would caution against the keeping of quantities of potatoes in open containers—baskets or boxes—where even subdued light may get at them. Here apparently the conditions are rife for the starting of growth. Previous to visible growth from the eye, changes of a physiological character occur within the tuber. Solanin, a substance evidently required by the potato for the development of its sprouts, develops, and before growth starts, which is slow in the light, the potatoes are used for the table.

We have come across a number of cases of indisposition which the sufferers associated with food, but four were undoubtedly due to the eating of potatoes kept as described. Moreover, in two of them we were able to determine the presence of solanin in part of the cooked potatoes prepared for food, some of which actually caused the trouble. In the others, raw potatoes, when chewed, produced the characteristic persistent sensation associated with solanin. Cooking does not destroy solanin, since it is scarcely soluble in water.

We have requested a number of persons to chew small pieces of potatoes picked out from bags, in order to test whether they were able to detect without being previously informed, the peculiar taste in such potatoes. In every case it was detected. It naturally becomes more difficult to do so when the potatoes are flavoured or seasoned for the table. We have further been able to associate a peculiar colour of the skin of the raw potatoes with the presence of solanin. Everyone will know the somewhat greyish colour of the skin which an unpeeled boiled potato assumes when allowed to get cold. The skin of raw potatoes containing solanin in sufficient quantity to cause trouble resembles that of a boiled one, and the experimental chewing of a small quantity might well be resorted to.

The question of poisoning with solanin from eating potatoes has been discussed with a number of physicians, and while some of them had seen literature references, not one was able to state that he had ever come across a case. This is very likely. The case of a person falling sick with evidence of more or less severe poisoning is invariably attributed to other causes; acute indigestion, ptomaine, etc., are the most likely to be held responsible, for who would suspect a case of poisoning to be due to eating potatoes? For this reason one hears little of it, and finds less in medical literature. We believe, however, that a good many otherwise mysterious cases may be due to the solanin content of potatoes. At any rate, it would be advisable for physicians to take note of this condition of potatoes and its relation to human health. Personally, we have never come across a case that proved fatal, but a recent report in "Science" records two deaths from the eating of "'greened" tubers. Evidently such tubers should not be eaten.

The symptoms which we have observed in about eleven persons during the past few years were headache, nausea, pressure in the ears from within, accompanied by thirst, vomiting, and a peculiar degree of fatigue and weakness. The symptoms occurred from within ten to twenty-four hours after the eating of potatoes containing solanin. The physician attending the cases referred to in "Science" records the symptoms as follows: "The first symptom was epigastric pain, which increased in severity until nausea and vomiting ensued, which began from one to two hours after the pain started. After emesis of the stomach contents and bile, the vomiting ceased and there was but little pain. All (eight persons) were constipated except the fourteen-year-old boy, who exhibited mild diarrhoea. There was no fever; the temperature was 97·4° to 98·4°. The pulse was normal. The expression was dull, while the patients were apathetic, indifferent and extremely exhausted. Two were restless before exhaustion began. One was extremely thirsty, the others did not crave water. The respirations were extremely difficult and accelerated, but not of the Cheyne-Stokes type. No particular odour to the breath. Weakness and prostration were marked. Consciousness was retained by the two who died until within three or four hours of death. No convulsions. Examination of the chest, abdomen and reflexes was negative."—A. A. Hansen "Two fatal cases of potato poisoning", "Science," March 27/25, p. 340-341.

In the foregoing observations on solanin we do not wish to be unduly alarmist. We have, it is true, pointed out the conditions under which solanin poisoning might occur. The chances, however, of such cases happening are about on a par with the occurrence of cases of illness arising from eating shellfish or strawberries, though these latter cases are not strictly analogous, being rather cases of individual physiological susceptibility to certain toxic effects.

POTATO INSPECTION AND CERTIFICATION

That this very important branch of the service continues to increase in popularity can be seen at a glance by consulting the summary which follows:—

Year	Fields inspected	Fields passed	Acres inspected	Acres passed	Per cent fields passed	Per cent acres passed
1920	.....	.....	7,613·0	3,956·0	.....	52·0
1921	2,646	1,634	7,900·0	4,290·0	61·7	54·3
1922	3,283	2,139	11,250·0	6,991·0	65·3	62·1
1923	2,914	2,061	9,681·0	7,099·7	70·7	73·3
1924	5,586	3,868	19,238·87	13,916·64	69·25	72·3

All told, there was a total of 2,450 applications accepted for inspection in 1924, for a total of 5,586 fields, 19,238 acres in all, which represents about a 100 per cent increase over the 1923 crop. This does not include the large acreage inspected for the standing field crop competitions in some provinces, the records of which are not detailed here. It should be mentioned here that this work was carried on at a very small increase in cost over 1923. When the increased acreage is considered, as well as the additional work our inspectors undertook in co-operation with Provincial Departments of Agriculture, also the additional work in connection with the inspection of large shipments to England and Cuba, it can be seen that economy was practised to obtain these satisfactory results.

Following is a summary of the inspection work by provinces:—

Province	Number of fields inspected	Number of acres inspected	Number fields passed	Number acres passed	Per cent fields passed	Per cent acreage passed
Prince Edward Island	2,296	9,002·87	2,026	8,365·12	88·24	92·77
Nova Scotia	158	297·6	117	224·3	74·0	75·39
New Brunswick	1,351	6,309·93	746	3,594·6	55·22	56·96
Quebec	530	1,350·75	172	351·75	32·45	26·04
Ontario	546	1,083·0	345	671·0	63·1	61·9
Manitoba	70	190·5	37	80·0	52·7	42·0
Saskatchewan	122	371·0	92	246·0	75·41	66·3
Alberta	174	336·75	114	183·0	65·51	54·34
British Columbia	339	296·47	219	200·87	64·6	67·7
Totals	5,586	19,238·87	3,868	13,916·64	69·25	72·3

During the growing season the total of 19,238·87 acres was inspected, (*a*) as nearly as possible at the blossoming period, and (*b*) three or four weeks later. This means that within about six to seven weeks the acreage named was inspected twice, making 38,477·74 acres inspected in all. Irish Cobblers and Green Mountains were the principal varieties grown again this year, the greatest increase being in Cobblers.

These figures are very interesting from a standpoint of disease control, when such a large acreage is taken into consideration, and with so many growers taking part. Some credit must be allowed the inspectors for the careful work done the previous year, for the present excellent showing in the total percentages represents to a certain extent a check on their work.

What has been accomplished in Prince Edward Island, where 92·77 per cent of the acreage offered passed the two rigid field inspections this year, is a good lesson of what is possible when disease control measures are applied in earnest.

The total number of fields and the acreage rejected for various reasons were 1,718 and 5,321·58 respectively, summarized as follows by provinces:—

Province	Rejected		Chief Reasons for Rejection	
	Number of fields	Acreage		
Prince Edward Island	270	637·75	Moasic	851 fields
Nova Scotia	41	73·3	Mixed varieties	231 "
New Brunswick	605	2,715·33	Blackleg	151 "
Quebec	358	999·0	Leaf Roll	118 "
Ontario	201	412·0	Lack of vigour	114 "
Manitoba	33	110·5	Adjacent to fields showing high percentage of disease.	73 "
Saskatchewan	30	125·0		
Alberta	60	153·1	Combination of above diseases, insect injury, blight, etc	180 "
British Columbia	120	95·6		
Total	1,718	5,321·58	Total	1,718 "

The fields that were rejected were with a few exceptions all planted with seed other than certified. This shows very plainly the necessity of carrying on the certified seed work. The growers themselves now recognize the value of certified seed, as the present demand for same proves.

PERCENTAGE OF DISEASE FOUND—BY PROVINCES

—	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Average per cent disease in total fields inspected—									
Blackleg	0·20	0·5	0·74	1·4	0·22	0·92	0·65	1·4	0·07
Leaf Roll	0·053	0·25	0·352	0·52	0·8	1·2	0·15	0·05	0·53
Mosaic	0·70	0·24	1·61	8·9	1·0	1·3	0·59	1·8	1·47
Wilts	0·065	0·1	0·036	0·007	0·08	0·1	0·04	0·23	1·04
Average per cent disease in fields passed—									
Blackleg	0·16	0·41	0·534	0·48	0·14	0·64	0·46	0·61	0·04
Leaf Roll	0·049	0·14	0·244	0·21	0·47	0·94	0·1	0·08	0·41
Mosaic	0·24	0·12	0·533	0·91	0·28	0·96	0·31	0·75	0·73
Wilts	0·068	0·04	0·016	0·009	0·03	0·06	0·01	0·12	0·33
Average per cent disease in fields rejected—									
Blackleg	0·48	0·77	1·01	1·8	0·33	0·93	1·2	3·5	0·18
Leaf Roll	0·08	0·59	0·48	0·67	1·17	1·6	0·3	0·005	0·55
Mosaic	4·19	0·6	2·92	12·8	2·19	1·8	1·4	4·3	3·04
Wilts	0·038	0·25	0·06	0·006	0·09	0·3	1·4	0·45	1·89

The yields obtained were particularly good this year on Prince Edward Island, also in the Maritime Provinces and east to Ontario, while the crop was light in the Prairie Provinces owing to unfavourable weather conditions for potatoes. Prince Edward Island and New Brunswick had bumper crops, but unfortunately the fall sales were low compared with 1923. This may have a steadying effect on the business.

The large shipments of potatoes to Cuba and England, for which certificates are required, added considerably to the work of our inspectors. This can be realized better when it is stated that to the end of the season certificates were issued for over 1,450,000 bushels which were shipped to Cuba, and for over 250,000 bushels to England.

STANDARDS

CERTIFIED SEED POTATOES, 1925

Field

	Per cent
Blackleg	3
Leaf Roll (Curly Dwarf, etc.)	2
Mosaic	2
Wilts	3
Foreign	1

Providing that in no case shall a total of more than 6 per cent be allowed.

Tuber

	Per cent
Wet Rot (bacterial)	2
Late Blight and Dry Rot	3
Common Scab and Rhizoctonia—severe	5
Powdery Scab	1
Necrosis, Wilts and Internal Discoloration, other than due to variety	5

Providing that in no case shall a total of more than 10 per cent be allowed.
Not more than 2 per cent of the tubers shall be foreign, badly off type, or damaged by sunburn, cuts, cracks, bruises, insects, etc.
No frost injury shall be allowed.
Not more than 5 per cent by weight of the tubers shall be below three ounces or above twelve ounces.

It has been found advisable to modify the tuber standard slightly to include Necrosis and Internal Discolorations—5 per cent. Other slight changes have been made which will perhaps make the standard a little more clear to the growers.

GENERAL AND ECONOMIC BOTANY

Enquiries of a miscellaneous nature received during the year related to the cultivation of various medicinal plants such as Ginseng, Golden Seal, Seneca Root, Peppermint, Cascara Sagrada, Lavender, and Sumbul; the culture of various plants of economic importance including Wild Rice, White Mustard, Black Mustard, Broom Corn, Chicory, and Castor Oil Bean; plants suitable for feeding muskrats; trees hardy in Manitoba; literature dealing with the wild flowers of Canada; the nature and distribution in Canada of seaweeds used in the manufacture of Agar.

In connection with the arboretum and botanical garden, the List of Seeds for Exchange collected in the year 1923 contained the names of 1,054 species and varieties and was mailed to more than fifty of the leading botanical gardens of the world.

During the year 1,208 packets of seed were received from foreign botanical gardens. These included eighteen varieties of oat and six varieties of wheat from Tabor, Czechoslovakia, which were despatched to Winnipeg and Saskatoon in order to be tested for disease-resistance by the officers attached to this division.

On the other hand, 3,127 packets of seed were sent out and 2,568 specimens of rooted plants. Of these 103 packets of seed were sent to Echo Experimental Farm, Manchuria, China; 409 packets of seed to New York Botanical Garden, U.S.A.; 2,500 seedlings of sugar maple to the Department of Forests, France; a consignment of hickory nuts to New Zealand. Trial samples of various ornamental plants, rock plants, wild flowers, medicinal plants, and wild rice were sent on request to a large number of persons in various parts of Canada and some foreign countries.

Altogether seeds were exchanged with the following botanical gardens: Brooklyn, U.S.A.; New York, U.S.A.; Buenos Aires, Argentine Republic; Montevideo, Uruguay; Trinity College, Dublin, Ireland; Glasnevin, Dublin, Ireland; Glasgow, Scotland; Oxford, England; Kew, England; Christiania, Norway; Lund, Sweden; Uppsala, Sweden; Göteborg, Sweden; Copenhagen, Denmark; Groningen, Holland; Amsterdam, Holland; Brussels, Belgium; Les Barres, France; Lyon, France; Nancy, France; Paris, France; Bordeaux, France; Talence, France; Lausanne, Switzerland; La Mortola, Italy; Pisa, Italy; Palermo, Italy; Berlin-Dahlem, Germany; Proskau, Germany; Budapest, Hungary; Brno, Czechoslovakia; Prag, Czechoslovakia; Tabor, Czechoslovakia; Leopol, Poland; Warsaw, Poland; Cernauti, Romania; Cluj, Romania; Jassy, Romania; Tiflis, Transcaucasia; Ariana, Tunis; Tokyo, Japan.

Several papers containing the results of various physiological experiments were published during the year. These were: "The effect on tomato, soy bean, and other plants of altering the daily period of light" (American Journal of Botany, April, 1924); "Does light determine the date of heading out in winter wheat and winter rye?" (American Journal of Botany, October, 1924); "Duration of Light and Growth." (Annals of Botany, July, 1924). The results of this last investigation may be summarized as follows:—

Experiments were conducted with sixteen different species of plants, including wheat, rye, flax, hemp, soy bean, tomato, buckwheat, sunflower, etc.

Some plants were grown in darkness; others with an exposure to daylight for 3, 5, 6, 10, 12, and 15 hours respectively; while still others were exposed to electrical illumination from nitrogen lamps in addition to full daylight, thus bringing the total exposure to light up to 18 and 20 hours respectively.

It was found that the rate of growth was more rapid at first in the plants exposed to a diminished supply of light, but at the end those constantly exposed to daylight for a greater number of hours daily ultimately attained the greater height. From the results obtained the deduction is made that the

rate of growth, whether in light or darkness, depends on the amount of reserve material available for the formation of new tissue, and that, if two plants have the same supply of reserve material, the one grown in diminished light will make the more rapid growth while this reserve lasts.

The plants grown under a diminished supply of light were deficient in mechanical tissue and had a tendency to become decumbent, or, as in the case of soy bean, to assume a twining habit. Plants grown under such conditions, moreover, usually remained unbranched.

The effect of electrical illumination varied in different cases. Where the natural period of daylight from December to March varied from nine to twelve hours, the addition of an average nightly illumination of nine hours with lamps varying from 100 to 300 watts had a beneficial result in most cases and promoted the rate of growth and accelerated the time of flowering.

In the plants exposed to daylight for more than 12 hours daily from March to June an average additional electrical illumination of 5 to 6 hours nightly had most effect in the case of spring wheat, did not accelerate the time of flowering in buckwheat or tomato, and prevented flowering in soy bean. As compared with full daylight, electrical illumination in the case of hemp had a retarding effect on both the height and weight of the plants.

In the case of tomato, soy bean, buckwheat, and hemp there appears to be an upper limit to the amount of light which a plant can make use of, beyond which the plant makes no additional growth. (J. A.).

SYSTEMATIC BOTANY AND WEED STUDIES

That part of our service having to do with weeds and systematic botany generally was freely used during 1924. Calls for talks to agricultural short-course students, older school children, and Boy Scouts were responded to. Press articles were prepared, and, as last year, use was made of mimeographed articles on weeds of special concern. On a few occasions field inspections were carried out to discover what plants, if any, were responsible for suspected poisoning of animals. Suspicions are frequently misplaced, but in one case the sickness and loss of horses were quite evidently due to the prevalence of horsetail on a farm where much-needed drainage would largely have removed the danger.

The identification of weeds and other plants, many of them collections of specimens from teachers interested in building up herbaria in their institutions, continues to take much time, particularly in the summer months when weed investigations also claim all possible attention. The time and work involved in the careful naming of plants are not begrudged by any means, providing always that correspondents will take the pains (too often not taken) to send complete, well-preserved, and thus readily studied specimens, keeping for themselves duplicates numbered to correspond, so that we can reply by number and retain plants needed for our herbarium. Such acquisitions, and even the records of distribution obtained from plants named, are often valuable, more especially in the cases of introduced weeds not yet widespread in Canada.

Considerable time was devoted to the herbarium, first in connection with its transfer to new quarters, and also in mounting and incorporating a wealth of material accumulated in past years. About 1,400 sheets were added, making good many deficiencies. While in no sense aiming to duplicate the National Herbarium in Ottawa, our collections must yet be made as representative as possible to facilitate the identification work coming to us, and inseparable from our other objects.

At the instance of the Dominion Chemist, botanical analyses were made of hay from experimental plots at Cap Rouge, Que., and Maple Creek, Sask.; the former being experiments with basic slag applications, and the other with irrigation. Samples from Maple Creek have now been examined for the second

year, and indicate a distinct improvement in the composition of the herbage on the plots under irrigation, as compared with others from untouched prairie. Several species tolerant of alkali are present, but whether increasing or otherwise is not yet clear.

Weed survey plans were further elaborated during the year. Field work was confined to the area commenced last year and extending to the southwestern peninsula of Ontario, one of the main purposes being to get lines of survey sufficiently continuous in all directions to indicate which weeds are of general distribution, and which are still of sporadic occurrence or limited range within the area. A convenient system of records has been developed which shows with equal facility the weeds of any given place, or all the localities of any particular weed. Over 350 plants of more or less weedy or poisonous character are now being dealt with, and already their distribution is shown by entries numbering close to 20,000. Since a means is now ready for utilizing the records obtained, it is hoped to extend the survey steadily into other agricultural districts, and especially into the frontier belts of the country, where many weeds are presumably just arriving, and might be prevented indefinitely from gaining a foothold, if taken in hand at once.

Studies of various weeds and control measures were continued, and will be carried farther before being reported on fully. A few points of practical interest may be touched on briefly.

Field bindweed (wild morning glory) is reputed to be a "shy" seeder, but evidence is accumulating to show that this depends much upon the conditions of growth. Patches growing luxuriantly seldom set seed although blooming freely; but in adverse environments, as on exposed banks, railway cuttings, etc., dwarfed plants have been seen well loaded. During 1924 little or no fresh seed was found anywhere, but occasionally in such places, seed of the previous year still remained on the old vines. This habit of increased dependence upon seeding when season or soil are unfavourable to vegetative propagation is not at all rare, and may be observed in some other weeds with strong perennial root systems, as for instance, couch grass. Use should be made of this information by guarding against such sources of our agricultural seeds, or of hay containing couch grass. In the case of bindweed, eradication is at best a slow and uncertain task, and until accomplished, infested areas should be segregated as much as possible from clean land, not only when there is danger of seed being produced, but always to avoid dragging pieces of the roots about on the implements used.

Mouse-ear hawkweed (*Hieracium Pilosella*) is a troublesome weed which is spreading in parts of eastern Canada and adjoining States. The only patch known at Ottawa is conveniently located for experimental work, which was accordingly commenced this year. In spite of previous efforts to suppress it several acres of lawn are now infested. So far tests with dry salt and brine applications, and sodium arsenite sprays of various strengths do not indicate the necessary difference between grass and weed to make chemical measures practicable. Sodium arsenite (prepared by boiling together one pound white arsenic and two pounds washing soda, and making up to five gallons) destroyed all vegetation above ground, but within a few weeks the plots were becoming green again with the hawkweed but little behind the grass in recovery. As this species is shallow-rooting, ploughing just deep enough to turn the sod completely will be necessary. The sods can then be shaken out or removed, after which the cultivator should be set a little deeper, to get the fibrous roots running below the first few inches, which roots have proved to be capable of budding when left undisturbed. Patches of mouse-ear hawkweed not broken up must be kept closely mowed to prevent the maturing and blowing away of the plumed seeds. As only the flower scapes rise above the ground this will of course contribute nothing, in itself, towards eradication.

A series of plots was laid out, on which to test the effect of various herbicides on dandelion. The results were similar to those of other experimenters, iron sulphate (two pounds to a gallon applied at the rate of fifty gallons per acre) killing the leaves without permanent injury to the grass, and being on the whole the best adapted of the chemicals used. Nickel sulphate, as a by-product which might be available at a low price, was tried in a limited way, but its action appears to be slower, and, as so far used, a three per cent solution was less severe than a twenty per cent solution of iron sulphate. The difficulty in dandelion spraying is that only the parts hit by the spray are killed, the roots, crown, and even sheltered leaves remaining to push up new growth, which must be sprayed repeatedly before much weakening occurs in old plants. In a new lawn or in conjunction with deep spudding of old plants the method is worthy of trial by anyone who will stay faithfully on the job until finished.

The use of dry salt on such lawn and pasture weeds as daisy fleabane, common plantain, self-heal, and king devil, gave fairly good results early in the season while the leaves were well spread out on the ground to catch and hold the salt. The loss of these leaves was of little consequence to plants already pushing up a stem. (H.G.)

OTHER ACTIVITIES OF THE DIVISION, INCLUDING EXHIBITIONS, CO-OPERATION, AND GENERAL ADVICE

An exhibit attracting many thousands of visitors was prepared and placed on show at Toronto and Ottawa. In former years we sought by our exhibit to teach the public the importance of plant diseases, weeds and poisonous plants, and to advise inquirers in regard to their individual problems. While a certain amount of interest was taken in such an exhibit, which required considerable time and care in its preparation, we decided that the results were not worth the time expended. For this reason, during the past few years we prepared an exhibit which we thought would appeal to the public, and arrangements were made for the showing of living specimens of mushrooms and toadstools, which were collected daily in the locality. This exhibit appealed to the people and showed the great interest that is being taken in mushrooms, or rather, the common edible fungi of woods, meadows, and countrysides. At the same time it was shown that the general public knows little about edible and poisonous fungi. A fatality occuring at the time of the Toronto exhibition of mushrooms, served to bring home to a good many visitors the grave dangers that exist in eating varieties of fungi, about the edibility of which one is not absolutely sure. In the case referred to, we were able to visit immediately the locality where the fungi causing death were collected, and we discovered many specimens of one of the most poisonous ones, viz., *Amanita phalloides* Fr. It may be mentioned here that there is no way of distinguishing by any test edible fungi from poisonous. The safest and only method is accurate knowledge, and he, who lacks such, had better let this commodity severely alone.

Our exhibit gave rise to many hundreds of inquiries relative to the growing of mushrooms in beds in one's cellar. Most alluring advertisements appear from time to time in the press, claiming that a lucrative income is positively certain from the culture of mushrooms by the use of the spawn advertised. While remarkable successes have no doubt been obtained, we desire to point out that failure is more frequent than success. So much depends upon proper conditions, especially of moisture and temperature, which are so difficult to control under the facilities available in one's cellar, that the success is largely the person's who sells the spawn. Unless conditions are exceptionally favourable, the results are not worth the trouble and inconvenience, and, generally speaking, the quantity of mushrooms produced is barely sufficient for one slice of toast, and "regular shipments" to be disposed of at a high profit exist only in the imagination.

Many appreciative remarks are being received about the plant disease survey, to which Mr. F. L. Drayton devotes many months of exacting and painstaking work. Credit, however, is also due to the many contributors to this survey, who must devote many hours to the observations they so generously place at our disposal. This survey is now establishing quite a reputation for itself; it is no longer an advertisement of the diseases that Canada is able to produce, but a record indicating the thoroughness with which economic plant diseases are observed throughout Canada.

An important phase of our work, which we are anxious to develop as much as possible, concerns the co-operation with provincial and other institutions, either doing similar work to ourselves, or that are able to make use of members of our staff in their short course and other educational work. Provincial departments, through their district representatives, are naturally in very close touch with farmers and their problems, and whenever opportunity affords, the members of this division are glad to be of assistance. Such help has been rendered for some years, but we have never endeavoured to indicate the actual manner in which we were able to co-operate. This year we have kept a record of the principal activities in this regard. Naturally, most of our work is carried on in the various provinces, and indirectly such work aids, or is intended to aid, provincial departments.

In Prince Edward Island, Mr. S. G. Peppin, the District Inspector, was called upon to give thirty-five lectures on potato diseases at short courses in many different parts of the Island. A series of lectures on plant pathology was given to the students at the Prince of Wales College, Charlottetown.

In Nova Scotia a course of lectures was given to the students of the Nova Scotia Agricultural College on "Potato Diseases and their Control" by Mr. W. K. McCulloch, who also gave a demonstration of leaf roll and mosaic disease in seed potatoes. Mr. J. F. Hockey assisted the Provincial Department of Agriculture during the month of February, giving a series of twelve lectures and laboratory periods to some twenty-five to thirty students on the subject of general botany and common plant diseases.

In Ontario, at St. Catharines, the officer in charge, Dr. G. H. Berkeley, and Mr. A. B. Jackson, assisted in a three weeks' short course of lectures to farmers and fruit growers throughout the Peninsula in relation to raspberry and fruit tree diseases generally. Mr. J. Tucker, the District Plant Disease Inspector for Ontario, renders co-operative services to the province. He is especially co-operating with the Provincial Department in potato work with Professor A. H. MacLennan of the Ontario Agricultural College; lecturing at the various agricultural short courses and vegetable growers' meetings; judging potatoes at the Royal Winter Fair, Provincial and County fairs; giving seed-treating demonstrations on a number of farms in the Fort William and Port Arthur districts, in co-operation with agricultural representatives; aiding in field inspection and disease report on the potato experimental plots for the Field Husbandry Department of the Ontario Agricultural College; field training of the provincial judges of potatoes, etc.; judging potato plots in the standing field crop competitions throughout the province for the Agricultural Fairs Branch; lecturing to growers in the potato fields on field days in co-operation with the agricultural representative; assisting in spraying demonstrations on potatoes at Fort William, Port Arthur, and in the Rainy River districts in co-operation with agricultural representatives; lecturing at various agricultural meetings held by the agricultural representatives; preparing and setting up exhibits of potatoes and potato diseases for fall fairs, in co-operation with the Horticultural Department of the Ontario Agricultural College.

In New Brunswick, Mr. D. J. MacLeod gave lectures before the New Brunswick Agricultural School at Fredericton, Sussex, etc., and a short course before the New Brunswick Fruit Growers' Association; also lectures to the students of the Forestry School of the University of New Brunswick on forest tree diseases.

In Quebec, Mr. H. N. Racicot assisted the students of the Agricultural College at Ste. Anne, addressed meetings arranged for by the District Agronomist, and conducted a series of demonstration experiments in co-operation with provincial district representatives. He also judged potatoes at Rimouski and other fairs. Mr. Bernard Baribeau has also assisted in every possible way by co-operating with the agronomes interested in the selection of potato strains and in relation to the control of potato diseases.

In Manitoba and Saskatchewan the plant pathologists have lectured to students on plant pathology, and are working in constant close association with representatives of colleges and universities. Mr. J. W. Scannell reports that in Manitoba we have been assisted by Mr. Almey of the Extension Department of the Manitoba Agricultural College in getting in touch with new and interested growers. Also, through Mr. Almey he was able to attend a few meetings of the Great Plains Horticultural Association which were held in Winnipeg last summer. Professor Broderick of the Horticultural Department of the Manitoba Agricultural College requested his assistance in judging the potato exhibits at the Winnipeg Garden Show. In Saskatchewan the Markets Branch of the Provincial Department of Agricultural assists us in finding a market for certified seed potatoes. The Department recommends the planting of certified seed only. The University of Saskatchewan, through their Extension Branch, requested that we judge the potatoes at Seed Fairs and at the same time give short talks on potato diseases.

For the Field Crops Commission, Department of Agriculture, Alberta, the potato exhibit at the Provincial Seed Fair was judged. At the same time the Alberta Seed Growers' Association was addressed on potato diseases. The University of Alberta, through their Extension Department, asks us to address meetings on potato diseases from time to time. The Field Husbandry Department assists by the distribution of certified seed.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, CHARLOTTETOWN

(S. G. Peppin, Acting Officer in Charge)

This laboratory was mainly responsible for the introduction and success of the seed potato industry, as well as for the determination of the present methods of control of diseases of the potato in this province. Our experiments, therefore, were planned towards solving, if possible, the problems which confront the farmer who specializes in the production of seed potatoes. By following the same practices as recommended for the seed grower, the commercial grower also should derive equal benefit.

Previous years' experiments have established the fact that the best control of the two principal diseases, mosaic and leaf roll, is obtained by systematic early and careful rogueing of all diseased and suspicious plants, providing the percentage present at the start is not too high. Particular stress, therefore, was placed on such disease problems as the control of Common Scab, Powdery Scab, Rhizoctonia, Black Leg, and Late Blight. Other activities included a Seed Strain Demonstration, a test of varieties from British Columbia, and a series of demonstrations on the use of inoculated sulphur for the control of Common Scab at plots selected on fourteen different farms scattered throughout the province.

COMMON SCAB (*Actinomyces scabies* (Thax.) Güssow)

The common scab disease of potatoes is quite prevalent in this province and is the cause of considerable loss, not alone to the commercial grower, but also, and particularly so, to the seed growers.

Generally speaking the soil here is acid in its natural state and, in consequence, a practice, which up to late years has been very common, was to treat the land with " Mussel Mud ". This mud is found where old oyster and mussel beds have been formed, and contains a high percentage of lime. On many farms, particularly those within hauling distance of these beds, the mud has been used quite freely. Wherever this has been done we invariably find the common scab abundant. The severity of the attack usually depends on three or more factors: (1) on the amount of mud applied, (2) how recently it was put on the land, and (3) on local or seasonal conditions, such as soil, moisture, and temperature.

Seed treatment as a control of common scab is not effective unless the land in which the potatoes are planted is free of the organism. It should, nevertheless, be carried out consistently each year in order to eliminate as far as possible the scab and other disease organisms which may be resting on the surface of the tubers used as seed—the majority of such organisms being killed by proper seed treatment.

Soil treatment experiments using inoculated sulphur and common sulphur have given us only partial control of common scab, so little so, in fact, that we can now positively state: " Where the land has been treated with mussel mud it is not advisable to grow potatoes thereon for a considerable period. This period may range from twenty-five years for a light or medium application of mud to forty-five years or more where a heavy amount was put on." Our experiments also demonstrate the fact that it is not possible to treat the land with sulphur, inoculated or otherwise, in a quantity sufficient to economically grow a crop of potatoes under present conditions. The results obtained in the various experiments where partial control was obtained are summarized in the following tables.

EXPERIMENTS TO DETERMINE THE VALUE OF SULPHUR (INOCULATED AND COMMON) ON THE DEVELOPMENT OF COMMON SCAB

1923 — Treatment	Per cent of Crop	
	Marketable	Unmarketable
Inoc. sulphur, 300–1,200 lb. (average of 4 plots)	50·8	49·2
Common sulphur, 300–1,200 lb. (average of 4 plots.)	47·0	53·0
Check, 300–1,200 lb. (average of 2 plots)	32·2	67·8

1923 — Treatment	Per cent of Crop	
	Marketable	Unmarketable
Inoc. sulphur, 1,200 lb. (average of 2 plots)	73·0	27·0
Inoc. sulphur, 900 lb. (average of 2 plots)	62·0	38·0
Inoc. sulphur, 600 lb. (average of 2 plots)	56·0	44·0
Check (average of 4 plots)	41·5	58·5

EXPERIMENTS TO DETERMINE THE CUMULATIVE EFFECT OF SULPHUR (INOCULATED AND COMMON), ALSO OF SECOND YEAR APPLICATIONS ON THE DEVELOPMENT OF COMMON SCAB

1924 — Treatment	Per cent of Crop		Yield per acre in bushels
	Marketable	Unmarketable	
Inoc. sulphur applied 2 years, 300-1,200 lb. (average of 4 plots)	50·8	49·2	175
Inoc. sulphur applied 1 year (average of 4 plots)	10·4	89·6	218
Common sulphur applied 2 years (average of 4 plots)	49·8	50·2	158
Common sulphur applied 1 year (average of 4 plots)	18·4	81·6	215
Check (average of 2 plots)	0·0	100·0	238

1924 — Treatment	Per cent of crop		Yield per acre in bushels
	Marketable	Unmarketable	
1,200 lb. inoc. sulphur applied 2 years	51·8	48·2	144
900 lb. inoc. sulphur, 2 years	38·0	62·0	220
600 lb. inoc. sulphur, 2 years	23·0	77·0	220
Check	0·0	100·0	204

It will be noted that in each experiment the heaviest application of sulphur reduced the yield to a considerable extent.

POWDERY SCAB (*Spongospora subterranea* (Wallr.) Johns.)

The season of 1923, which was moist and cool, was favourable for the development of powdery scab. This fact led us to attempt further experiments on the control of this disease. Unfortunately the 1924 season proved to be the reverse of the previous season, and little or no scab, comparatively speaking, developed in the province. In our experiments where diseased seed, untreated, was used the resulting crop was prefectly clean. Further evidence in support of this was found in another common scab project which, in 1923, produced a crop with approximately 50 per cent powdery scab,* whereas the same plots, in 1924, produced a crop absolutely free of this disease. Soil moisture and temperature

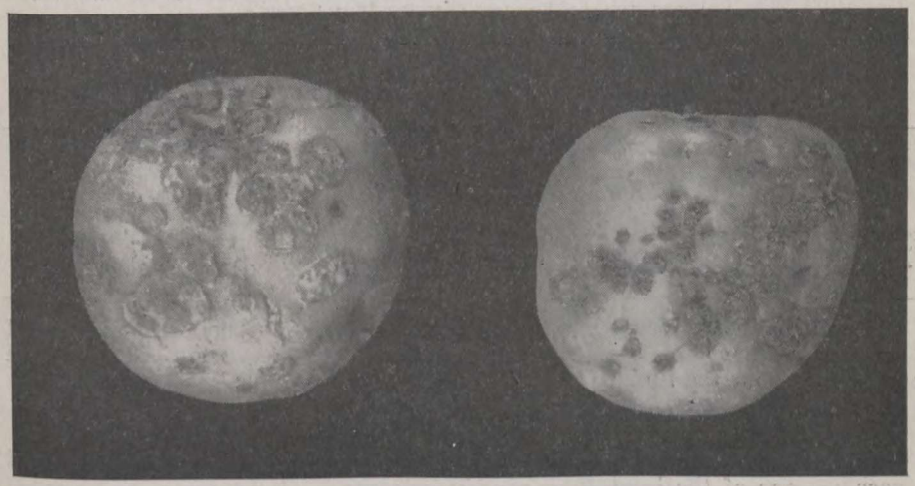

Fig. 2.

COMMON SCAB POWDERY SCAB

Note different appearance of the two scabs.

* It is interesting to note that sulphur did not in the least prevent this form of scab.

are without doubt the controlling factors in the development of the powdery scab disease on potatoes.

RHIZOCTONIA (*Corticium vagum* B. & C.)

The sclerotial or resting stage of the rhizoctonia fungus, commonly called black scurf, is unquestionably the most objectionable stage on potatoes. This scurf is in the form of irregular, hard, black masses, which somewhat resemble dark soil or ashes, and vary in size from a pin point up to three-sixteenths or one-quarter of an inch in diameter. These masses or spots cannot be removed by washing, but are easily scraped off, since they only rest on the skin of the tuber. The presence of black scurf on seed potatoes is undesirable. The causative fungus is also present in most soils. Many experiments have been carried on for controlling this disease with what may appear positive results. Our opinion for some time has been that no seed treatment of any kind will control black scurf on potatoes, if the fungus is already present in the soil. It is quite reasonable to assume that seed treatment will destroy whatever is present on the seed tuber before planting, and be of some benefit in that regard toward lessening the amount of lesions which appear on the stems of the plants. But it is not reasonable to assume that the same treatment will have any effect on the "scurf", which only develops when tubers are formed some three and one-half or four months later. In order to prove this theory an experiment using diseased seed was carried on in duplicate on infected soil. The treatments used included hot and cold water, hot and cold formalin, hot and cold bi-chloride of mercury, also three other compounds known as Semesan, Germisan, and Uspulun, with eight untreated checks scattered throughout the plots. The results obtained were quite contradictory. The cold water treatment gave the highest percentage of clean tubers, and the checks gave better results than four of the treated plots. Further experimentation will be necessary in order to definitely prove our theory regarding this stage of the fungus.

Control of the disease, however, was obtained by early digging of the crop. Here again diseased seed was planted untreated on infected land. The results are shown in the next table.

THE RELATIONSHIP BETWEEN DATE OF DIGGING AND THE AMOUNT OF RHIZOCTONIA (BLACK SCURF) DEVELOPING ON POTATOES (VARIETY IRISH COBBLER)

Date of Digging	Per cent of crop diseased
September 2	3·0
" 9	2·5
" 17	37·3
" 23	54·2
October 1	56·6
" 7	58·3
" 16	65·0

It will readily be seen that early digging considerably lessens the amount of scurf which develops, even when diseased seed is planted untreated on land known to harbour the fungus.

BLACK LEG STUDIES

This disease sometimes assumes serious proportions in certain seasons, and is, perhaps, one of the hardest to effectively control. It is generally supposed that infected tubers carry the disease over from year to year, and, when cut, infect healthy cut sets in the same receptacle. We endeavoured to prove this by saving from diseased black leg plants tubers which had already begun to

rot the previous fall. Some were saved separately (the rot drying up considerably in storage), while others were placed in bags containing healthy, uncut seed. None of the tubers visibly affected produced black leg plants, neither did any of those placed among healthy seed infect them in any way. All the sets, excepting two, grew more or less normal-sized plants. The two sets, which rotted in the ground, were replaced with healthy sets which, in turn, also produced healthy plants. Diseased sets were also placed in pails containing freshly cut, healthy sets, and kept at room temperature for four weeks before planting. All grew into normal healthy plants. The control of this disease, we believe, lies in the care taken of the seed tubers after treatment, and of the cut sets to keep them cool and dry before planting. In all probability soil, moisture, and temperature also have considerable influence in the development of the organism.

LATE BLIGHT (*Phytophthora infestans* (Mont.) de Bary)

The practice of spraying with liquid Bordeaux has now become quite general throughout the province. The question, however, has been repeatedly asked by certain growers, "Will dusting control late blight and rot of potatoes?" In order to test the value of dusting an experiment was planned. A traction machine was loaned by the Niagara Sprayer Company together with sufficient dust to carry out our plans. An acre plot was used containing 22 rows of Green Mountains and 16 of Irish Cobblers, which was divided into two parts, two-thirds to receive dust, and one-third only sufficient liquid poison to control insects. The first application of dust was applied on July 18, second August 5, third August 20, and fourth on September 2. Before the last application was given late blight was present on many of the plants both in the dusted and undusted plots. The Cobbler section about this time was beginning to ripen and was practically dead by September 15. The Mountains, however, remained green until October. In the meantime the blight had not developed in sufficient intensity to kill the vines, but could be found "fruiting" on most moist mornings.

The treated section was dug on October 1 and the untreated on October 2. Some late blight rot was noticeable on the tubers at that time, but, since the plot was being used as a seed strain test, a measured section of every row was bagged and kept separately in the laboratory cellar until sorted. Each lot was carefully sorted between November 15 and 22. The results are summarized in the next table.

EXPERIMENT TO DETERMINE THE VALUE OF BORDEAUX DUST IN THE CONTROL OF LATE BLIGHT AND ROT OF POTATOES

Variety	Treatment	Yield per Acre in Bushels				Per cent Rot
		Sound Tubers	Rotted Tubers	Small	Total	
Green Mountain	Dusted	107	174	5	286	60·8
"	Not dusted	172	116	10	298	39·0
Irish Cobbler	Dusted	225	13	14	252	5·2
"	Not dusted	199	8	20	227	3·5

It will readily be noticed that the undusted section of each variety gave a less percentage of rot than the dusted. This is no doubt due to the fact that the dust kept the vines in a more green or succulent condition just at the particular time when climatic conditions favoured the development of the fungus. *No late blight rot was found in stock which had been thoroughly sprayed with Bordeaux mixture by traction machines*, some was found in that where only hand machines were used, and little or none in the varieties Dakota Red and McIntyre grown commercially, which are seldom sprayed at all for blight. These two varieties are more or less resistant to the disease.

Fig. 3.—Size of seed-piece plot two months after planting.

EXPERIMENT TO DETERMINE IF SMALL SIZED TUBERS (WHOLE OR CUT) CAN BE USED AS SEED

This experiment was conducted on the suggestion of the Dominion Botanist to determine if small sized whole tubers, such as are generally used in Europe, could be economically planted in this country also. Small potatoes which had been graded out from certified seed were used. The sizes were 3 ounces, 2 ounces, 1½ ounces, 1 ounce, and ½ ounce whole tubers, and 1½ ounces, 1 ounce, and ½ ounce cut sets, the latter three being halves of whole tubers. Great care was exercised in weighing these out previous to planting. The rows were 36 inches apart, and the seed dropped 10 inches apart in the row. In order to have sufficient replication, the experiment was conducted in quadruplicate, and the results taken from an average of the four plots. Plant growth was in accordance with the size of the seed piece, the larger sizes coming up quicker and maintaining a larger vine throughout the whole season. The results are shown in the following table.

EXPERIMENT TO DETERMINE THE EFFECT OF SIZE OF SEED PIECE ON YIELD

Seed used	Yield per Acre in Bushels			Per cent small	Order of merit after deducting seed used
	Marketable	Small	Total		
3 ounce whole tuber	426	110	536	20·5	1
2 " "	408	76	484	15·7	3
1½ " cut set	432	61	493	12·4	2
1½ " whole tuber	409	61	470	13·0	4
1 " cut set	394	52	446	11·7	5
1 " whole tuber	365	57	422	13·5	6
½ " cut set	352	36	388	10·8	8
½ " whole tuber	364	39	403	9·6	7

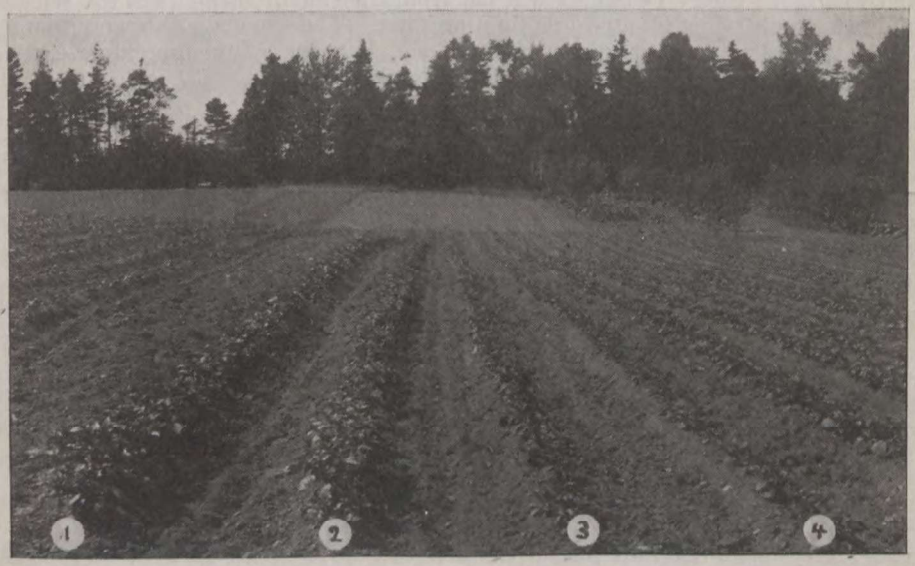

Fig. 4.—Size of seed-piece plot, one month from planting date.
Row 1—3-ounce seed-piece
Row 2—2-ounce seed-piece
Row 3—1-ounce seed-piece
Row 4—½-ounce seed-piece

In calculating the yields all tubers of 3 ounces and under were considered as unmarketable in order to conform to the minimum size allowed in our seed certification standard. The results clearly indicate that the largest size tuber, whether used whole or cut into two, gave the best yield, both total and marketable. It also maintained that position after deducting the amount of seed used in planting, which in the 3-ounce whole amounted to 54½ bushels per acre. Another interesting point brought out was the percentage of small tubers, which varied in proportion to the size of set used.

It should be borne in mind, however, that the seed used was from certified stock which had been thoroughly rogued the previous year for such diseases as leaf roll and mosaic. Commercial growers with ordinary stock would not be advised to follow the practice of planting small potatoes. Seed growers are not advised to do so unless the stock is reasonably free of the diseases mentioned. The grower who maintains a seed plot, which he keeps thoroughly rogued, could no doubt use small seed to advantage. These deductions are based, not alone on this experiment, but on personal observations covering the last four years in handling the potato inspection service in the province. The experiment will be continued in order to collect as accurate data as possible on the subject.

HILL SELECTION OF POTATOES

The question is often asked "What is the value of Hill Selection?" An experiment to determine this was planned along the following lines. Five growers, whose Irish Cobbler fields were in excellent condition and practically free from disease, were chosen. One hundred of the best hills were dug, the number of tubers per hill, yield, type, and uniformity being the factors aimed at. One medium sized tuber was taken from each hill, and the remainder left with the grower to form the nucleus of a seed plot. Later, one hundred tubers of approximately the same size as the selected ones were taken from the "run of pile" for purposes of comparison. A set containing one eye only and weighing exactly 1½ ounces was cut from the side of each tuber, the selected and run of pile being planted in adjoining rows. The eye ends also were planted in another plot, no particular weight of set, but averaging approximately the same. The rows when dug gave the following yields:—

—	Average weight per hill	Yield per acre
Selected hills (one eye)	2 lbs. 3¾ oz.	490 bushels
Run of pile "	2 lbs. 3¼ oz.	482 "
Selected hills (eye ends)		476 "
Run of pile "		440 "

The chief advantages gained from the practice of hill selection methods may be summarized as follows: (1) The strain is made free of all varietal mixture, (2) diseased and weak hills are eliminated, which influence the yielding qualities of the strain as a whole, (3) the best type of the variety is obtained, (4) such stock serves as a basis of certified seed for local distribution.

SEED STRAIN DEMONSTRATION

Thirty-eight one-half bushel samples of seed were taken from the exhibit at the local Winter Seed Fair to be used in the form of a seed strain test. Twenty-two were Green Mountains and sixteen Irish Cobblers. Disease counts were made throughout the growing season, most of the strains proving

to have a low percentage. The variation in yield in Green Mountains was from 331 bushels down to 235 bushels per acre, an average of 287. In Irish Cobblers the yield varied from 295 bushels down to 188 bushels per acre with an average of 252. The results obtained should prove of considerable benefit to intending purchasers of new seed stock.

EXHIBITIONS AND EXTENSION

An exhibit was prepared illustrating all the local potato diseases in their natural state as nearly as possible. Other specimens of plant diseases, in bottled or mounted dry form, were shown along with a number of photographs. This exhibit was shown at the County Fairs of Georgetown, Souris, and Summerside, also at the Provincial Fair at Charlottetown.

THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY AT KENTVILLE, N.S.

Mr. J. F. Hockey, pathologist in charge, assumed his duties in Nova Scotia in September, 1924. He spent the fall months in a survey of the province, and attended to the equipment of this laboratory, which occupies the upper story of the Administration Building, erected during the year at the Dominion Experimental Station, Kentville.

THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY AT FREDERICTON, N.B.

Owing to the appointment of D. J. MacLeod, M.A., as officer in charge in July, 1924, some time was necessarily consumed in becoming acquainted with the general conditions in the province, the practices pursued, and the more important diseases of the various crops grown. Investigational work was chiefly confined to the study of the nature, effect, and control of potato diseases. Throughout the season a collection of potato diseases was made, and numerous observations were recorded for reference in future experimental work. An exhibit was prepared of the most important potato diseases, and in November Mr. MacLeod assisted the provincial authorities in lecturing to the students of the Agricultural School on plant diseases and seed potato certification. Owing to the lateness of the season, no new experiments were initiated with the exception of an investigation of the overwintering in the soil of the causal organism of potato black leg, the results of which will be reported later.

VARIETAL RESISTANCE OF TURNIPS TO CLUB ROOT

This experiment was initiated by Mr. G. C. Cunningham, one of the former officers in charge of the laboratory, with the view of finding varieties of turnips which are resistant to club root, the common disease of crucifers. The procedure adopted by Mr. Cunningham was followed as closely as possible; that of growing a number of varieties upon club root infected soil, choosing at harvest time the stecklings which appeared resistant to the disease, and planting the same the following year for seed. In order to further prove the resistant values of these varieties, it was proposed to test them for a number of years upon infected soil. Unfortunately the varieties tested by the initiator were lost, with the result that the whole experiment had to be repeated. Thirty different varieties were planted in soil inoculated with club root, and attended to in the growing season in the ordinary manner.

The following table shows the results obtained at harvesting time, occurring in the order of the percentage of severe disease present. Disease was classified as

severe when the stecklings were damaged to an extent sufficient to render them unmarketable, and slight when the disease was confined to the rootlets.

Variety	Severe	Slight	Total
86 May Turnips, Marienlyst, Ottawa	12·1	9·1	21·2
109 Improved Yellow Swedish, Gen. Swedish Seed Co	32·8	60·2	93·0
105 New Century Purple Top, Rennie	35·9	64·1	100·0
84 Bangholm Swede, Sludsgaard, Ottawa	37·0	59·2	96·2
94 Best of All, Ewing	42·2	50·7	92·9
113 Fynsk Bortfilder Parti	43·7	27·0	70·7
85 Bangholm Swede, Herning Strain, Ottawa	48·0	12·0	60·0
108 Dimars H. H. McNutt	49·0	35·3	84·3
110 Shepherd Golden Glow Swede	54·3	41·4	95·7
92 Bangholm-Nappan	57·0	41·1	98·1
91 Bangholm-General Swedish Seed Co., Svalof	57·8	42·2	100·0
90 Bangholm Swede—Ewing	58·6	41·4	100·0
89 Bangholm Purple-top—Rennie	61·3	33·9	95·2
103 Magnum Bonum—Rennie	63·4	36·6	100·0
112 Dalis B. L. 773	66·6	8·3	74·9
100 Invicta Bronze top—Rennie	66·7	33·3	100·0
101 Kangaroo Bronze Green Top—Rennie	69·3	30·7	100·0
102 Hartley's Bronze Top—Rennie	70·5	29·5	100·0
87 Olsgard Bangholm Swede, Hjalmar Hartman & Co., Copenhagen	71·7	28·3	100·0
88 Bangholm No. N16 Swede—A. Trifolium	73·0	26·4	99·4
107 Best of All—Rennie	74·0	26·0	100·0
97 Halewood's Green Top—Ewing	78·3	21·7	100·0
104 Irish King Bronze Top—Rennie	79·7	20·3	100·0
93 Shepherd Swede—Trifolium	80·7	19·3	100·0
111 Yellow Tankard B. L. 351	83·6	16·4	100·0
99 Universal—Ewing	86·6	13·4	100·0
106 Canadian Gem Purple Top—Rennie	86·7	13·3	100·0
95 Garton's Superlative—Ewing	89·9	10·1	100·0
98 Kangaroo—Ewing	94·4	5·6	100·0
96 Mammoth Clyde Purple Top—Ewing	97·7	2·3	100·0

It would appear rather premature to draw any conclusions from an experiment of this kind at the end of the first year. Stecklings from the first twelve varieties included in the foregoing table were collected and stored with the hope that opportunity will be afforded to continue the investigation another season.

COMPARISON OF THE RELATIVE SUSCEPTIBILITY OF MOSAIC-AFFECTED AND HEALTHY POTATO PLANTS (YOUNG AND OLD) TO EARLY BLIGHT

The fluctuating occurrence of the potato disease early blight brought to mind the idea that a study should be made of the conditions which predispose to the disease. The possibility that mosaic-affected, young and old plants differed as to their susceptibilities, formed the basis of this experiment.

Living cultures of the causal organism of the disease were isolated from specimens found upon the experimental plots. These were subjected to the usual tests, and were found, upon inoculation into healthy plants, to produce the characteristic symptoms of the disease.

Green Mountain and Irish Cobbler plants grown from disease-free seed potatoes and from mosaic-affected tubers were chosen for this experiment.

Inoculations were made by spraying a suspension of spores upon the leaves of the various plants. The first series were inoculated when the plants were a few inches high, the second at midsummer, and the third at the time the plants began to show signs of death.

No visible difference was observed as to the susceptibility of the various plants to the disease; the characteristic symptoms appeared in each case about four days after they were exposed to infection.

From these results it is apparent that other factors must influence the spread of the disease. We hope to repeat this experiment another year.

OFF-TYPE TUBERS

The question often arises as to whether the abnormal forms found among potato tubers are hereditary or not. In order to secure further light upon the matter a number of different off-type tubers from certified Green Mountains and Irish Cobblers were planted in soil conducive to the production of normal forms. The following were selected for this purpose:—

(1) Round oblong (Rose on end).
(2) Round oblong (Rose on side).
(3) Strawberry type.
(4) Bull nose cylindrical.
(5) Wasp-waisted.
(6) Pointed at seed end.

Upon harvesting it was observed that, with the exception of the first two forms upon the foregoing list, less than 1 per cent of the progeny were similar in type to the parents. No. (1) showed 15 per cent round oblong with rose on the end, and 6 per cent rose on the side, while No. (2) showed 3½ per cent round oblong with rose on the side, and 10 per cent with rose on the end.

From these results it would appear that these abnormal characters are not dominant and are probably produced by some other factor than heredity.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, STE. ANNE DE LA POCATIÈRE, QUE.

(H. N. Racicot, Plant Pathologist, Officer in Charge)

Field experiments on important plant diseases, chiefly potato diseases, prevalent in this district, were conducted by this laboratory. The experimental plots covered an area of two acres, which was placed at the disposal of the laboratory by the Superintendent of the Dominion Experimental Station.

LATE BLIGHT OF POTATOES (*Phytophthora infestans* (Mont.) de B.)

Spraying experiments with Bordeaux mixture were conducted to determine for this district the number of applications necessary and the time at which they should be made to control late blight of potatoes, and the effect of Bordeaux mixture upon the yield, especially in dry seasons when late blight is almost entirely absent. The six sprayings, begun early, on July 2, gave on the whole the best results. Sprayings were made every ten days with 4:4:40 Bordeaux mixture.

Plot No.	Number and time of sprayings	Date when late blight on vines first noted	Late vines	Blight tubers	Yield in bushels per acre
1	Control, unsprayed.....	August 11.....	23%*	1·17%†	332
2	4, commencing July 2.....	" 25.....	Trace	0·70%	415
3	6, " " 2.....	" 25.....	"	0·00%	399
4	4, " Aug. 1.....	" 25.....	"	0·22%	361
5	6, " " 1.....	" 25.....	"	0·18%	395

*This figure represents an average of three counts of 100 leaves at different places in this plot.
†These figures are for tubers at time of harvesting.

PRELIMINARY OBSERVATIONS ON CONSTITUTIONAL POTATO DISEASES

Five plots were set out and planted with certified seed potatoes. These plots were sprayed with Paris green, lead arsenate, calcium arsenate, and nicotine sulphate (Black-leaf 40), in combination with Bordeaux mixture. The percentage of mosaic in the plots was determined, and observations will be made from year to year on plots planted with seed from these plots to determine if these sprays will control insects (potato aphids in particular), and thus prevent mosaic. Nicotine sulphate dust will be added to the sprays already listed above.

Two plots were planted side by side with certified seed potatoes, and in one plot all the vines were artificially inoculated with mosaic (by the leaf-mutilation method). Records will be kept from year to year to determine the decrease in yield caused by mosaic, if removal of diseased hills is not carefully practised. The other plot will be kept as free from mosaic as possible. This year's results show a slight decrease in yield, but the reduction is still well within the latitude of normal experimental variation.

—	Yield per acre	Decrease in yield
	bush.	p.c.
Healthy plot	324	.....
Mosaic plot	313	3·4

To demonstrate to growers in our part of the country who still believe that mosaic disease does not reduce yields, two plots were set out, one planted with certified seed, and the other with tubers from mosaic plants, and records of the yield were carefully made at harvest time. This experiment was duplicated at Luceville, Rimouski county, P.Q.

Locality	Plot	Per cent Mosaic	Yield per acre	Decrease
			bush.	p.c.
Ste. Anne	Certified seed	0	361	.....
"	Mosaic "	100·0	233	35·5
Luceville	Certified "	3·3	253	.....
"	Mosaic "	55·6	127	49·8

A number of plots were treated with inoculated sulphur, supplied by the Texas Gulf Sulphur Company. The sulphur was broadcast over the plots and worked into the soil. This experiment was carried out in four localities. The results obtained were as follows:—

Locality of experiment	Pounds of sulphur per acre	Per cent clean	Per cent scabby but saleable	Per cent scabby and unsaleable
Ste. Anne de la Pocatière	0	22·1	52·8	25·1
	300	8·1	67·8	24·1
	450	51·2	33·3	15·5
Bic, Rimouski county	0	10·0	90·0	0
	300	40·0	60·0	0
N.D. du Sacré Coeur, Rimouski county	0	14·0	86·0	0
	300	17·0	83·0	0
Rivière Blanche, Matane county	0	25·0	75·0	0
	300	45·0	55·0	0
	450	54·0	46·0	0

COMMON SCAB OF POTATOES

Scabby tubers were treated with certain chemicals and commercial seed disinfectants, and planted in 50-foot rows. The results are recorded below. No conclusions are to be drawn until the experiment has been carried on for some years.

Row	Treatment	Per cent scabby	Per cent clean
1	Control, untreated	35·7	64·3
2	Bayer's Uspulun, 0·25 p.c., 30 min	29·5	70·5
3	DuPont's Semesan, liquid, 0·25 p.c., 30 min	28·8	71·2
4	DuPont's Semesan, dust, 3 oz. per 60 lb	33·3	66·7
5	DuPont's Dust Disinfectant No. 12, liquid, 0·25 p.c., 30 min	15·1	84·9
6	DuPont's Dust Disinfectant No. 12, dust, 3 oz. per 60 lb	33·9	66·1
7	DuPont's Dust Disinfectant No. 13, 3 oz. per 60 lb	30·2	69·8
8	DuPont's Dust Disinfectant No. 15, 3 oz. per 60 lb	15·3	84·7
9	Mercuric chloride, 1:1000, 1½ hrs	21·7	78·3
10	Formalin, 1:300, 1 hr	36·1	63·9

OAT SMUT (*Ustilago Avenae* (Pers.) Jens., *U. levis* (K. & S.) Magn.)

Oats of the variety Abundance from a smutted field were treated by various chemicals and disinfectants and sown in one-eightieth-acre plots. The dry and the wet formalin treatments gave the best results.

Plot No.	Treatment	Germination tests		Per cent smutted heads
		Plates	Soil	
1	Control, untreated	70·2	83·2	6·25
2	Formalin, 1: 300, soaked 5 min., drained, covered for 1 hour	58·5	77·0	0
3	Formalin "dry" treatment, equal parts, 1 qt. per 50 bush., covered for 2 hours	37·0	67·0	0
4	Bayer's Uspulun, 0·25% sol., soaked for 2 hours	43·5	81·0	2·5
5	DuPont's Semesan, liquid, 0·33% sol., soaked for 2 hours	70·0	83·0	2·75
6	DuPont's Semesan, dust, 3 oz. per bush	81·0	82·0	5·0
7	DuPont's Dust Disinfectant No. 12, liquid, 0·33% sol., soaked 2 hours	85·0	83·0	4·75
8	DuPont's Dust Disinfectant No. 12, dust, 3 oz., per bush	63·5	82·0	4·5
9	DuPont's Dust Disinfectant No. 13, dust, 3 oz. per bush	92·0	89·0	6·75
10	DuPont's Dust Disinfectant No. 15, dust, 3 oz. per bush	85·0	82·0	5·75
11	Copper carbonate dust, 4 oz. per bush	72·0	73·0	3·33
12	Flowers of sulphur, 6 oz. per bush	12·5	71·0	3·25
13	Copper sulphate, powdered, and lime, equal parts, 4 oz. per bush	26·5	82·0	3·75

BEAN MOSAIC

Healthy bean seeds were planted in alternate rows to rows set with seeds produced by mosaic plants the preceding year. Observations were made to determine to what extent mosaic is transmitted by the seed, and also whether it is transmitted in the field from diseased plants to healthy plants. A very large percentage of the seeds from mosaic plants transmitted the disease, but in no case did any healthy plant develop mosaic symptoms during the season.

	Per cent germination	Per cent diseased plants
Healthy seeds	91	0
Mosaic seeds	88	87

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, ST. CATHARINES

(G. H. Berkeley, Plant Pathologist, Officer in Charge)

Our main efforts during the past year have again been applied to the enlarging of our extension service. We have extended our raspberry inspection and certification service to the following districts outside of the Peninsula: Belleville, Trenton, Brighton, Port Hope, Newcastle, West Hill, Pickering, Scarboro, Agincourt, Milton, Clarkson, Burlington, Claremont, Port Burwell, London, Burford, Brantford, Granton, Caledonia, Waterford, Wilsonville, Lambeth, Brooklin, Cayuga, Simcoe, Hagersville, Hornby, Dorchester, and Byron. Mr. A. B. Jackson, Assistant Pathologist, was in charge of the raspberry certification service this past year. We have found in most of these districts that the raspberry growers had no idea whatever of "mosaic" and "leaf curl", although their plantations in most cases had a very high percentage of these diseases. Several growers considered leaf curl a "foreign" or "wild" variety and, although they realized it was useless, nevertheless they had made no effort to rogue it, and hence the disease has spread rapidly. As for mosaic, very few growers knew anything about it, although they were aware that something was wrong, because they were not getting satisfactory crops. In most cases the trouble was attributed to the "soil" or "variety", whereas in reality it was mosaic and leaf curl. In such districts as Newcastle, Port Hope, Trenton, Scarboro, and Agincourt, where the percentage of mosaic was very high, this was particularly true. To these growers our service has been of great value, because now they know not only the reason for their poor crops and their general dissatisfaction in the growing of raspberries, but, better still, they have been shown how simple a matter it is to put raspberry growing in their district on a sound economic basis once again. Unless the growers in some of these districts obtain certified stock and endeavour to eradicate these two diseases, the commercial raspberry industry in such districts will soon be a thing of the past.

Besides this great enlargement of our raspberry inspection and certification service, we also sent out, to a mailing list of some 3,000 fruit growers, circulars on the following subjects: (1) Peach Leaf Curl, (2) Peach Scab, (3) Blue Stem disease of Raspberries, (4) List of Growers having Certified Stock for Sale, and (5) Fall Spraying for Peach Leaf Curl. Also five articles for the daily press and a bulletin on tomato diseases were prepared by the officer in charge.

For two years now this laboratory has been making a special effort to assist the grower with the various spray schedules. As a result the direct usefulness of our laboratory has been greatly increased. At the request of some of the most influential growers we have already started a spray service somewhat similar to that in force in New York State. Such a service will place all spraying operations on a more systematic basis, and will reduce the customary "slips" and "misses" of spraying to a minimum. Already some seventy-five growers have joined our spray service. This is the first service of this kind to be started in Ontario, and, we believe, in Canada.

In all, the staff has made over 700 visits to farmers in various parts of Southern Ontario. In most cases these have been by request for raspberry inspection or for information on various diseases. Demonstrations and assistance have been given growers this year in the cutting out of "dead arm" of grapes and "fire blight" of pears.

The following research projects are being carried on by the members of the staff:—

(1) Mosaic spread.
(2) Effects of mosaic; mosaic symptoms on various varieties of raspberries.
(3) Blue stem of raspberries. The *Verticillium* Problem.
(4) Root rot of strawberry.
(5) A Plum disease.
(6) Aster wilt. General Fusarial Studies.

During the past year much additional equipment has been purchased; a chemical laboratory has been added; steam heat has been installed throughout the laboratory building, and a small greenhouse 11 feet 2 inches by 18 feet has been erected. A plot of land 40 feet by 100 feet immediately to the rear of the laboratory has been obtained, and will be used for demonstration plots.

RASPBERRY MOSAIC

The status of raspberry mosaic in the Niagara peninsula is much the same as last year. A survey made during the past summer has shown that mosaic is general, not only on the red varieties, but also on the purple, and black raspberries. Certain varieties of blackberries are also susceptible though to a much lesser extent. During this past summer the following varieties have been found infected with mosaic by the staff of this laboratory:—

Cuthbert, Marlboro, Herbert, Brighton, Viking, Seneca, Columbia, Shaffer, Royal Purple, Count, Golden Queen, Highland Hardy, June, King, Donsboro, Ontario, Marldon, Newman '23, St. Regis, Belle de Fontenay, Latham, Redpath, Ohta, Cumberland, Plum Farmer, Gregg, and various varieties of blackberries. At the present time the writer knows of no variety that is immune to raspberry mosaic.

In the Port Hope and Newcastle districts mosaic is particularly severe, many patches being 100 per cent. infected. In the Brighton, Trenton, and Belleville districts Cuthbert plantations show infection up to 50 per cent, whilst the London and Waterford districts show only from a trace up to 3 and 4 per cent.

In general throughout the Niagara peninsula the spread of mosaic appears to have been about the same as last year.

Certified stock has now been in use for two years, and we have found from careful observations that, where certified stock has been set out and carefully rogued by the grower during the growing season, in most cases only a fraction of one per cent mosaic is now present. In many such plantations no more than twenty or twenty-five plants have had to be rogued during the two years. Therefore, from two years' experience with certified stock, it would appear that plantations of certified stock can be kept practically free from mosaic by careful inspection and rogueing on the part of the grower. If this freedom from mosaic can be maintained during the third, fourth, and fifth years, etc., then it would appear to be only a matter of time until mosaic will be of no great economic importance.

Several plantations have been observed again this year which contained a small percentage of very faintly and finely mottled plants. These plants later showed definite mosaic. As a result of our experimental plot at Vineland we are now able to say definitely that plants, which show a blotchy mottling in the fall as noted in our last annual report, do not necessarily develop into mosaic.

This fall, suckers from mosaic plants, that attained 15 to 20 inches in height before frost defoliated them, at no time showed mosaic symptons. Many such suckers have been marked for observation in the spring and summer.

The results obtained from our selection-in-leaf plantations which were set out last fall have been very encouraging. In three such plantations no more than 2 per cent mosaic showed up this summer. In one plantation of 2,000 plants set out on the farm of Mr. Wesley Gallichan with stock selected-while-in-leaf from a plantation at Vineland, which showed at the time of selection up to 25 per cent mosaic, only six mosaic plants were found. These were rogued, four early in June, and two in August. It will be interesting to follow this particular patch and see if, by yearly rogueing, it can be kept free from mosaic.

We have nine experimental plots, four at Vineland and five around St. Catharines, for the purpose of finding out what effect spraying to keep down insects will have on the spread of mosaic. As yet we have data for only one year and, therefore, are unable at the present time to state whether or not spraying will be of any value in checking mosaic spread.

CERTIFIED RASPBERRY STOCK

This year thirty-three growers with a total acreage of 51½ acres received certificates stating that their plantations of raspberries were sufficiently free from disease to be used for planting purposes. This year no patch was certified that contained more than four or five mosaic bushes per acre before rogueing. This is by far the best stock this laboratory has been able to offer raspberry growers. In 1922 twenty-five acres of certified stock was obtainable; in 1923, forty-two acres; in 1924, fifty-one and one-half acres. In 1922 the stock was obtained from plantations with as high as 5 per cent mosaic; in 1923 from plantations with as high as 3 per cent; while in 1924 plantations with more than four or five mosaic bushes per acre were rejected for certified stock. This shows very clearly the decided progress that has resulted from our raspberry inspection and certification services. Results so far appear to justify the statement that, in the Niagara peninsula, mosaic is being gradually brought under control. There are still many patches in the Niagara peninsula which show considerable mosaic, but during the last three years their number has been greatly reduced.

In those districts, where mosaic is still epidemic, as in Newcastle, and Port Hope, etc., we have strongly advised the growers to obtain certified stock. If such districts do not soon make a determined effort to fight mosaic, the raspberry industry in such sections will be a thing of the past. During the last month this office has received several enquiries for certified stock from various organizations in New York and other States of the Union, where mosaic has almost wiped out the raspberry industry. We expect, therefore, that a considerable amount of our certified stock will be sent across the border.

RASPBERRY LEAF CURL

The prevalence of leaf curl in the Niagara peninsula is, without doubt, on the wane. There is, however, a yearly occurrence of it in most sections, but, generally speaking, the number of such bushes in a plantation is very small. In other districts, such as Waterford, Belleville, Trenton, Port Hope, Newcastle, and Milton, leaf curl is present to quite an appreciable extent, some plantations having around 6 per cent and 7 per cent curl. In these districts the high percentage of curl is due entirely to the fact that the growers have not been in the habit of rogueing such bushes. In the Niagara peninsula, where rogueing operations for curl and mosaic are fairly general, as a result of our inspection service, leaf curl is being gradually eradicated. Wherever system-

atic rogueing is continuously carried out from early spring till fall the disease has become of little importance. It is, of course, true that a certain monetary loss is sustained yearly in the removal of the rogued bushes. Wherever bushes have been rogued, new plants may be set in their place, provided that the rogueing operations have been thorough. In other words the disease does not persist in the soil.

In our extension work this past summer we have again made a special effort to inform the grower of the necessity that rogueing for leaf curl must start early in the spring and be caried out faithfully all summer until late fall. Whenever a leaf curl bush is noticed in the plantation it must be dug out immediately. Experience has shown that where such systematic rogueing has been in force two or more years the disease is pretty well under control, and the yearly loss due to removal of bushes has been decreased from 5 or 6 per cent to practically the zero point.

RASPBERRY BLUE STEM

A survey made this past summer has shown that western blue stem is fairly general in southern Ontario on red and black varieties of raspberries. In some districts it is the most important disease. In the Waterford and Caledonia sections blackcaps are very severely infected. It has now been definitely ascertained that a large percentage of the so-called "cane blight", which has been reported by this laboratory in previous years as being prevalent in Ontario, has turned out to be western blue stem. This has been proved by numerous isolations from so-called "blighted" canes. In nearly all cases a *Verticillium* sp. was obtained. The first symptoms are generally a discoloration of leaves and cane, with the resultant dropping of the lower leaves first. Sometimes the leaves turn yellow and drop before the cane takes on a blue colour. In other cases the blue discoloration occurs first. In still others, defoliation takes place but it is not accompanied by discoloration of the cane. In most cases the entire plant becomes defoliated; occasionally, however, one or more canes appear healthy, while the remainder are decidedly diseased. No fruiting bodies have as yet been found in the field. Blue stem canes when brought in to the laboratory soon lose their blue colour. Isolations from such diseased material have always given *Verticillium* spp. of the *Acrostalagmus* type. The organism isolated is practically identical with the organism described by Lawrence in 1912 as *Acrostalagmus caulophagus*.

Cultural studies of the following organisms are now being carried out on five standard media, under standard conditions of temperature, moisture, reaction, etc.

(1) A monospore culture of *Verticillium* sp. from Cuthbert raspberries isolated at St. Catharines.

(2) A monospore culture of *Verticillium albo-atrum* isolated by Harter and obtained from Centraal Bureau voor Schimmelcultures, Holland.

(3) A monospore culture of *Verticillium albo-atrum* from potato, which was isolated and identified in 1912 by Mr. C. W. Carpenter.

(4) A monospore culture of *Verticillium Dahliæ* isolated by Klebahn and obtained from Centraal Bureau voor Schimmelcultures, Holland.

(5) A monospore culture of a *Verticillium* sp. isolated from maple by A. W. McCallum, of the Division of Botany, Ottawa.

To date the following interesting facts have been obtained:—

1. The two cultures of *Verticillium albo-atrum* appear to be identical.

2. The Verticillium isolated from raspberries at St. Catharines is dissimilar from both *Verticillium albo-atrum* and *Verticillium Dahliæ*, the two standards.

3. The *Verticillium* sp. isolated at St. Catharines agrees with the description of *Acrostalagmus caulophagus* as described by Lawrence in 1912.

4. It is our intention to name the *Verticillium* sp. isolated from raspberries at St. Catharines *Verticillium caulophagus* since our sp. is not similar to *V. albo-atrum* or *V. Dahliæ* but is similar to the description given by Lawrence for *Acrostalagmus caulophagus*.

We expect to publish at an early date a fairly complete cultural study of the organisms named above.

As yet we are not prepared to recommend any control measures other than a four- or five-year crop rotation, taking into consideration that this organism apparently attacks also potato, tomato, and egg plant. Rogueing, where the infection is slight, so far has given good results.

STRAWBERRY ROOT ROT

The so-called strawberry " root rot " or " winter injury " was present again this summer throughout Ontario. Many plantations were severely attacked. It was again observed this year that new settings suffered severely.

Samples of this trouble have been obtained from over fifteen different sections of Ontario, and isolations made from this material have in every case given *Fusarium* spp., and, in some cases, bacteria, similar to that isolated from strawberry roots last year. *Fusarium* spp. have been isolated from diseased material from such widely separated districts as Milton, Caledonia, Waterford, Beamsville, Vineland, Burlington, and Brighton.

A preliminary study of the isolated *Fusarium* cultures appears to show that there is a particular *Fusarium* sp. common to all the districts referred to above. Also free-hand cross sections of diseased material have shown abundant mycelium in the wood elements. These facts point to the possibility of a *Fusarium* sp. as being one of the causal factors. At the present time a more systematic cultural study of these *Fusarium* spp., along with inoculation tests in the greenhouse, is under way. So far, therefore, no definite results have been obtained. Continued inoculation tests with the bacteria isolated last year have so far given negative results. This is, no doubt, largely due to the fact that we have been forced to carry on inoculation experiments up to the present in the main room of our laboratory, where it is impossible to maintain constant or satisfactory temperature and moisture conditions. However, now that we have a greenhouse for inoculation tests, it will be possible to maintain such conditions and satisfactory results will now be obtainable.

CHERRY—BLOSSOM BLIGHT

An experiment for blossom blight control on sour cherries was carried out again this past summer on the sour cherry orchard of Mr. P. McDermid, of St. Catharines. The following applications were applied:—

(1) May 10. Pre-blossom, 1:40 lime sulphur spray to one-half the orchard.

(2) May 24. A 1:40 lime sulphur spray was applied to the remainder of the orchard when the trees were almost in full bloom.

(3) June 23. A 1:40 lime sulphur and arsenate of lead spray was applied to the whole orchard, except the check trees.

Six trees in the middle of the orchard were left unsprayed so as to serve as check trees.

The spray applied in full bloom destroyed many of the petals, but had no adverse influence on the setting of the fruit. However, as no blossom blight occurred in any part of the orchard, check trees included, no satisfactory data as to the efficacy of the full-bloom in comparison with the pre-blossom spray were obtainable.

PEACH LEAF CURL

Last fall we had ten fruit growers apply the dormant spray to a part of their peach orchard in the fall instead of the spring as they had been in the custom of doing. The rest of the orchard was sprayed early in the spring. One or more trees were left as checks. In every case, but one, almost perfect control of peach leaf curl was obtained. The failure in this one case was due entirely to the fact that the grower used only 3 pounds instead of 12 pounds of soluble sulphur to 40 gallons of water. Check trees this spring showed 75 per cent to 100 per cent curl. These results were obtained in one of the worst curl years in the history of the peninsula.

Every grower who applied the spray last fall has already done the same this fall, and in fact some forty-five or fifty additional growers have fall sprayed their peaches this year. For the first time, the St. Catharines Cold Storage and other spray dealers have found it necessary to order spray material for fall use. This is entirely due to our advocacy of fall spraying by means of circulars, press articles, etc.

PEACH SCAB

During 1922, and 1923 particularly, peach scab was very general in the peninsula, and severe in certain localities. In 1923 the St. John peaches on the farm of Mr. Frank Bayne, Vineland, were rather severely spotted. Accordingly, an experiment was carried out on this farm this year to ascertain the value of wettable sulphur in producing clean peaches in a scab year. Four trees were left as a check. One application only was applied four weeks after the blossoms had fallen. The check trees showed severe scab infection on one side of the fruit. The sprayed trees were practically clean. Percentage counts showed that the single spray had been 90 per cent efficient in controlling scab.

APPLE SCAB

An experiment on control of apple scab was carried out in the apple orchard of Mr. H. E. Maycock, Vinemount, Ont. This was a joint project between the Entomological Laboratory at Vineland and this laboratory. Mr. Ross, of the Entomological Laboratory, and Mr. G. C. Chamberlain, of this laboratory, were in charge of the experiment.

This orchard of 1,840 McIntosh Red apple trees was divided into five blocks. The following applications were applied: (1) just after the buds had burst, (2) "Pink", (3) post-blossom, (4) three weeks later.

The following spray and dust materials were used:—

Block I.—Sulphur dust for four applications.
Block II.—Lime sulphur for three applications.
Block III.—Check.
Block IV.—Bordeaux sprays for the first two applications, and wettable sulphur for the last application.
Block V.—Bordeaux dust for the four applications.

The following results were obtained:—

Block	Yield in bushels	Per cent					
		Clean	Scab Light	Scab Severe	Codling Moth	Other Insects	Russeting
1. Sulphur dust.....	Row 1. 4 bush.	.....	.....	98·2	1·5	0·3	.....
	Row 2. 7 "	.....	2·5	93·0	1·5	3·0	.....
	Row 3. 7 "	.....	3·6	94·1	1·8	0·5	.....
	Row 4. 10 "	.....	3·3	95·0	0·3	1·4	.....
	Row 5. 23 "	1·0	14·0	83·5	0·5	1·0	.....
	Row 6. 29 "	2·3	8·2	87·2	1·9	0·4	.....
2. Lime sulphur.....	Row 1. 42 "	34·9	57·9	0·7	6·5	0·0	.....
	Row 2. 30 "	18·7	70·0	6·8	2·7	1·8	.....
	Row 3. 43 "	8·5	65·7	20·4	4·8	0·6	.....
	Row 4. 51 "	24·6	62·4	6·7	3·7	2·6	.....
	Row 5. 39 "	40·5	49·6	5·5	2·5	1·9	.....
	Row 6. 52 "	18·8	69·8	5·0	4·3	2·1	.....
3. Check (3, inner rows).....	..... ½ "	.....	1·2	94·3	3·8	0·7	.....
4. Bordeaux.....	Row 1. 78 "	45·8	47·7	3·4	2·5	0·6	25·8
	Row 2. 90 "	32·9	48·7	7·5	7·5	3·4	10·7
	Row 3. 81 "	5·8	69·3	20·4	3·4	1·1	23·2
	Row 4. 65 "	13·8	69·5	8·7	5·7	2·3	12·3
	Row 5. 61 "	26·9	46·2	10·5	3·2	13·2	29·5
	Row 6. 69 "	8·4	58·7	16·7	8·1	8·1	13·1
5. Bordeaux dust.....	No harvest.....	.....	1·1	96·1	2·8	.....	.....

Mr. Chamberlain, in his report, writes as follows:—

"The above results were obtained by grading one bushel of fruit from each row in each block, except the check and the Bordeaux dust blocks. In the check block there was not more than one-half bushel of fruit on the trees. In the Bordeaux dust block the crop was very light, badly scabbed, deformed, and was not harvested.

"In the sulphur dust block scab infection was very bad, the crop which was harvested being small, cracked, and badly deformed. The yield was seriously affected by the heavy early infections, which resulted in the dropping of a large quantity of fruit from pedicel infection. Some improvement was noticeable in this block towards the lime sulphur block, particularly in the row lying adjacent to it.

"In the lime sulphur block there was a marked improvement in yield, with the fruit of good size and colour. The light scab recorded in this block was to a large extent a result of late infection in midsummer, which a fifth spray would have effectively controlled. However, it was thought dangerous to apply a fifth spray of lime sulphur to this block on account of the severe injury which had resulted from the two previous sprays. The spray injury had been very severe, and the trees had just nicely recovered, and would have suffered a dangerous set-back had this spray been applied.

"In the Bordeaux-liquid block the best yield was obtained; the fruit was of good size, but the colour was not equal to that of the lime sulphur block. The very marked difference in the yield of the Bordeaux block over that of the lime sulphur may be attributed to the injury resulting from the early applications of lime sulphur, which was very severe on the foliage and on the set of fruit. The fruit suffered considerable russeting from the Bordeaux spray although wettable sulphur had been substituted for this spray in the post-blossom application. A considerable amount of late midsummer infection was found on this fruit also.

"The Bordeaux dust plot was extremely bad. The fruit was scarce, also small, badly cracked, and deformed. This crop was, therefore, not harvested. The Bordeaux dust block was the innermost block, and lay slightly lower than the other blocks. There was, therefore, less air drainage and less sanitation in this block.

"These unfavourable results may be accounted for as follows:—

"(1) There was a great lack of sanitation in the orchard. Old apple leaves and weeds abounded untill well after post-blossom spray.

"(2) The weather was most unfavourable for successful spraying or dusting. Rain would interfere and delay operations continuously, and at the same time would favour ascospore discharge and aid primary infections.

"(3) It is believed that the spraying operations were commenced a week or ten days too late for the primary infection. It is believed in this connection that, if heavy primary infection takes place, it becomes very difficult to combat the later scab infection.

"In the check block of sixteen trees there was hardly one-half bushel of fruit on the trees, and these were absolutely worthless."

GRAPE CHLOROSIS

Early this spring the grapery of Mr. Parnell, Geneva street, city, contained a considerable amount of chlorosis and dead arm. Applications of iron sulphate and magnesium sulphate were applied to the vines in various stages of chlorosis. The grapery was plotted. In the late summer, wherever the iron sulphate had been applied a marked recovery of the vine was apparent. This was not so apparent with magnesium sulphate. Chlorotic vines left as check became almost defoliated, and no fruit was set. Iron sulphate treated vines regained to a large extent their green colour, the leaves became almost normal in size, and marketable fruit was produced in most cases. This grapery will be kept under observation in 1925, when additional applications of iron sulphate and magnesium sulphate will be applied.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, WINNIPEG, MAN.

(Co-operating with the Manitoba Agricultural College)

(D. L. Bailey, Plant Pathologist, officer in charge.)

VARIETAL RESISTANCE OF OATS TO BLACK STEM RUST

A number of standard and of specially selected varieties of oats were grown in rod rows for a rust resistance test at Morden, Winnipeg, Brandon, and Indian Head. The rows were sown at the various places under the direction of the following persons: Superintendent Leslie at Morden, Mr. I. L. Conners at Brandon, Mr. W. P. Fraser at Indian Head. The notes were taken by D. L. Bailey at all places except Indian Head, where Mr. P. M. Simmonds kindly collected the data. The results are presented in the accompanying table. A study of the table indicates that, of all the varieties tested, only eight seemed resistant. Five of these, namely Richland, Heigira Rustproof Selection, Selection of Monarch Selection, Minnesota No. 437, and Minnesota No. 439, belong to *Avena sativa*, while the other three, White Tartar, White Russian, and Green Mountain, belong to *A. orientalis*. The last three named varieties are identical, and will henceforth be given the name White Tartar in conformity with the usage of the Cereal Investigations Department of the U.S.D.A.

The selections of Heigira Rustproof and Monarch Selection were increased from plants, whose reaction to the biologic forms of *P. graminis Avenae* known to occur in America, had been tested in the greenhouse. The varieties have not been present in sufficient quantities to test their suitability in other respects.

Minnesota No. 437 and No. 439 are fourth generation material from Victory x White Tartar and Minota x White Tartar crosses respectively. Both varieties were generously supplied by Dr. H. K. Hayes of University Farm, St. Paul, and seem very promising.

Richland has little to recommend it except its early maturity and its resistance to stem rust. It appears to have all the undesirable features of Kherson from which it was developed. Its marked susceptibility to Crown Rust is particularly objectionable.

1924—VARIETAL RESISTANCE OF OATS TO STEM RUST (*P. graminis Avenae*)

Variety	Classification	Severity of Infection in Percent at			
		Winnipeg	Morden	Brandon	Indian Head
Avena nuda	Avena nuda	50	30	50	35
A. strigosa	A. strigosa	60—90	40	45	45
A. brevis	A. brevis	75—90	38	30	35
A. sterilis nigra	A. sterilis	85	55		
A. sterilis selection	"	85—95	75	55	35
Red Rustproof	"	85	60		
Burt	"	75	55	50	30
King	"	85			
Black Norway	A. sativa	80—85			
Victor	"	75—90			
Monarch	"	60—75	70	30	33
Black Mesdag	"	50			
Black Diamond	"	50			
Monarch Diamond	"	40—90			
Joanette	"	50—90	60		30
CI 620	"	50—90			
North Finnish	"	85			
Garkhova 473	"	90			
Garkhova 691	"	90			
Kherson	"	30—80	45		
Kherson selection	"	30—95	65	75-S	30
60 Day	"	30—95	55	tr S	25
60 Day selection	"	15—80	50		
Early Champion	"	tr 75			
Awnless Probsteier	"	55—90			
Japan Selection	"	60—85			
Golden Drop	"	60—95			
CI 603	"	50—90			
Green Russian	"	40—90			
Canadian	"	20—80			
Tobolsk	"	30—90			
Silvermine selection	"	80			
CI 602	"	85			
Early Dakota	"	30—90			
Irish Victor	A. sativa	60—90			
Danish Island	"	80			
Early Gothland	"	80			
Belyak	"	30—90			
Silvermine	"	80			
Scottish Chief	"	70			
June	"	90			
Swedish Select	"	tr 90			
Lincoln	"	20—90			
Idamine	"	50—85			
Black American	"	60—80			
Wisconsin No. 7	"	80			
Iowar	"	70			
Richland (Iowa 105)	"	5 R			
Nebraska No. 21	"	50—90			
Comewell	"	40—85			
Kanota	"	40—90			
Ferguson Navarra	"	30—80			
CI 749	"	5—75			
CI 836	"	40—90			
Red Rustproof	A. sterilis	60—80			
Golden Rain	A. sativa	80			
Cole	"	20—90			
Cornellian	"	85			
Richland CI 787	"	trace			
Garton 748	Avena orientalis	30—90	55	tr S	20
Garton 784	"	60—90			
Garton Gray	"	30—90			20
Black Tartarian	"	80	50	4 S	
Golden Giant	"	85	60		18
Sparrowhill	"	90	55	tr S	12
Garton 585	"	60—80	55		
Tartar King	"	60—90		5 S	15
Storm King	"	80	65	tr 60	15
White Tartar	"	10 R	trace	trace	trace
Green Mountain	"	tr—10R	trace	trace	0
White Russian	"	tr—10R	trace	trace	trace

VARIETAL RESISEANCE OF OATS TO STEM RUST (*P. graminis Avenae*)—Con.

Variety	Classification	Severity of Infection in Percent at			
		Winnipeg	Morden	Brandon	Indian Head
Albion	A. sativa	80			
Early Mountain	"	30—80			
Standwell	"	50—90			
Empire	"	50—90			
Old Island Black	"	30—80			
Aurora	"	70—90			
Red Texan	"	80			
Richland Ks 209	"	tr—5R	trace	0	0
Heigira Rustproof Selection	"	trace			
Monarch Selection Selection	"	trace			
Minnesota, 437	"	5—10R	trace	0	0
Minnesota 439	"	3—10R	trace	0	trace

NOTE.—A wide range in percentage indicates differences in maturity. Small percentages followed by R indicate marked resistance.

Where only a few scattered but vigorous pustules were present, a subscript 'S' is added to indicate susceptibility.

BIOLOGIC SPECIALIZATION IN *PUCCINIA GRAMINIS AVENAE*

Considerable attention has been given to this project throughout the year. As a detailed publication on the subject will appear shortly, only a brief summary of the results will be presented here.

(*a*) Five biologic forms of *Puccinia graminis Avenae* have been distinguished and the characteristic reaction of each on seven differential hosts described.

(*b*) In addition to differences in parasitism, significant differences in the size of the urediniospores were found to exist between some of the biologic forms, when all were grown under identical conditions. In such cases, however, the differences were less than the fluctuations induced in the spore size of a single form by varying the environment conditions. Therefore, morphologic differences alone could not be relied upon as a means of identifying the various forms.

(*c*) A preliminary study of the grass host range of the five biologic forms is reported on. The infection capabilities of the five forms were remarkably similar and the host range decidedly limited.

(*d*) The geographic distribution of 14 cultures of Form I, 38 cultures of Form II, 15 cultures of Form V, two cultures of Form III, and one of Form IV, was determined. Form IV is of Swedish origin and has not been found in North America. Two cultures of Form III, one from Sweden and one from South Africa, have been worked with, but none of American origin has been found. Forms I, II, and V are very widely distributed throughout the United States and Canada.

(*e*) Field tests of a large number of oat varieties were carried on at Indian Head in Saskatchewan, and at Brandon and Winnipeg in Manitoba. The uniform susceptibility of all the varieties, except White Tartar and Richland, indicated a widespread distribution of Form II, and the absence of Forms III and IV.

(*f*) The infection of Victory, which is susceptible to all five biologic forms, occurs in a way which is very similar to the mode of infection of a susceptible wheat variety by *P. graminis Tritici*. Penetration is through stomata. An appressorium forms over the stoma, a very small penetration tube passes through the stomatal opening, and the contents of the appressorium flow

through and form a substomatal vesicle beneath. From this substomatal vesicle, hyphae grow out in all directions. There is very little killing of host tissue, except where uredinia are being formed.

(*g*) The resistance of Richland does not seem at all depedent on morphological characters. The mode of infection is much the same as in a susceptible variety, except that pronounced local killing of infected tissues seems to limit the development of the fungus.

THE EPIDEMIOLOGY OF CEREAL RUSTS IN MANITOBA

BLACK STEM RUST

The fall of 1923 was so mild and long that satisfactory uredinial material was not available for overwintering studies.

Pycnia were found first this year at Winnipeg on June 17, and aecia on June 24. This was much later than usual. (1923; O-May 31, 1-June 5; 1924, O-May 15, 1-May 18). Subsequently, barberries wherever found were rusted moderately to heavily. The weather was cold and dry, hence the spread of rust from barberries was slow and lagged behind the general epidemic.

The first collection of the uredinial stage in 1924 was on wheat in southern Manitoba. About that time a very light scattering of primary infections appeared throughout at least the southeastern and central parts of Manitoba. For about two weeks weather conditions were ideal for rust development and by July 26 stem rust was very general, secondary infections were appearing rapidly, and rust was beginning to spread to grasses.

Wheat was relatively quite as late in development as the rust. This, combined with the abundance of inoculum and the favourable conditions for rust development that existed then, made a repetition of last year's epidemic seem almost inevitable at that time (July 26-30). The situation remained serious practically until the wheat matured, with the wheat and rust, as it were, running a neck and neck race. Weather conditions changed about the first of August, however, and subsequently, while there was abundant rainfall, the temperature was low. The combination was somewhat more favourable for wheat than for rust. Growing conditions in the earlier part of the season too had resulted in a limited growth of hard straw, and this may have had some effect in limiting rust development subsequently. With an abundance of rust inoculum present during the last month of its development, the fate of the wheat crop depended, however, primarily on weather conditions. Since this was the case the ultimate development of the rust was as patchy as the local conditions of weather and crop maturity were variable. This makes the estimation of loss from rust a very difficult matter. Unquestionably some damage occurred, but as compared with last year it was slight. During the latter part of August reports of infections of 75 per cent severity were common throughout Manitoba (Emerson, Gretna, Portage, Neepawa, Dauphin, Russell). By this time the grain was nearly matured and, in many places, probably because of cool weather, had filled surprisingly well, even where fairly heavily rusted. In other places a reduction in yield of from 30-50 per cent occurred. From the data at hand 10 per cent reduction in yield seems to be a reasonable average. This would place the reduction in yield at approximately 5,000,000 bushels.

Stem rust on oats appeared about the same time as on wheat, but seemed somewhat slower in developing. Some of the oat crop was very late, however, and rusted seriously.

Timothy rust was very rare this season, which was in striking contrast to its abundance last year. The winter was particularly severe in regard to winter killing, and apparently the urediniospores of timothy rust were no exception. Only a few collections were made in the north of the province, and these were late in the season.

Leaf rust of rye (*Puccinia dispersa*) was unusually rare, while leaf rust of wheat was much less common than usual.

Crown rust of oats was relatively rare. This was undoubtedly correlated with the very light infection of the aecial stage on the buckthorn in the spring.

VARIETAL RESISTANCE OF OATS TO CROWN RUST

In the experiment already outlined on varietal resistance of oats to black stem rust, data were also taken on the resistance of these varieties to crown rust. The results are summarized in the annexed table. Since there was very little crown rust present this season the test was not as final as could be desired. The variation in percentage infection, however, seemed more attributable to time of maturity than to well marked differences in susceptibility. Some differences in susceptibility were evident, but it seems desirable to repeat the experiment before final conclusions are drawn. The marked susceptibility of Richland was demonstrated. This is unfortunate in view of the resistance of this variety to stem rust.

1924—Varietal Resistance of Oats to Crown Rust
(*Puccinia coronata*)

Variety	Classification	Severity of Infection (*a*) in per cent at		
		Winnipeg	Morden	Indian Head
Avena nuda	Avena nuda	10	tr	tr
A. strigosa	A. strigosa	10	tr S (*b*)	5
A. brevis	A. brevis	tr	0	5
A. sterilis nigra	A. sterilis	10	tr	
A. sterilis selection	"	20—50	tr	0
Red Rustproof	"	tr—10	0	
Burt	"	tr—10	tr	tr
King	"	tr—30		
Black Norway	A. sativa	tr—30		
Victor	"	tr—50		
Monarch	"	tr—30	0	tr
Black Mesdag	"	tr—30		
Black Diamond	"	tr—30		
Monarch Diamond	"	tr—50		
Joanette	"	30—60	tr S	tr
C. I. 620	"	tr—50		
North Finnish	"	40		
Garkhova 473	"	50		
Garkhova 691	"	50		
Kherson	"	tr—30	tr S	
Kherson selection	"	tr—40	tr S	
60-Day	"	tr—30	tr S	tr
60-Day selection	"	tr—50	tr S	tr
Early Champion	"	tr—50		
Awnless Probsteier	"	tr—40		
Japan selection	"	tr—50		
Golden Drop	"	10—50		
C. I. 603	"	20—40		
Green Russian	"	tr—10		
Canadian	"	tr—10		
Tobolsk	"	tr—50		
Silvermine Selection	Avena sativa	20		
C. I. 602	"	tr—10		
Early Dakota	"	tr—10		
Irish Victor	"	tr—5		
Danish Island	"	40		
Early Gothland	"	30		
Belyak	"	tr—30		
Silvermine	"	tr—30		
Scottish Chief	"	20		
June	"	5		
Swedish Select	"	tr—5		
Lincoln	"	tr—10		
Idamine	"	20—45		

1924—VARIETAL RESISTANCE OF OATS TO CROWN RUST—*Con.*
(*Puccinia coronata*)

Variety	Classification	Severity of Infection (a) in per cent at		
		Winnipeg	Morden	Indian Head
Black American	"	20—45		
Wisconsin No. 7	"	35		
Iowar	"	40		
Richland (Iowa)	"	70		
Nebraska No. 21	"	tr—30		
Comewell	"	tr—30		
Kanota	"	10—40		
Ferguson Navarra	"	tr—50		
C. I. 749	"	tr		
C. I. 836	"	0—40		
Red Rustproof	A. sterilis	tr—20		
Golden Rain	A. sativa	15		
Cole	"	0—30		
Cornellian	"	20		
Richland C.I. 787	"	70		
Garton 748	Avena orientalis	tr—5	tr S	tr
Garton 784	"	tr—5		
Garton Gray	"	tr—30		
Black Tartarian	"	5	tr S	tr
Golden Giant	"	50	tr S	tr
Sparrowbill	"	5	tr S	tr
Garton 585	"	50		
Tartar King	"	tr—10	tr S	tr
Storm King	"	tr—40	tr	tr
White Tartar	"	tr—40	tr S	tr
Green Mountain	"	tr—10	tr S	tr
White Russian	"	30—50	tr S	tr
Albion	A. sativa	15		
Early Mountain	"	35		
Standwell	"	15		
Empire	"	10—40		
Old Island Black	"	0—10		
Aurora	"	30—50		
Red Rexan	"	30		
Richland Ks 209	"	tr—70	1	1
Banner	"	tr—10	tr	tr
Heigira Rustproof Selection	"	40—80		
Monarch, Selection	"	tr—30		
Minnesota, 437	"	30—60	tr S	tr
Minnesota, 439	"	30—50	tr S	0

NOTES—(*a*)Wide ranges in percentage infection indicate usually different stages of maturity.

(*b*) Where only a few scattered but very vigorous pustules were present a subscript S is added to indicate susceptibility.

SEED TREATMENTS FOR THE CONTROL OF SMUTS

Seed lots.—Marquis wheat artificially smutted with a maximum spore load of bunt; Banner oats artificially smutted with a maximum spore load of covered smut. Thorpe barley artificially smutted with a maximum spore load of covered smut.

Treatments.—Copper carbonate dust 2 ounces per bushel and ½ ounces per bushel; Germisan, Uspulun, and Semesan dust, each at the rate of 2 ounces per bushel; Uspulun, Semesan, and Germisan dip, 0.25 per cent solution for 60, 60, and 30 minutes respectively. Formaldehyde (1:320) sprinkle, and formaldehyde (1:1) spray. The dust treatments in each case were carried out by shaking about a pound of seed with the appropriate amount of the chemical in a quart fruit jar.

Planting.—Three plots of each treatment were planted. Each plot consisted of three eighteen-foot rows, one foot apart. The plots were systematically replicated.

Results.—The experiment with barley smut was a complete failure, inasmuch as smut failed to develop altogether except for a few scattered heads.

The results of the other two experiments are tabulated.

It will be noted that the percentage infections in the check plots of the experiment on the control of bunt were low, being 10.5, 10.5, and 12 in the three plots. Thoroughly satisfactory control was achieved only through the standard formaldehyde sprinkle and the Germisan dip. The uncertainty and undesirability of the concentrated formaldehyde spray were once again demonstrated. Considerable smut occurred in the plots treated with copper carbonate. This is interesting in the light of the accumulated evidence that copper carbonate is effective in controlling bunt. The explanation seems to be in the method of application. With a regular dusting machine, wheat readily absorbs two ounces of copper carbonate per bushel. With the method used here it was noted that when applied at that rate to small seed lots, a considerable amount of copper carbonate was not taken up. This emphasizes the primary importance of methods of application in dust treatments.

The percentage of smutted heads in the variously treated oat plots, together with the other data relating to this experiment, is tabulated below. The percentage infections in the check plots are so low that it is unsafe to base any general conclusions on the results.

SEED TREATMENT FOR THE CONTROL OF BUNT

Chemical	Application		Percentage germination *(b)*		Stimulation	Percentage infection plot *(c)*		
	Rate	Method	8 days	16 days		1	2	3
Copper carbonate.	2 oz. per bush.....	Dusted *(a)*.....	83	83	None	0	2·0	5·0
"	4 "	Dusted.....	81	84	None	0	1·5	2·5
Germisan.....	2 "	Dusted.....	65	66	Some	tr.	0·5	2·5
" ...	0·25 p.c. solution..	30 min. dip.....	81	82	Marked	tr.	0	0
Semesan.....	2 oz. per bush.....	Dusted.....	83	85	Marked	1·0	1·5	2·5
"	0·25 p.c. solution..	60 min. dip.....	90	91	Very marked	1·5	2·0	4·5
Uspulun.....	2 oz. per bush.....	Dusted.....	87	87	Marked	0	1·5	2·0
"	0·25 p.c. solution..	60 min. dip.....	80	83	Some	1·0	1·0	3·5
Formaldehyde	1:320.....	Sprinkle, covered 4 hrs.	50	57	Retarded	tr.	0	0
"	1:1.....	Spray, covered 4 hrs.	65	70	Retarded	6·5	8·0	8·0
Check.....	.....	.....	66	68	Normal	10·5	10·5	12·0

(a) Finely powdered chemical shaken with the seed in a quart jar.

(b) Each percentage the average of two trials, 100 seeds each in plots in soil.

(c) Each percentage determined from at least 200 heads selected at random from three rows. Each head cut through with scissors to determins infection.

SEED TREATMENT FOR THE CONTROL OF OAT SMUTS

Chemical	Application		Percentage germination *(b)*		Stimulation	Percentage infection plot *(c)*		
	Rate	Method	8 days	16 days		1	2	3
Copper carbonate.	2 oz. per bush.....	Dusted *(a)*.....	97	97	None	1H*(d)*	2H	5H
"	4 "	Dusted.....	93	97	None	0	1H	2H
Germisan.....	2 "	Dusted.....	97	97	Some	4·0	4·3	6·0
"	0·25 p.c. solution..	60 min. dip.....	98	98	Some	1H	2H	3H
Semesan.....	2 oz. per bush.....	Dusted.....	95	96	Marked	0·5	1·0	1·0
"	0·3 p.c. solution...	120 min. dip.....	95	98	Marked	1H	2H	4H
Uspulun.....	2 oz. per bush.....	Dusted.....	93	97	Slight	1·0	1·2	3·0
"	0·25 p.c. solution..	120 min. dip.....	98	100	Slight	2H	2H	2H
Formaldehyde	1:320.....	Sprinkle, covered 4 hrs.	90	97	None	1H	3H	10H
"	1:1.....	Spray, covered 4 hours.	84	84	None	1H	1H	1H
Check.....	.....	.....	97	99	Normal	2·0	3·0	4·5

(a) Finely powdered chemical shaken with grain in a quart jar.
(b) Each percentage the average of two trials, 100 seeds each in plots in soil.
(c) Each percentage from a count of 300 heads chosen at random from the three rows.
(d) A subscript H after a figure in the percentage infection column indicates that number of smutted heads in the whole three rows.

VARIETAL RESISTANCE OF OATS TO SMUT

Eighteen grammes each of eighty oat varieties were artificially smutted with an equal volume of smut. The varieties were planted in rod rows, one foot apart. The results are presented in tabular form. The reason for the very light infections is not apparent inasmuch as all the seed carried a maximum spore load of viable spores. The soil temperature at planting was slightly below optimum and considerable soil moisture was present. It seems probable that very little is shown by this experiment of the comparative genetic resistance of the various varieties.

VARIETAL RESISTANCE OF OATS TO SMUT

Variety	Classification	C.I. No.*(a)*	Percentage infected
Avena nuda.....	Avena nuda.....	.....	26
A. strigosa.....	A. strigosa.....	.....	0
A. brevis.....	A. brevis.....	.....	0
A. sterilis nigra.....	A. sterilis.....	.....	0
A. sterilis selection.....	"	.....	0
Red Rustproof.....	"	.....	0
Burt.....	"	.....	tr.
King.....	"	.....	0
Oklahoma 606.....	"	.....	0
Black Norway.....	A. sativa.....	.....	0
Victor.....	"	.....	tr.
Monarch.....	"	1876	0
Black Mesdag.....	"	1877	0
Black Diamond.....	"	.....	0
Monarch Diamond.....	"	.....	0
Joanette.....	"	.....	0
.....	"	620	0
North, Finnish.....	"	1882	tr.
Garkhova.....	"	.....	2
Garkhova 691.....	"	.....	tr.
Kherson.....	"	.....	tr.
Kherson selection.....	"	.....	tr.
60-Day.....	"	826	tr.
" selection.....	"	.....	tr.
Early Champion.....	"	1623	3
Awnless Probsteier.....	"	.....	tr.

VARIETAL RESISTANCE OF OATS TO SMUT—*Con.*

Variety	Classification	C.I. No.(a)	Percentage infected
Japan selection	"	.....	2·5
Golden Drop	"	.....	tr.
C.I. 603	"	603	tr.
Green Russian	"	.....	tr.
Canadian	"	1625	tr.
Tobolsk	"	1809	tr.
Silvermine selection	"	.....	tr.
C.I. 602	"	602	tr.
Early Dakota	"	.....	tr.
Irish Victor	"	1896	tr.
Danish Island	"	.....	tr.
Early Gothland	"	723	0
Belyak	"	.....	tr.
Silvermine	"	.....	0
Scottish Chief	"	.....	tr.
June	"	.....	tr.
Swedish Select	"	802	tr.
Lincoln	"	1463	tr.
Garton 784	A. orientalis	.....	tr.
Garton Gray	"	.....	0
Black Tartarian	"	.....	0
Golden Giant	"	1606	tr.
Sparrowbill	"	1604	tr.
Garton 535	"	.....	tr.
Tartar King	"	.....	tr.
Storm King	"	1602	1·5
White Tartar	"	1614	4
Green Mountain	"	.....	3
White Russian	"	1614	tr.
White Mountain	"	.....	tr.
Albion	A. sativa	729	0
Early Mountain	"	1624	tr.
Standwell	"	1975	tr.
Empire	"	1974	tr.
Old Island Black	"	1881	0
Wisconsin No. 7	"	1154	tr.
Iowar	"	847	tr.
Richland	"	Iowa 105	0
Nebraska No. 21	"	841	0
Comewell	"	1317	tr.
Kanota	"	839	tr.
Ferguson Navarra	"	966	0
C.I. 749	"	749	tr.
C.I. 862	"	862	0
Red Rustproof	"	1356	tr.
Golden Rain	"	1718	tr.
Cole	"	843	0
Cornellian	"	1843	0
Aurora	"	787	tr.
Red Texan	"	.....	5
Richland	"	Ks 209	tr.
Idamine	"	1834	0
Black American	"	1758	0

tr.=trace, 1-4 smutted heads in the rod row. (a) Cereal Investigation number U.S. Dept. Agriculture.

PLANT DISEASE SURVEY

Considerable attention was devoted to a survey of the diseases of economic plants this year. As the material is incorporated in the Plant Disease Survey Report for the Dominion, it is omitted here for the sake of brevity.

BARBERRY ERADICATION

A resurvey was made of all previously located plantings. The results indicated the desirability of this, because, in the great majority of cases in the cities and towns, the bushes had not been removed. This was due almost entirely to carelessness rather than to antagonism on the part of the owners. Through

the marked energy and persistence of Mr. C. E. Maguire, we were able during this season to get rid of every barberry planting in Manitoba, of which we have any record.

At the same time the survey of towns and villages was continued, and by the end of the season, 176 of these had been surveyed. Only a very limited number of new plantings were located, and these were destroyed wherever found. This work practically completes the survey of all the cities, towns, and villages of the province, which are of any significant size.

Toward the end of the season some attention was given to the question of the probability of barberries becoming naturalized under Western Canadian conditions. The most interesting result in this connection was the finding of about 20 seedlings, evidently of this year's growth, on the farm of Mr. Motherall at Snowflake. These all occurred in very close proximity to the location of a barberry hedge which was removed from there in 1923. The place was very effectively sheltered and ideal in all respects, except for the possibility of undue competition, for young plants to develop. In spite of this, however, no seedlings of more than current year's growth were found. A close watch will be kept on this district next season.

WHEAT ROOT ROTS

The wheat root rot problem has been given considerable attention during the last year. The aspects of the problem to which attention has been specially directed to date are: (1) the fungous flora of wheat roots in Manitoba, (2) the relation of various cultural rotations to the fungous flora of wheat roots, and (3) pathogenicity studies with organisms isolated from infected wheat roots.

The data accumulated have become too extensive and the experimental methods too involved to permit of a satisfactory presentation of them in a brief report. Accordingly, only a few of the general results will be presented here.

(1) The Fungous Flora of Wheat Roots in Manitoba

A large number of pure culture isolations have been made from wheat roots collected especially for that purpose from a number of localities in Manitoba, as well as from wheat roots submitted from various places for diagnosis. The results, as presented in the accompanying table, indicate the widespread association of *Helminthosporium sativum*, P. K. and B., and *Fusarium* sp. with wheat root rots in Manitoba.

THE FUNGOUS FLORA OF WHEAT ROOTS IN MANITOBA

Wheat Roots from	Number of isolations	Roots Infected		Percentage of Roots Infected by	
		Number	Per cent	*Fusarium* sp.	*H. sativum* P.K. & B.
Adelaide, Man.	15	5	33·3	20	13·3
Elva, Man.	10	3	30·0	10	20·0
Morden, Man.	30	27	90·0	53	37·0
Napinka, Man.	25	10	40·0	20	20·0
Oak Bluff, Man.	30	14	46·0	33	13·0
Portage Plains, Man.	36	36	100·0	45	55·0
Portage Plains, Man.	22	22	100·0	45	55·0
Sperling, Man.	10	8	80·0	70	10·0
Southern Manitoba	75	36	45·0	35	10·0
Winnipeg, Man., Agr. College	62	57	92·0	58	34·0

(2) The Relation of Rotations to the Fungous Flora of Wheat Roots.

Through the courtesy of Professor Ellis the rotation plots of the Manitoba Agricultural College, Field Husbandry Department, were made available to us. Pure culture isolations were made from a hundred wheat roots selected at random from the following plots: wheat after fallow; wheat continuously for one, two, three, four, and five years; third crop of wheat after sod; wheat after oats, barley, rye, flax, corn, potatoes, turnips, grasses, clover, and sunflower. The results, in so far as they relate to the number of roots infected in each plot and the fungi present, are summarized in the following table:

THE RELATION OF CULTURAL ROTATIONS TO THE FUNGOUS FLORA OF WHEAT ROOTS

Wheat Roots Derived from	Percentage of Roots Infected (100 Isolations)			Percentage of Infected Roots in Trial 1 Infected by		
	Trial 1	Trial 2	Average	*H. sativum* P.K. & B	*Fusarium* sp.	Other fungi
First crop wheat after fallow	70	71	70·5	13	79	8
Second " "	76	77	76·5	35	60	5
Third " "	87	77	82·0	19	72	9
Fifth " "	92	85	88·5	15	81	4
Third " " sod	60	.....	.....	15	76	9
First " " oats	89	82	85·5	18	76	6
First " " barley	94	83	88·5	33	66	1
First " " rye	74	71	72·5	33	67	0
First " " flax	88	79	83·5	31	68	1
First " " corn	65	64	64·5	33	67	0
First " " potatoes	60	64	62·0	25	75	0
First " " turnips	63	60	61·5	21	78	1
First " " sunflower	69	71	70·0	20	80	0
First " " grasses	71	70	70·5	25	75	0
First " " clover	69	69	69·0	10	90	0

(3) Pathogenicity Studies

Extended greenhouse studies have been made to determine the virulence of the organisms isolated from wheat roots. The only virulent pathogens encountered throughout the investigations were *Helminthosporium sativum,* P.K. and B., and *Fusarium.* Even among these organisms there was the greatest variation in virulence in relation to both wheat and the other cereals. Further studies on the nature and identity of these strains are in progress.

BUCKTHORN SURVEY

The survey of the towns and villages of the province proceeded so rapidly this summer that we have now completed the survey of 173 localities. This number includes practically all the important cities, towns, and villages. A list of the towns surveyed and a table summarizing the year's results follow. It will be noticed that buckthorn was found in only 20 towns this summer. This confirms the impression given by last year's survey, that it will be a relatively simple matter to get rid of the buckthorn in all but a few of the larger towns.

TOWNS SURVEYED FOR EUROPEAN BUCKTHORN IN 1923-24

The number after certain localities indicates the number of plantings found in each case. Otherwise the localities were free of buckthorn.

Alexander	Bagot	Bergen
Arborg	Balmoral	Berton
Argue	Beaver	Beulah
Arnaud	Belmont	Binscarth
Austin	Benard	Birtle

Boissevain
Brandon (9)
Bradbury
Brumlie
Burnside
Caye
Carberry
Cardale
Carman (1)
Carroll
Cartier
Cartwright
Clandeboye
Clanwilliam
Crandall
Crystal City
Culross
Cypress River
Dana
Darlingford
Dauphin (1)
Decker
Deleau
Deloraine
Dominion City
Douglas
Dropmore
Dugas
Dunrea
Elie
Elkhorn
Elliots
Elm Creek (1)
Emerson (3)
Fairfax
Fairview
Fannystelle
Finlay
Gautier
Gimli
Gladstone (2)
Glenboro
Glenlea
Golden Stream
Grandview
Gretna
Griswold
Gunton
Halbro
Hamiota (1)
Hartney (1)
Haywood
High Bluff
Holland
Homewood
Hummerston
Ingelow
Jordan
Kaleida
Katrine
Kemnay
Keyes
Killarney
Komarno
Landseer
Larivière
Lauder
Lavinia
Letellier
Longburn
Lyleton
MacDonald
Macgregor
Manitou
Margaret
Marquette
Mayfeld
McConnell
Meadows
Medora
Melbourne
Melita (1)
Miniota
Minto
Minnedosa (3)
Minitonas
Morden (1)
Morris (4)
Morton
Mowbray
Muir
Napinka (1)
Nassau
Neepawa (1)
Nesbitt
Newdale
Ninette
Niverville
Oak Bluff
Oakburn
Oak Lake
Oak River
Oakville
Oberon
Parkview
Petersfield
Petrel
Pipestone
Portage (10)
Poplar Point
Rapid City
Rathwell (1)
Reaburn
Reston
Rivers
Riverton
Roblin
Rossburn
Rossendale
Rosser
Russell
St. Adolphe
Ste. Agathe
St. Claude
St. Jean Baptiste
St. Malo
St. Norbert
St. Pierre Jolys
Sanford
Selkirk
Shoal Lake
Sinclair
Snow Flake
Solsgirth
Somerset
Souris
Sperling (1)
Starbuck
Stonewall (2)
Strathclair
Sydney
Swan River
Teulon
Thornhill
Treherne (1)
Two Creeks
Underhill
Valley River
Virden
Vista
Waldron
Wawanesa
Wellwood
Westbourne
Willard
Windygates
Winnipeg (many)
Woodside

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, BRANDON, MAN.

(I. L. Conners, Plant Pathologist, Officer in Charge)

For the past year a study of means to control cereal smuts has been under way.

SMUT CONTROL EXPERIMENTS IN CO-OPERATION WITH THE DOMINION EXPERIMENTAL FARMS

Through the co-operation of the Dominion Experimental Farms at Lacombe, Alberta, Indian Head, Rosthern, and Scott, Sask., and Brandon, Man., experiments on the control of wheat bunt and of covered smut in hulless oats were again carried out, similar to those made previously by Mr. W. P. Fraser, Dominion Field Laboratory of Plant Pathology, Saskatoon, Sask. The seed was treated at Brandon, and it was then forwarded to the various stations. Seeding and other operations, including harvesting and threshing, were done by the Experimental Stations. The estimate of smut percentages was obtained by members of the Division of Botany.*

OUTLINE OF THE EXPERIMENTS

Marquis wheat, heavily smutted, was obtained from the Grain Inspector at Fort William, Ont.

Liberty (hulless) oats grown at the Dominion Experimental Station, Scott, Sask., were artificially smutted. The seed, that was planted at Indian Head, Scott, and Lacombe, was only lightly dusted with spores (1 part of spores to 2,500 parts of seed by weight). The seed was not noticeably smutty, but a difference could be readily detected when it was compared with an unsmutted sample. The seed used in the Rosthern and Brandon plots was well blackened. The same seed lot of each cereal was used at all the stations.

TREATMENTS AND METHODS OF APPLICATION

Formalin Dip.—Formalin solution 1:320, seed dipped five minutes, drained, covered for one hour, and then dried by spreading out in a thin layer in the laboratory. The formalin was tested by the Department of Chemistry, University of Saskatchewan, Saskatoon, and the solution was made up to the proper strength.

Copper Carbonate Dust.—"Corona Coppercarb", a commercial form of copper carbonate supplied by the Corona Chemical Division, Pittsburgh Plate Glass Co., Milwaukee, Wis., was applied at the rate of 3 ounces per bushel for wheat, and 4 ounces per bushel for hulless oats. According to the company, this dust contains not less than 18 per cent copper. It is very finely ground, so that the seeds become readily covered with the dust. The seed was treated in a small hand machine until thoroughly coated with dust.

Copper Sulphate and Calcium Carbonate Dust.—Equal parts of monohydrated copper sulphate and precipitated calcium carbonate were thoroughly mixed together. Both ingredients were in the form of a very fine powder. The seed was successfully coated by machine, when the dust was applied at the same rates as the copper carbonate dust.

Sulphur Dust.—"Superfine" sulphur, 95 per cent passing a 200-mesh sieve, was applied by machine at the rate of 6 ounces per bushel.

* The writer is greatly indebted to Mr. W. P. Fraser and his assistant, Mr. Russell, for the estimates made at Rosthern, Scott, and Lacombe. Mr. P. M. Simmonds, of the Dominion Laboratory of Plant Pathology at Indian Head, kindly made the counts at that place. The writer is further indebted to Mr. Fraser for material for and advice in conducting many of the experiments.

Semesan Soak.—The seed was soaked in 0·3 per cent solution of "Semesan" for one hour, drained, and spread out to dry. Semesan is an organic mercury compound manufactured by I. E. Dupont de Nemours Co., Wilmington, Delaware.

Chlorophol Soak.—The seed was soaked for one hour in 0·3 per cent solution of "Chlorophol". This is another mercury organic compound.

Check.—No treatment.

Estimate of Smut.—The amount of smut present was estimated by selecting 100 heads from ten different places in the two plots, five from each plot. The percentage of smut in each treatment was based on the number of the smutted heads in the 1,000. Where only a trace or no smut is reported the whole plot was carefully examined.

Smut-fungi present.—The wheat bunt was caused mostly by *Tilletia Tritici,* (Bjerk.) Wint., but *T. laevis,* Kühn was responsible in part. *Ustilago levis,* (K. & S.) Magnus was used in the oat experiments.

Yield.—Yields are given in bushels and pounds per acre.

Size of Plots.—The plots were one-fortieth of an acre each, seeded in duplicate.

Moisture.—The soil moisture was evidently abundant. The soil moisture in the first 12 inches was 18 per cent at seeding time on the plots at Scott.

Temperature.—Although no systematic data were collected on soil temperature, it may be said that the temperature was unusually low this spring.

SEED TREATMENT FOR THE CONTROL OF BUNT IN WHEAT

Station	Treatment	Date Seeded	Previous Crop	Percentage of bunt	Yield per acre						Remarks
					Series 1		Series 2		Average		
					bush.	lb.	bush.	lb.	bush.	lb.	
Indian Head	Formalin dip			0	–	20	5	20	5	20	Due to sparrow injury, the yields of the first three plots of Series 1 are not considered in average.
	Copper carbonate dust			0·4	–	20	6	–	6	–	
	Semesan soak			1·7	2	40	6	40	6	40	
	Copper sulphate and carbonate dust	Calcium May 7	Sunflower	0·7	4	40	4	40	4	40	
	Sulphur dust			3·9	5	–	7	20	6	20	
	Chlorophol soak			2·3	7	20	6	40	7	30	Dry summer, plants small, plots thin.
	Check			20·3	6	40	6	–	6	40	
Rosthern	Formalin dip			trace	11	20	17	20	14	20	Dry weather, grain short, but no differences due to treatment could be detected.
	Copper carbonate dust			1·1	6	40	19	20	13	30	
	Copper sulphate and carbonate dust	Calcium May 9	Wheat	0·5	14	40	17	20	16	30	
	Check			31·4	13	20	12	–	12	20	
Scott	Formalin dip			0·1	11	50	7	40	9	45	Dry summer, no apparent difference in the plots.
	Copper carbonate dust			0	8	20	8	–	8	20	
	Sulphur dust	May 14		4·4	5	50	6	40	6	45	
	Check			23·2	6	–	6	–	6	–	
Lacombe	Formalin dip		Fall ploughing	trace							
	Copper carbonate dust		after alfalfa	0·1							
	Sulphur dust	May 9		13·3							
	Check			51·4							

Fairly high percentages of bunt were obtained in the checks as compared to the figures frequently reported for Marquis. Nevertheless the amounts at the different stations ranged from 20 per cent at Indian Head to over 50 per cent at Lacombe, although the same seed lot was used throughout.

Copper carbonate dust, and the mixed dust of copper sulphate (monohydrate) and calcium carbonate gave good control when compared with the standard formalin treatment. Sulphur dust has again proved unsatisfactory. The uncertainty of its action precludes the use of this cheap substance for the control of bunt.

The organic mercury compounds, Semesan and Chlorophol, were not as effective this year as last. They will be discussed more fully in another part of the report.

On account of the marked lack of moisture during the growing season, variations in the plots tended to be reflected in the yields. It is evident the variation between the plots treated alike is so great that no consistent differences in yields due to the different treatment of the seed can be substantiated.

SEED TREATMENT FOR THE CONTROL OF COVERED SMUT IN LIBERTY (HULLESS) OATS

Station	Treatment	Date Sown	Percentage of Smut	Yield per acre						Remarks
				Series 1		Series 2		Average		
				bush.	lb.	bush.	lb.	bush.	lb.	
Indian Head	Formalin dip		31·2	8	8	9	14	8	11	Previous crop sunflowers.
	Copper carbonate dust		0·4	10	20	9	14	10	17	
	Semesan soak		13·7	8	28	9	24	8	26	Very poor stand on account of dry summer.
	Copper sulphate and Calcium carbonate dust	May 7	3·8	9	14	14	4	11	9	
	Sulphur dust		0·3	10	–	10	–	10	–	
	Chlorophol soak		0·4	8	8	8	28	8	18	
	Check—No treatment		22·4	5	20	10	–	7	20	
Lacombe	Copper carbonate dust		trace							On late ploughing after alfalfa.
	Semesan soak		5·8							
	Copper sulphate and Calcium carbonate dust	May 9	0·4							
	Check—No treatment		55·0							
Scott	Copper carbonate dust		0·1	11	26	17	2	14	14	
	Semesan soak		1·5	11	6	24	4	17	5	
	Copper sulphate and Calcium carbonate dust	May 14	0·2	14	4	12	–	13	4	
	Check—No treatment		42·0	11	6	5	30	8	18	
Rosthern	Copper carbonate dust		1·1	9	14	7	2	8	8	On summer-fallow. Weather dry, grain very short.
	Semesan soak	May 9	18·0	7	2	7	2	7	2	
	Sulphur dust		0·5	7	2	7	2	7	2	
	Check—No treatment		78·4	2	12	2	12	2	12	
Brandon	Copper carbonate dust		0·6	42	18	44	4	43	11	Stand fairly uniform. Copper treatments appeared somewhat more vigorous.
	Semesan soak		10·6	38	28	37	22	38	25	
	Copper sulphate and Calcium carbonate dust	May 14	2·5	51	26	43	18	47	22	
	Check—No treatment		60·8	29	14	20	–	24	14	

In the preceding table are reported the results obtained with various seed treatments for the control of covered smut in Liberty (hulless) oats. These results are generally in accord with those previously reported by Mr. Fraser. The standard formalin treatment was modified; the grain was dipped for five minutes in formalin solution 1:320, covered for twenty minutes, and then rinsed in water. This treatment increased the amount of smut. Copper carbonate and sulphur dusts gave effective control, the copper sulphate and calcium carbonate dust was slightly less effective. Semesan, however, failed to control as it did previously.

From these experiments and those previously reported by Mr. Fraser it is evident that copper carbonate dust satisfactorily controls covered smut in hulless oats. The standard formalin or any modifications of it have proven unsatisfactory. Copper carbonate dust has been the most thoroughly tested dust treatment for the control of covered smut in hulless oats. Until something better or cheaper is found it is recommended to the grower of hulless oats. Care must be taken to coat the seed thoroughly with the dust. Some kind of a dusting machine is almost necessary to accomplish this satisfactorily.

High percentages of smut lowered the yield. The different treatments apparently only affected the yield in so far as they controlled the smut.

Germination tests were made on blotting paper and on soil for both the wheat and hulless oats, but due to delay in completing the tests the details are omitted. The results showed, however, that the seed especially of the Liberty oats was injured slightly by formalin. The other treatments apparently affected the germination but little.

Seedling counts of unit areas were made at Scott and Rosthern by members of the Dominion Experimental Station staff at each place. With the wheat, formalin reduced germination slightly, while copper carbonate seemed to give slightly better results than the untreated plot. With the hulless oats, on the contrary, the copper treatments gave a lower percentage stand than the check or Semesan.

More detailed studies on the effect of the fungicide on the seed and plant will be made another year.

SMUT CONTROL EXPERIMENTS IN CO-OPERATION WITH THE CROP PROTECTION INSTITUTE AND THE DIVISION OF BOTANY.

Within recent years there has been an increased interest in the control of seed-borne diseases. It has been found that formalin causes considerable seed injury, whenever the seed lies in a dry seed bed for a period before germinating. This has led to the introduction of copper, nickel, and other dust treatments. Copper carbonate dust has been demonstrated to be effective against wheat bunt in various parts of the world. In soil infested with various root rotting fungi, seedling blight, root rot, and leaf and head blight are often serious. To reduce injury from these fungi, the use of various compounds has been advocated. The most notable of these are the organic mercury compounds.

The following experiment was conducted to test the efficiency of these various newer substances for the control of smuts or other diseases present in wheat, barley, and both common and hulless oats.

OUTLINE OF THE EXPERIMENT

Seed.—The varieties used were as follows: wheat, Marquis No. 15; hulless oats, Liberty; common oats, Banner; barley, Manchurian. The seed was grown in 1923; the wheat and hulless oats at the Dominion Experimental Station, Scott, Sask., and the other two at the Dominion Experimental Farm, Brandon.

Artificial Inoculation.—The seed in this experiment was all artificially inoculated with the respective smuts. The wheat seed was mixed with bunt spores (*Tilletia Tritici*) at the rate of 1 part of spores to 100 parts of seed by weight. The oats were well blackened with covered smut spores (*Ustilago levis*) and the barley was similarly inoculated with spores of the covered smut (*Ustilago Hordei*) (Pers.) K. & S. The barley seed also was slightly infected with barley stripe (*Helminthosporium gramineum*).

Size of Plots.—The plot for a single treatment consisted of three 16-foot rows planted a foot apart. Each plot was systematically replicated twice.

Rate of Seeding.—Wheat 15, barley 16, hulless oats 14, common oats 13, grams per row.

Date of Treatment.—The dust treatments were completed about May 1, while the wet treatments were done on May 7.

Date of Sowing.—Wheat, May 9 and 10; barley, May 12 and 13; common oats, May 14 and 15; hulless oats, May 17 to 22.

Nature and Condition of the Soil.—The wheat and common oats were sown on rich loam in excellent condition. The range had been summer fallowed the previous season. The hulless oats and the barley were on stubble plowed in the spring. The soil was a heavy loam and was in poor condition. The moisture was medium for the type of soil.

Temperature during Germination.—The temperature during the period of germination was low. The soil temperature frequently dropped below 40° F. at night, and 60° F. was about the maximum day temperature. Frequently, however, the day temperature of the soil failed to reach 50° F.

Precipitation.—No precipitation occurred during the germination of the wheat and common oats, but the hulless oats and barley continued to germinate until after two light rains had fallen.

Stand.—The wheat and common oats germinated very evenly and the stand was very uniform. The germination and stand of the hulless oats and barley were irregular. There was no striking difference in the comparative vigour or stand due to the various treatments, except with Corvusin on barley, where the germination was greatly retarded and reduced.

Estimate of Smut.—Four counts of a hundred heads were made in each plot of barley and oats. The percentage of smut for each treatment is based on a total count of 1,200 heads. For wheat only half the number of counts was made.

Treatments and Methods of Applications.—In the accompanying table are given the details of the method of application of the various substances used in both the wet and dust treatments.

TREATMENTS AND THEIR METHOD OF APPLICATION FOR THE CONTROL OF SMUT

Treatment	Substance used	Strength of Solution	Method of Application
Sprinkle	Formalin	1:320	Seed sprinkled and turned until every grain was thoroughly wet. No excess of fungicide used. Seed was thinly but thoroughly coated.
	Semesan	0·5%	
	Uspulun	0·5%	
	Germisan	0·5%	
	Corvusin	100%	
Dip	Formalin	1:320	Seed dipped for 5 minutes in solution, drained, and covered one hour.
	Semesan	0·3%	
	Uspulun	0·25%	
	Germisan	0·25%	
Soak	Semesan	0·3%	Seed soaked in Semesan, Chlorophol,and Uspulun for wheat, hulless oats and barley 1 hour, for common oats 2 hours. Time of soaking in Germisan, one half of above.
	Chlorophol	0·3%	
	Uspulun	0·25%	
	Germisan	0·25%	
Presoak and dip	Semesan	0·3%	Seed first soaked 6 hours in water, drained, dipped 5 minutes in fungicide, and covered one hour.
	Uspulun	0·25%	
	Germisan	0·25%	
Presoak and soak	Semesan	0·3%	Seed first soaked 6 hours in water, and drained. Further procedure as under "Soak."
	Uspulun	0·25%	
	Germisan	0·25%	
Dust	Semesan	.....	The dusts, except sulphur, were applied at the rate of 2 oz. per bushel for wheat and 3 oz. per bushel for the other grains. The seed was shaken in a small container with the proper amount of dust until the seed was evenly coated. Sulphur applied at rates of 4 oz. and 8 oz. per bushel to all the grains.
	Uspulun		
	Copper carbonate (Nichol's)		
	" " (Corona)		
	" " (Fox)		
	Nickel carbonate (International)		
	Dupont 13		
	Suplhur "superfine"		

SEED TREATMENT FOR THE CONTROL OF (a) BUNT *(Tilletia Tritici)* IN WHEAT, (b) COVERED SMUT *(Ustilago Hordei)* in BARLEY, and (c) COVERED SMUT *(Ustilago levis)* IN COMMON AND HULLESS OATS.

Treatment	Percentage of Smut in			
	Wheat	Barley	Hulless Oats	Common Oats
Formalin sprinkle	0·8	2·7	14·9	1·2
" dip)	1·0	3·8	42·3	0·4
Semesan sprinkle	25·5	17·0	40·5	15·0
" dip	7·0	7·8	31·9	12·8
" soak	5·3	7·8	16·4	5·7
" presoak and dip	5·8	11·9	14·9	10·1
" presoak and soak	4,8	6·8	13·5	3·5
Uspulun sprinkle	11·5	6·9	18·0	8·8
" dip	2·0	3·7	22·3	6·7
" soak	1·8	2·3	11·3	2·0
" presoak and dip	3·2	4·8	14·4	4·1
" presoak and soak	1·5	3·7	9·7	2·0
Germisan sprinkle	0·8	4·7	16·4	12·5
" dip	trace	3·6	12·3	14·8
" soak	0·3	2·3	10·9	4·3
" presoak and dip	0·7	5·3	10·4	4·3
" presoak and soak	trace	4·5	12·8	0·3
Chlorophol soak	6·8	3·7	22·8	2·9
Semesan dust	2·0	6·2	14·3	4·2
Uspulun dust	2·5	3·9	36·4	9·9
Copper carbonate (Nichol's)	7·3	3·6	3·3	1·3
Nickel carbonate (International)	12·3	1·9	3·4	0·2
Dupont 13 dust	12·7	8·6	58·5	13·0
Check (no treatment)	22·7	7·9	52·2	13·1
Corvusin sprinkle	2·5*	9·3	41·4	3·3
Copper carbonate (Fox)	2·3*	4·8	4·8	1·5
Copper carbonate (Corona)	.....	6·2	4·9	1·2
Sulphur dust, 4 oz per bushel	9·3*	1·1	3·8	0·2
" 8 oz. per bushel	8·3*	0·9	1·8	0·2
Check	30·8*	.....	.....	.....

* Results obtained as part of another experiment, planted May 8.

Only a brief discussion of the results recorded in the table may be given, since one year's results cannot be considered as final.

On account of the low percentage of covered smut in the untreated plots of barley, it is impossible to draw any conclusion. Sulphur dust reduced the smut from approximately 8 per cent to 1 per cent. Other treatments were less effective, or actually increased the amount of smut.

The results obtained with the organic mercury compounds are disappointing in the light of the favourable reports of other workers. Semesan failed to control in any of the treatments, Uspulun was somewhat better, while Germisan gave good control of wheat bunt. The directions for dissolving these substances in water were carefully followed. Possibly the hardness of the water may have precipitated some of the mercury out of solution. Whatever is the cause of the failure it has not been accounted for. Since the treatments were carried out simultaneously in the same solution for each of the compounds respectively, the variations from cereal to cereal and from treatment to treatment should be significant. Semesan and Uspulun were also used as dusts, and gave fair control of wheat bunt.

The dusts were not as effective as might be expected. The seed was more heavily smutted than it usually is as it comes from the thresher. The results show that the dust treatments will be ineffective in the control of smut in heavily smutted grain. The copper carbonate dusts were fairly successful in the control of smut. The nickel carbonate dust gave very low percentages with oat smut. Sulphur gave strikingly low percentages with both oats and barley. As has been already shown, sulphur does not control bunt in wheat. Dupont 13 dust failed to control any of the smuts.

"Corvusin," apparently a creosote oil, is a very disagreeable substance to handle and does not look promising.

A number of additional substances were tested in a separate experiment as dusts for the control of wheat bunt. The results are as follows:—

Corona 610	1·3	per cent of	bunt
" 620	0·2	"	"
" 640	1·7	"	"
" 640 S	12	"	"
Copper sulphate (monohydrate)	0·5	"	"
Copper and calcium carbonate 1: 1	3	"	"
Nickel carbonate (Delow)	8	"	"
Nickel hydroxide (caustic precipitation)	9·7	"	"
" " (lime precipitation)	9·5	"	"
Nickel sulphide	6·8	"	"
Paris green	0·7	"	"
Check—No treatment	30·8	"	"

Most of these dusts were rather coarse, and the rate of application was increased to 3 ounces per bushel. The Corona dusts 610, 620 and 640 look promising. The nickel compounds were not so effective. Paris green gave very low percentage of bunt, but seed treated with Paris green showed marked seed injury when germinated on blotting paper, although in the parallel germination in soil no injury was apparent. This raises the question whether dusts, which contain a soluble fungicide, can be used. Copper carbonate and many of the other dusts tested are relatively insoluble. It has been shown by many workers that copper carbonate causes an insignificant amount of seed injury and that the seed may be treated some time in advance of sowing.

THE EFFECT OF THE SPORE LOAD ON THE CONTROL OF BUNT WITH COPPER CARBONATE

Seed of two varieties of red spring wheat, Prelude and Marquis, was smutted at different rates. When one part of smut spores was applied to 30 parts of seed by weight, the spore load was heavier than would occur naturally. The brush was filled with spores, masses of spores were lodged in the crease and the seed coat appeared speckled from the smaller masses of spores scattered over the surface. With one part of smut to 100 parts of seed the smut just filled the brush completely. When one part of smut was shaken with 500 parts of seed, the brush carried a medium load of spores. With the rate of smutting reduced to one to 1,000 the seed was just visibly smutted, while at the rate of one to 2,000 the seed appeared free of smut. The lots of the two varieties thus prepared were then treated with two different commercial brands of copper carbonate at the rate of 1, 2, 3, and 4 ounces per bushel respectively.

The different treatments and the checks were sown in single rod rows replicated twice. Two counts of 100 each were made from each row. The percentage of smut in any treatment was therefore based on the total count of 600 heads.

EFFECT OF SPORE LOAD ON THE CONTROL OF BUNT WITH COPPER CARBONATE—PERCENTAGES OF BUNT OBTAINED

Treatment	Prelude—Rate of Smutting					Marquis—Rate of Smutting				
	1:30	1:100	1:500	1:1000	1:2000	1:30	1:100	1:500	1:1000	1:2000
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Check—No treatment	87·3	82·5	40·2	27·2	11·3	42·2	37·3	22·3	10·0	7·8
Copper carbonate—										
Corona 1 oz. per bushel	77·7	44·8	16·8	5·0	4·2	34·2	21·2	3·3	1·0	1·0
" 2 "	72·7	44·8	5·0	2·0	2·3	28·0	11·8	0·8	trace	0·3
" 3 "	58·0	25·0	5·2	0·3	1·0	26·3	11·8	0·3	0·5	0·3
" 4 "	55·5	18·5	3·3	0·8	0·2	17·5	8·7	0·2	0·3	trace
Nichol's 1 oz. per bushel	79·2	53·8	12·2	3·3	2·2	37·5	25·5	2·5	1·8	0·5
" 2 "	72·2	35·5	4·5	0·8	0·7	35·3	21·8	0·8	0·7	0
" 3 "	64·7	34·8	4·3	1·0	0·5	34·0	15·3	0·3	0·2	0
" 4 "	59·7	29·2	1·7	0·7	0·3	23·5	14·2	0·2	0·3	0

It is evident that Marquis wheat is more resistant to the bunt fungus (*Tilletia Tritici*) used than Prelude. The greater the number of spores present on the seed the heavier the infection obtained in the resulting crop.

The results show conclusively that when seed is very heavily smutted, copper carbonate dust cannot be relied upon to control the smut completely. The seed cannot carry the combined spore and dust load. Thus a great deal of the copper carbonate falls off the seed and its effect is lost. Some other treatment therefore, such as the standard formalin method, should be used when seed carries excessive quantities of smut spores.

These two commercial brands of copper carbonate seem to be about equally effective. The manufacturers of Corona guarantee at least 18 per cent copper in their product. It is possible that the failure of these two brands of copper carbonate to give as high absolute control with the susceptible Prelude as with Marquis may be due to their low copper content. No pure copper carbonate was available when this experiment was run.

In the light of the results reported, 2 ounces of copper carbonate will give as high control as 3 or 4 ounces, provided the seed is not excessively smutty.

DISTRIBUTION OF *TILLETIA TRITICI* AND *TILLETIA LAEVIS* IN WESTERN CANADA

It seemed desirable to determine which species of *Tilletia* were responsible for bunt of wheat in Western Canada. *Tilletia Tritici* has been reported as confined to the Pacific coast of the United States, while *Tilletia laevis* is held responsible for the bunt of wheat in the important red spring wheat and winter wheat areas of the United States. Mr. Serls, Chief Inspector of Grain, at Winnipeg, Man., kindly supplied samples of smutty grain from the 1924 crop. Separate samples were taken from 27 cars of smutty wheat, received during approximately a month (Oct. 15 to Nov. 15). The cars were from 22 places, distributed as follows: 1 sample from 1 place in Manitoba, 6 samples from 6 places in Saskatchewan, and 20 samples from 15 places in Alberta.

Bunt balls picked out of these samples were examined under the microscope. In 6 samples *Tilletia Tritici* only was observed, and in 8 more *T. Tritici* predominated. In 4 samples *Tilletia laevis* only was found, while in 6 others it predominated. Three samples contained bunt balls of the two species in about equal proportions. In eight additional samples from the Chief Inspector of Grain at Edmonton, collected from cars from central and northern Alberta, seven yielded *T. Tritici* only and one mixed with *T. laevis*.

Tilletia laevis seems confined largely to the southern part of Western Canada, but one bunt ball of three present in a sample from High River, Alta. (township 74, range 16, west of the 5th Meridian), the most northerly and westerly point, from which a sample was examined, was *Tilletia laevis*. On the other hand, a sample of Durum wheat from Gravelbourg, Sask. (township 10, range 5, west of the 3rd Meridian), was mostly *Tilletia Tritici*. This species was also present in many other samples collected in the southern part of the three provinces. There is, therefore, no sharp delimitation of the area occupied by either species, although *Tilletia Tritici* seems to predominate in the northern areas.

Twenty of the twenty-seven samples examined from the Winnipeg office were from Alberta, but the bulk of the grain shipments were from Saskatchewan, Alberta taking second place, with Manitoba third during the period that the samples were collected. This would suggest that bunt was worst in Alberta.

RESISTANCE OF WHEAT VARIETIES TO BUNT

A preliminary experiment was run this year on the resistance of a number of wheat varieties to bunt. Dr. E. C. Stakman, Minnesota Agricultural Station,

University Farm, St. Paul, kindly supplied the seed of the different varieties. The seed was artificially smutted at the rate of one part of smut to 100 parts of seed by weight. Percentages of smut are based on two counts of 100 heads each, from single rod rows of each variety. The numbers in brackets after the name of the variety or selection are the Cereal Investigations accession numbers, under which they are entered by the United States Department of Agriculture.

RESISTANCE OF WHEAT VARIETIES TO BUNT

SERIES (A): VARIETAL RESISTANCE TO *Tilletia Tritici*

Variety	Percentage of smutted heads	
	Partial	Total Number
Vulgare group:		
Minn. 163 (2873) 22	10·5	71·5
Minn. 163 (2873) 73 (Glyndon Fife)	4·5	75·0
Haynes Blue Stem (2874)	6·0	49·5
Minn. 188 (2958)	6·5	67·0
Marquis (3641)	21·0	48·5
Power (3697)	16·0	56·0
Ruby, Ottawa 623	13·5	43·0
Kitchener (4800)	12·5	56·5
Red Bobs (6255)	5·0	43·5
Preston (3081)	7·5	75·0
Kota (3878)	18·5	75·0
Prelude (4233)	4·0	84·0
Hard Federation (4733)	8·0	57·0
Red Bobs (2157)	7·5	73·0
Stanley Fife (1594)	17·5	68·0
Glyndon Fife	7·0	81·0
Washington Club (4066)	0·5	82·5
Emmer group:		
Kubanka (4063)	11·0	30·5
" (1354)	19·0	37·0
" (2094) 13	10·5	23·5
" (2094)	12·0	20·0
" (2234) 5	14·0	42·0
" (2234) 14	17·0	35·0
" (2952)	10·0	26·5
Arnautka (1431)	8·0	65·5
" (1494)	11·5	38·5
" (1537)	12·0	35·0
Mindum 19	11·0	35·0*
Acme (5284) 17	4·0	73·0
Monad (3320)	9·5	48·5
Pentad (3322)	11·0	37·0
Kahla (2088) 4	9·0	15·0
Peliss (1584)	7·0	22·5
Iumillo (1736)	11·0	29·5
Bolley D 7 (3233)	12·5	60·5
White Spring Emmer (1524)	31·5	36·5
Khapli (4013)	29·5	57·5
Einkorn group:		
Einkorn (4013)	32·0	59·0

SERIES (B): VARIETAL RESISTANCE TO *Tilletia laevis*

Variety	Percentage of smutted heads	
	Partial	Total number
Haynes Blue Stem (2874)	7·5	68·0
Kota (3878)	6·0	86·5
Ruby, Ottawa 623	22·0	36·5
Arnautka (1493)	17·5	43·5
Acme	12·0	70·0
White Spring Emmer**	13·5	13·5

* Based on a count of 100 heads.
** Enclosing chaff not removed.

The varieties differ considerably in their resistance to bunt as shown in the table. Kahla showed only 15 per cent, while Washington Club developed 82.5 per cent of bunt. In general the Durums gave the lowest percentages. The Emmers and Einkorn were moderately susceptible, contrary to the report of other workers. This may be due to the removal of the chaff from the seed. Since commercial varieties of wheat thresh clean, it would seem that, to obtain a fair test with Emmers and Einkorn, the chaff should be removed. Since partially bunted heads cannot be detected unless the lower glumes are cut through with the scissors, especially in the Durums, Emmers, and Einkorn, this may be another reason that no smut has previously been reported in Einkorn and low percentages in Emmer. The few varieties that were smutted with both *Tilletia Tritici* and *Tilletia laevis* showed no marked difference in their behaviour, except white Spring Emmer. The chaff was not removed from the seed before smutting, and it is suggestive of the protection afforded to the seed by the enclosing glumes.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, INDIAN HEAD, SASK.

(P. M. Simmonds, Plant Pathologist, Officer in Charge)

This report includes only the summer work for 1924. Although the officer in charge has been on leave of absence to carry on, during the winter months, his studies and research work on cereal diseases at the University of Wisconsin, the summer work at the field laboratory has been carried on as usual. The work during the summer consisted chiefly of stem rust epidemiology studies in co-operation with the other western laboratories, collecting data and material for the root rot projects and other projects outlined, making plant disease survey observations, and taking plant disease notes in co-operation with other members of the Experimental Farm staff.

STEM RUST STUDIES

This work was carried on under the direction of the officer in charge at the Saskatoon laboratory, and consisted in making epidemiology observations throughout southern Saskatchewan, and collecting specimens at different points for stem rust strain work. In connection with the stem rust studies some spore traps were run at Indian Head throughout the season in an attempt to determine, to some extent quantitatively, the time of appearance and amount of urediniospores of *Puccinia graminis*, Pers. carried in the air. Large microscope slides were used for spore traps; these are about twice the size of the ordinary slide. They were coated on one side with a suitable mixture of glycerine and alcohol. Fifteen such slides were exposed daily, when possible, covering a period of 3 months (July-September), five each at three different locations. Other types of spores were commonly found and these are being recorded. The types of spores so far recorded are *Puccinia graminis* urediniospores, conidia of *Helminthosporium teres, H. gramincum, H. sativum, Fusaria,* and *Alternaria.* Because of the necessary absence at times of the officer in charge from Indian Head, accidents, and rain, the records are somewhat irregular.

PROJECTS

This season there appeared to be considerable evidence of severe and widespread root rot injury, especially in the wheat crop. Whether or not this was attendant upon the unusually dry spell, while the plants were in the seedling stage, remains for further study. A good amount of material and data was

obtained, which should be valuable in the pursuance of the root rot projects relating to injury caused by *Helminthosporium sativum* (P.) K. & B. and *Fusarium* spp.

Some material was collected in continuance of the work on *Fusarium* root rot of oats and *Fusarium* head blight of cereals in general. This material is being studied in its different phases at the University of Wisconsin.

PLANT DISEASE SURVEY NOTES

The plant disease survey notes were made while doing the stem rust epidemiology survey, and these were forwarded to the Central Farm laboratory for compilation. The collection of an unusual disease of barley was of interest.

Dilophospora graminis, Desm. on barley. In a field of barley at Carlyle, Sask., several plants were noticed to have twisted and otherwise distorted heads. A careful examination revealed on some of these heads a rather firm and distinct fungous growth as well as a considerable number of dark spots on the leaves in which pycnidia were formed. A microscopical examination revealed the presence of an unusual fungus. This was later determined by Dr. J. J. Davis of the University of Wisconsin as *Dilophospora graminis*, Desm., a fungus not uncommonly occurring on grasses, but apparently it has not been reported to any great extent as occurring on cereals. The disease was certainly not common. It was present in only a very small area near the edge of the field, where it may have come from nearby grasses. The plants attacked, however, were severely injured.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, SASKATOON, SASK.

(In Co-Operation With the University of Saskatchewan)

(W. P. Fraser, Plant Pathologist, Officer in Charge)

The work of the laboratory was carried on during the year with Mr. R. R. Hurst as assistant pathologist, and Mr. R. C. Russell as summer assistant. Mr. C. E. Maguire was engaged in barberry survey and extermination, but most of his time was spent in Manitoba.

The following is an outline of the experiments carried out during the year, and the results obtained.

TESTS OF RUST RESISTANT VARIETIES

The testing of varieties of wheat for resistance to the stem rust was continued. These included varieties generously furnished by Professor Hayes, of Minnesota Agricultural College, and other promising varieties, as well as the wheats commonly grown in Western Canada. These were seeded at a number of stations, through the co-operation of the staffs of the Dominion Experimental Farm and the Dominion Laboratories at Winnipeg and Brandon. The seeding was late so as to expose the rows to as severe rust conditions as possible. The season was very dry in central and northern Saskatchewan, and in consequence practically no rust developed. There was more stem rust at the stations in Manitoba and southern Saskatchewan, but it was not severe. An estimate of the percentage of rust present in the rows is given in the annexed table. As the rows were rather green when the first estimate was made at Winnipeg, a second estimate was made about a fortnight later by Dr. D. L. Bailey. Both of these are included in the table.

ESTIMATED PERCENTAGE OF STEM RUST ON VARIETIES OF WHEAT

Experimental Stations	Date sown, 1924	Date examined, 1924	1 Marquis	2 Marquis x Kanred 11-18-8	3 Marquis x Kanred 11-18-10	4 Marquis x Kanred 11-19-7	5 Marquis x Kanred 11-15-57	6 Marquis x Kanred 11-15-58	7 Marquis x Kanred B2-5	8 Marquis x Kanred B8-11	9 Kota Natural Cross	10 Kota 255M	11 Kota 30F	12 Marquis x Iumillo 11-15-43	13 Marquis x Iumillo 11-15-44	14 Marquis x Iumillo 11-15-51	15 Marquis x Iumillo 11-15-55	16 Marquis x Iumillo 11-55-59	17 Marquis	18 Reward	19 Kitchener	20 Marquis (Parker's Selection)	21 Red Bobs	22 Kubanka	23 Ruby	24 Little Club	25 Iumillo	26 Acme	27 Monad	28 White Spring Emmer
Morden	May 14	Aug. 13	45	40	40	35	40	45	40	40	20	15	15	5	3	10	20	15	35	35	50	30	33	3	45	80	tr.	tr.	tr.	tr.
Winnipeg	May 17	Aug. 14	40	40	35	35	35	35	35	40	20	25	22	5	3	10	15	12	40	30	40	15	35	5	40	60	tr.	tr.	tr.	0
		Aug. 29	75	85	85	70	80	85	85	95	40	25	30	40	20	55	60	50	80	75	85	40	70	35	70	60	tr.	tr.	tr.	tr.
Brandon	May 15	Aug. 16	45	30	20	15	15	20	15	15	2	4	3	1	1	5	5	5	30	20	50	7	15	2	40	75	tr.	tr.	tr.	0
Indian Head	May 16	Aug. 26	10	10	7	7	8	10	9	10	5	12	9	3	3	4	5	5	8	6	12	tr.	4	tr.	7	60	0	tr.	tr.	0
Saskatoon	May 14	Aug. 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rosthern	May 14	Aug. 27	tr.	tr.	0	tr.	0	0	0	tr.	tr.	0	0	tr.	0	0	0	tr.	tr.	0	0	0	0	0	0	tr.	tr.	tr.	tr.	tr.
Scott	May 15	Sept. 3	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	5	tr.	tr.	tr.	tr.	10	tr.	0	tr.	0
Lacombe	.....	Sept. 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

As in last year's tests (see Report of Division of Botany, 1923: 38), the Marquis Iumillo hybrids of Professor Hayes proved markedly resistant, and the Marquis Kanred crosses susceptible. The Durums, Acme, Monad, and Iumillo proved resistant as in previous experiments. A selection from Marquis by James L. Parker, of Gilbert Plains, was included in the rows. This wheat showed decided resistance, and deserves further trial; but, as agronomists agree that it is not identical with Marquis, tests as to its breadmaking qualities are necessary.

The yield in grams per 16-foot row was taken at all the stations except Brandon and Lacombe, and is given in a separate table. The rows were seeded late and, as the season was dry, germination was poor in some of the rows. This partly accounts for some of the marked variations in yield. Under the very dry conditions a slight variation in the amount of moisture in the soil is the most important factor influencing yield, therefore the yields are not as significant as under more favourable conditions. Nevertheless, the yields of the resistant varieties generally do not differ much from that of Marquis.

YIELD IN GRAMS PER ROW OF SIXTEEN FEET

Variety	Row No.	Winnipeg	Morden	Indian Head	Saskatoon	Rosthern	Scott	Average
Marquis	1	233·2	.....	500·9	177·5	168·1	142·5	244·4
Marquis x Kanred, 11-18-8	2	218·8	379·4	541·2	174·9	99·7	123·5	256·2
Marquis x Kanred, 11-18-10	3	226·8	336·2	550·0	181·9	120·2	140·6	259·3
Marquis x Kanred, 11-19-7	4	263·7	352·2	465·8	223·5	140·5	125·6	261·9
Marquis x Kanred, 11-15-57	5	142·7	383·7	283·0	191·5	175·9	93·4	211·7
Marquis x Kanred, 11-15-58	6	214·7	331·7	550·5	268·4	148·5	89·9	267·3
Marquis x Kanred, B2-5	7	256·5	364·4	583·7	266·4	157·2	117·3	290·9
Marquis x Kanred, B8-11	8	276·3	433·3	338·0	260·3	138·3	128·9	262·5
Kota (Natural Cross)	9	165·0	427·5	278·7	237·5	142·6	90·5	223·6
Kota 255M	10	256·5	394·0	536·5	241·8	166·4	109·3	284·1
Kota 30F	11	185·0	416·2	366·1	225·9	148·2	103·8	240·9
Marquis x Iumillo, 11-15-43	12	384·1	397·0	275·0	198·5	185·1	92·8	255·4
Marquis x Iumillo, 11-15-44	13	263·2	517·9	304·1	219·5	164·9	103·4	262·1
Marquis x Iumillo, 11-15-51	14	305·5	479·9	300·0	207·6	202·1	101·6	266·2
Marquis x Iumillo, 11-15-55	15	263·3	533·5	374·1	169·0	171·6	74·8	264·4
Marquis x Iumillo, 11-15-59	16	262·2	633·2	390·5	225·6	194·3	77·3	297·2
Marquis	17	234·8	513·5	414·7	191·5	277·6	94·7	287·8
Reward	18	180·7	426·1	275·7	168·7	185·0	83·1	219·9
Kitchener	19	153·4	.....	.....	201·8	181·3	118·8	.....
Marquis (Parker's Selection)	20	241·9	530·5	270·5	196·1	148·4	94·8	247·0

PHYSIOLOGICAL VARIETIES OR STRAINS OF STEM RUST

The determination of the physiological varieties or strains of stem rust was continued. The determination of the collections made in 1923 was completed and the following strains recognized:—

II. From Saskatoon (collection on barberry) in Saskatchewan.

III. From Winnipeg in Manitoba. Carlyle (2 collections), Rosthern, Saskatoon (collection from barberry), Saskatoon (2 collections), Muenster in Saskatchewan; and Wainwright and Camrose in Alberta.

XI. From Winnipeg, Dauphin, and Treesbank in Manitoba; and Rosthern, Arcola, and Saskatoon in Saskatchewan.

XVII. From Brandon and Morden in Manitoba; Estevan, Carlyle (2 collections), Battleford, Shellbrook, and Rouleau in Saskatchewan; Edmonton and Wainwright in Alberta.

XXI. From Brandon and Morden in Manitoba; Battleford and Shellbrook in Saskatchewan; Edmonton in Alberta.

XXXIV. From Indian Head, Carlyle, and Watrous in Saskatchewan.

From collections made in 1924, as far as the determinations have been completed the following strains were found:—

III. From Emerson in Manitoba, Swift Current, Rosthern (2 collections), Antler, Truax, Shaunavon, Saskatoon in Saskatchewan; and Edmonton in Alberta.

XI. From Morden (2 collections), Melita, and Virden in Manitoba; Antler and Oxbow (2 collections) in Saskatchewan.

XII. From Brandon and Virden in Manitoba.

XVII. From Emerson in Manitoba.

XXXIV. From Winnipeg in Manitoba; Yorkton and Indian Head in Saskatchewan; and Lacombe in Alberta.

The most striking result in the list of strains determined for 1924 is the few collections of strain XVII. This has in the past been the most prevalent strain over the wheat growing districts of Western Canada. This year it was not often collected. It was noted this season that the Durums, such as Kubanka, were not heavily rusted as in previous years. This was probably explained by the small amount of strain XVII present, and the prevalence of strains to which the Durums, as Arnautka and Kubanka, are resistant, as strain III.

WINTERING-OVER OF THE UREDINIOSPORES OF STEM RUST

Tests of the germination of the urediniospores of stem rust (*Puccinia graminis*) were made in the spring and early summer. All the collections tested were obtained from *Hordeum jubatum* or wheat exposed during the winter. The spores from one of the collections on *Hordeum jubatum* germinated about 1 per cent, but no germination was obtained from the other spores tested. The conditions during the winter were probably not favourable for the over-wintering of urediniospores. Observations were made during the summer on susceptible grasses, but no evidence of their being infected before wheat was obtained, as would probably be the case if stem rust wintered over on grasses. The season was very dry and not favourable for infection, and only a very slight development of rust resulted on wheat in central and northern Saskatchewan, except on very late grain. Very little rust was present in the region covered by the observations made from this laboratory (i.e., central and northern Saskatchewan and Alberta).

SPORE TRAPS

A number of spore traps for determining the spore content of the air were exposed from June 12 to October 12, but owing to the pressure of other work no traps were exposed between August 11 and October 2. The chief object of these experiments was to determine the time of the appearance of the urediniospores of stem rust. The most common spores obtained in the traps were of the following genera:—

Heterosporium, Alternaria, Helminthosporium, Fusarium, Ustilago, Oidium. The urediniospores of *Puccinia graminis* were not collected till the exposure of October 2, but, as was pointed out, no exposures were made between August 11 and October 2.

BARBERRY SURVEY

Mr. C. E. Maguire was engaged in barberry survey and eradication during the summer, but spent most of his time in Manitoba, where more barberries had been located. He succeeded in having eradicated practically every barberry bush located in Saskatchewan. A hedge at Regina was removed under the direction of Mr. M. P. Tullis, Field Crops Commissioner of the Department of Agriculture, Regina. The following barberries were removed: A hedge at Outlook, 12 bushes in Saskatoon, 3 in Prince Alberta, 12-foot hedge in Battleford, 4 bushes in North Battleford, one at Imperial, and several shoots springing up from old roots at Indian Head. One bush was located late in the season at Battleford which the owner promised to remove, and about a dozen shrubs in Saskatoon still remain which have never been infected by rust. These will be removed in the early spring. A number of places were resurveyed during the year, but no new barberries were located, except one at Battleford.

THE CROWN RUST OF OATS AND BUCKTHORN SURVEY

There was a considerable amount of infection of crown rust on the cultivated Buckthorn, *Rhamnus cathartica*, but little developed on oats, doubtless due to the dry weather conditions. In 1923 crown rust was very severe on the Buckthorn and oats in Saskatchewan, and observations made at Indian Head and other places indicated that the buckthorn was directly responsible for heavy infection on oats. A survey of cities and most of the towns in Saskatchewan was made in 1923, but was omitted from the report of that year. It was found that large numbers of buckthorn have been planted in the cities and some of the larger towns, but that few are present in the smaller towns. In Saskatoon there were over 3,000 feet of hedge, over 2,000 in Regina, and over 4,000 at Estevan. There are also hedges at Weyburn, Moose Jaw, Lumsden, Indian Head, Humboldt, Prince Albert, and a smaller number in a few other places. Most gratifying co-operation was obtained from the manager of the Prairie Nurseries at Estevan, who willingly agreed to remove the buckthorn in his nursery, and substitute some other shrub in future orders.

Aecia of the crown rust are found on the native buckthorn, *Rhamnus alnifolia* L'Hér. Inoculations were made on a number of oat plants with these aecia, but only a few small uredinia developed. It is evident that oats are not congenial hosts for the rust from the native buckthorn. Inoculations on grasses from the aecia on *Rhamnus alnifolia* resulted in heavy infection on *Scolochloa festucacea* and *Calamagrostis canadensis*. The aecia on the native buckthorn, therefore, belong to a form of the crown rust on grasses.

Inoculations were also made on oats with aecia from the cultivated buckthorn, *Rhamnus cathartica*. All the inoculations resulted in heavy infection.

Aecia which are usually assigned to a form of the crown rust are very common on the buffalo-berries, *Shepherdia argentea, S. canadensis,* and the silver berry, *Elæagnus commutata.* Experiments were tried to determine their relationship to the crown rust of oats. Many inoculations were tried on oats, but without result. Inoculations with the aeciospores from *Elæagnus* resulted in heavy infection on *Calamagrostis inexpansa,* and the aeciospores from *Shepherdia canadensis* infected heavily several of the Brome grasses. No infection was obtained in the inoculations with the aecia from *Shepherdia argentea.* A full report of this work will be published elsewhere.

THE "TAKE-ALL" DISEASE OF WHEAT

In last year's report the presence of "take-all" foot-rot of wheat was reported in one field in northern Saskatchewan. A study of this disease was begun.

Field Experiments.—Through the co-operation of the owner of the field a number of spring wheat varieties were seeded in the part of the field which was worst infected the previous season. The object was to determine if any of the varieties suitable for Western Canada would show resistance. Plots of the following varieties were seeded: Marquis, Ruby, Red Bobs, Golden, Preston, Acme, Kota, and a Marquis Kanred hybrid (Minn. 11-18-8). Plots of Marquis wheat, treated with Semesan, sulphur and copper carbonate dust, and Uspulun (wet treatment), were also seeded. The owner sowed the remainder of the field to Marquis. No foot-rot appeared in the field, either in the experimental plots, or in the Marquis seeded by the owner. The season was very dry and this may have been the reason for the lack of appearance of the foot-rot. However, in a part of a neighbouring field, there was a considerable amount of foot-rot found with the development of the mycelium and perithecia of *Ophiobolus cariceti* on the bases of the stems. It was rather remarkable that the foot-rot appeared under the same conditions as last year. In both cases it was the second year after breaking the prarie; that is the prairie was broken, seeded to wheat, and the next season the ground was ploughed, which would bring the prairie sod again to the surface. This suggested that the "take-all" fungus may be present on the prairie grasses. The native grasses were carefully examined without finding any evidence of the "take-all" fungus. A survey was made of fields in the district and in other places, where foot-rots of various kinds had been reported the previous season, but no evidence of *O. cariceti* was found. In many places, however, the wheat suffered so much from the lack of moisture, that it was very difficult to locate root-rot of any kind.

Cultural Study.—A preliminary cultural study of the fungus has been made by Mr. R. C. Russell and its pathogenicity tested on wheat, grown in tubes under sterile conditions, and in pots in the greenhouse. Wheat plants were grown in the greenhouse on soil from the diseased areas of the field, and root-rot developed with the production of the mycelium and perithecia of *O. cariceti.* The seedlings from wheat kernels inoculated with the mycelium of *Ophiobolus* and planted in pots of clean soil developed seedling blight and foot-rot, and, later, perithecia of *Ophiobolus.* Wheat seedlings grown in tubes under sterile conditions inoculated with the mycelium of *Ophiobolus* were killed, and the perithecia of *O. cariceti* developed. The spores from perithecia obtained from the stubble after overwintering in the field under natural conditions gave good germination, showing that the spores in the perithecia can withstand the severe conditions prevalent in the winter. Spores from material kept in the laboratory all winter were also viable in the spring.

The cultural and pathogenic studies are being continued, also the field survey will be continued next season.

Wojnowicia graminis.—Late in the fall a field at Senlac having been reported to be attacked by foot-rot, Mr. Hurst collected stubble from the diseased areas. On the bases of the stems and the adhering sheaths the pycnidia of *Wojnowicia graminis* were present. The fungus was later found to be associated with the *Ophiobolus* foot-rot. This suggested that it might be a pycnidial stage of the fungus causing that disease. The growth in culture, however, is so different, that it does not seem probable that it is related. Pathogenic studies by Mr. Russell in the laboratory indicated that it was a weak parasite, but the studies were not extensive enough to draw definite conclusions. On the host this fungus resembles *Ophiobolus cariceti* in the massing of dark mycelium, and the beaked pycnidia bear a close resemblance to the perithecia of *Ophiobolus.* The pycnidia usually develop more abundantly in the free leaf sheaths than the perithecia of *Ophiobolus,* and are surrounded by loose wefts of mycelium. The presence of bristles around the ostiole of the pycnidia is also a distinguishing character. The laboratory and greenhouse investigations of this fungus are being continued.

GLUME BLOTCH OF WHEAT

Glume blotch of wheat was very severe in 1923 on wheat in some districts, causing much injury. Collections of diseased heads were made in the spring of 1924, and the spores from the pycnidia present were tested for germination. Nearly 100 per cent germination was obtained, showing that the vitality of the spores in pycnidia is not affected by the winter. Probably the dry season prevented the general recurrence this season, but in some districts the disease was again severe. It seems probable that only the dry season prevented the recurrence of the disease in a more severe form than in the preceding season.

THE BROWNING AND STEM-BREAK DISEASE OF CULTIVATED FLAX

In 1923 a disease was found to be doing serious injury to the flax at the University of Saskatchewan. Investigation showed this to be similar to a disease which has been affecting the flax crop in Ireland for several years, the causal organism of which is *Polyspora Lini,* a new genus and species named and described by H. A. Lafferty in Volume 16 of the Proceedings of the Royal Dublin Society for 1920-22.

A project was outlined for the purpose of studying this disease under Saskatchewan conditions. Several varieties of flax were grown in the field, and these, along with all the University flax plots, were kept under observation. In late July the browning and stem-break continued throughout the growing season, to only a slight degree, however.

Flax was found to be affected with stem-break at Melville, Humboldt, Scott, Fielding, and Waldron. The season being a particularly dry one, it is highly probable that the disease was held in check by the dry conditions. The study of the disease is being continued. The work on this project was carried out by Mr. Hurst.

REPORT OF THE DOMINION FIELD LABORATORY OF PLANT PATHOLOGY, SUMMERLAND, B.C.

(H. R. McLarty, Plant Pathologist, Officer in Charge)

Winter conditions in 1923 and 1924 were very unfavourable to late maturing varieties of apples in the northern end of the Okanagan valley. Such varieties as Newton and Delicious suffered severe winter killing. From a study of the conditions in the worst affected orchard, where about 90 per cent of the Newtons were killed, and about 50 per cent of the Delicious, it would appear that the trouble was brought about by a lack of maturity in the trees when the early winter frosts came. Early maturing varieties, such as Gravenstein, Grimes, McIntosh, and Wealthy growing beside the later varieties, came through without injury.

An exceptionally dry spring and early summer, one of the driest on record, was unfavourable to the spread of fungous diseases, and the losses from such were consequently light. Scab and peach leaf-curl infections were slight, and powdery mildew was not severe enough generally to justify the undertaking of control measures. These climatic conditions were also very favourable for the prevention of blossom blight in pears and apples, and, as a consequence, the resultant loss from this cause was much less than usual.

Corky core occurred in a few orchards in both the Salmon Arm and Okanagan districts. As a rule, the injury occurred somewhat late in the season, and in the McIntosh variety was confined rather more to the flesh than to the core area as described in last year's report.

A very severe outbreak of gum spot or drought spot of prunes (see report of the Dominion Botanist, 1923) occurred in the Vernon area. The trouble was confined to orchards which had been allowed to become very dry, and to those which were suffering from an undue amount of seepage.

Losses from bitter pit were much above the average. The exceptionally dry spring and the usual delay in applying the first irrigation, were responsible, no doubt to a very large extent, for its unusual severity. The importance of early irrigation under such climatic conditions cannot be too strongly recommended.

Jonathan breakdown appeared more commonly this season than last, and, on late picked varieties especially, brought about comparatively heavy losses. Climatic conditions were such as to bring about maturity two weeks earlier than normally. Because of these conditions, and because of the known susceptibility of Jonathans to breakdown if left too long on the trees, warnings were sent out to the growers through the press, to exercise care to get the crop harvested in good time.

An unfamiliar spot on Newtons attracted considerable attention. It occurs usually on the stem end, is irregular in shape, and in colour is a light brown in the centre and margined with a purplish line. It is confined to the surface and does not enter into the flesh of the fruit. It is considered by some investigators that the trouble is related to early frost injury.

Phoma rot on beets made its appearance as a crown injury to stecklings of the long, red mangel. Affected crowns were characterized by a superficial, dead area, which did not extend into the heart of the root. Many of the buds on affected roots were killed, and others showed weak germination when planted. The infection observed was very limited, but, where it occurred, the yield of the seed crop was reduced from 50 per cent to 75 per cent.

AN EXPERIMENT TO DETERMINE WHETHER FIRE BLIGHT IS SPREAD BY PRUNING TOOLS IF THESE ARE NOT DISINFECTED WHEN USED IN CUTTING DURING THE WINTER SEASON

In the 1923 report, this experiment was divided into three parts. First, to ascertain the possibility of producing infection by cutting into live cankers with shears or saw and immediately cutting off with the same tool a twig or branch. Second, to determine the possibility of producing infection by pouring a distilled water dilution of the live bacteria over the pruning implement immediately previous to its being used in cutting off a twig or branch. Third, to find out the possibility of producing infection by pouring a distilled water dilution of the bacteria over the pruning implement, dipping the same in mercuric chloride 1:1000, and then pruning.

This year, parts numbers 2 and 3 were discontinued, as the possibilities of producing infection with live bacteria, or of preventing it by the use of disinfectant, were demonstrated sufficiently for our purposes. A seven-year old Winter Bartlett was used, and the same wire-screen cage as used last year was set over it to prevent the spread of any possible infection to the orchard.

Very suitable material was obtained for this year's tests, as all the cankers used in the experiment produced, when under test in the laboratory, vigorous cultures of the organism.

Inoculations were made as follows: February 26, 10 inoculations; February 29, 140 inoculations; March 1, 115 inoculations; March 3, 20 inoculations; March 6, 15 inoculations.

The last inoculations were made about two weeks before any appreciable swelling of the buds was noticeable.

Careful observation was made during the summer, but, of the 300 inoculations made, none produced infection.

THE LONGEVITY OF FIRE BLIGHT BACTERIA IN IMMATURE FRUIT

This experiment follows up the experiment of last year, where an unsuccessful attempt was made to obtain live bacteria from the calyx end of pears and apples gathered in badly blighted districts. The purpose of this year's work was to ascertain whether or not apples, inoculated during the growing season, could, without showing any external evidence of disease, carry in themselves the live organism during their storage period.

On an eight-year-old McIntosh tree, ten apples were inoculated twice every week during the growing season. Tested fire blight cultures were used in every case, and the method of inoculation was to pierce the apple to the core with a sterilized platinum needle well smeared with the organism.

A total of 220 inoculations was made, and the results to date are as follows:—

Rendered unmarketable because of rotting due to the organism, 133.

Dropped prematurely, but with no rotting, 4.

Dropped near the end of the season, but mature enough to store, 29.

Picked at the end of the season and stored, 43.

Missing, 11.

Observations, November 10—Healthy, 69; rotted and oozing at point of inoculation, 3.

Observations, December 10—Healthy, 64; rotted, 5, of which 4 were oozing at point of inoculation.

AN EXPERIMENT TO DETERMINE THE VALUE OF CERTAIN CULTURAL METHODS IN THE PREVENTION OF CORKY CORE IN APPLES.

In this experiment there were four plots placed under four different cultural methods. Plot No. 1—a cover crop of hairy vetch with water; plot No. 2—clean cultivation with the addition of manure and water; plot No. 3—clean cultivation, plus water; plot No. 4—clean cultivation and manure only, no water; plot No. 5—check plot.

In the spring of 1924, manure was applied to plots Nos. 2 and 4 at the rate of 16 tons per acre. During the season, irrigation was applied as needed, there being 12·79 acre inches put on plot No. 1 in three irrigations; 3·89 on plot No. 2 in two irrigations, and 5.64 on plot No. 3 in three irrigations. Soil samples were collected every week and soil moisture determinations made.

The results for this year are presented. It is not the intention of the writer, however, that any definite conclusions should be drawn therefrom, as the disease throughout the district was not nearly as severe this year as it was in the season of 1922.

Results.—Plot No. 1, no corky core; plot No. 2, no corky core; plot No. 3, no corky core; plot No. 4, one tree having corky core; check plot, badly affected.

AN INVESTIGATION OF THE ENVIRONMENTAL CONDITIONS IN ORCHARDS AFFECTED WITH CORKY CORE AS COMPARED WITH SIMILAR ORCHARDS FREE FROM THE DISEASE

The purpose of this experiment is to ascertain, if possible, whether there is any outstanding difference in the factors influencing growth between orchards affected with and free from this disease. Eight plots have been chosen in four different districts. In each district two plots have been chosen with a view to obtaining as many factors as possible in common, such as types of soil, variety and age of trees, etc. In each plot, a study is being made of factors influencing the growth of the tree. During the past season, special attention has been given to soil conditions. Soil samples have been collected from each plot, every week, during the growing season. Soil moisture determinations have been carried out on these in addition to acidity tests and mechanical analysis. Observations and records have also been made on root hair growth, leaf growth, and fruit growth.

A SURVEY OF SOIL MOISTURE CONDITIONS IN THE OKANAGAN VALLEY IN 1924

The purpose of this survey, as outlined in last year's report, is to obtain data on moisture conditions, as it is felt that there lies therein one of the chief factors causing many of our physiological diseases, such as corky core, drought spot, punk, breakdown, etc.

In this study, some 384 soil samples have been tested, their soil moisture, hygroscopic coefficient, and available moisture determined. In this connection, it is the policy of this laboratory to furnish soil moisture determinations for all growers requesting the same.

A BACTERIAL DISEASE OF TOMATOES NEW TO BRITISH COLUMBIA

There occurred this year, in the centre of one of the large tomato-growing areas in the Okanagan valley of British Columbia, a disease of tomatoes that is believed to be new to this province. The preliminary survey which has been carried out would seem to indicate that the trouble is limited to certain particular areas, and is not yet very widespread throughout the tomato-growing districts. Where the disease occurred, considerable uneasiness was felt by the growers lest it become epidemic in nature, and be a serious menace to the industry.

In the worst infection that occurred, the trouble was confined within quite definite areas, and did not total more than one acre in size. In this area the production was cut down approximately 75 per cent. Subsequent examinations in many other fields showed that in some a few scattered plants were affected, but in no place was there such a distinct area as above noted.

The disease was first noted by the grower about June 20 on Earlianas, for which the seed was obtained from a prominent American seed house. The diseased plants were to be found, for the most part, in fairly regular rows and defined areas, seeming to point to the infection of a few flats transferred from the green house. At the time the disease was first noticed the plants had set a good deal of fruit, the largest of which were from one to one and a half inches in diameter. As the season advanced, it was noticed that those plants which had been severely affected early in the year died, but those more lightly attacked matured some fruit. From observations there did not seem to be any very marked spread of the disease during the growing season to the healthy plants in the field. It was also observed that neither the kind of soil nor the amount and times of irrigation had any marked effect on the occurrence of the trouble.

The Symptoms of the Disease.—The first evidence of infection in a plant is to be seen in the sudden wilting down of a leaflet, or perhaps of a whole leaf, with at first no change in colour of the affected tissue. The first leaves affected may occur on almost any part of the plant. The wilted portions turn brown, shrivel, and fall off. The spread of the trouble in the plant is slow, but seems to be more rapid up and down the stem than around, resulting in a defoliation on one side of the plant—a rather distinct characteristic of the trouble. It is at least several weeks before the entire plant becomes affected, and, through loss of foliage, finally succumbs.

On the stems and petioles of the plant, where leaves or leaflets have been destroyed, small, sunken, brown patches occur, accompanied sometimes by longitudinal cracks. Owing to the fact that growth is arrested in any affected tissue, and owing to the slow spread of the disease allowing considerable growth in the plant before other portions become affected, many mis-shapen plants are to be found in a diseased area. Field examinations of the roots failed to show any diseased condition. Cross sections made of the stem and petioles showed that the pith and xylem tissues were browned, especially on the side where the disease was most severe. In inoculations it was found that the disease spreads more rapidly in the pith, running both up and down the stem from the point of inoculation, and that it apparently spreads from the pith into the vessels of the xylem. In badly affected plants it is often found that considerable portions of the pith have completely disintegrated, leaving large, open spaces. Under the microscope, the brown tissues showed the presence of bacteria in considerable numbers, but not massed, within the cells. These bacteria were very small, short, rod-shaped, and apparently non-motile.

Isolations.—In making isolations from the diseased tissue, considerable difficulty was experienced in obtaining pure cultures of any particular organism.

It was found that only by going beyond the brown tissue in the plant were we able to consistently obtain one particular form of bacteria. The method of isolation used was as follows: Portions of affected stems approximately one-half inch in length were immersed for four or five minutes in mercuric chloride 1:1000, next washed in hydrogen peroxide, and then, with flamed scalpel and tweezers, a smaller portion of inner tissue was removed and placed on potato agar. From this, we obtained a slow-growing, yellow bacterial colony, from which inoculations made into healthy tomato plants were capable of reproducing the typical disease.

INOCULATIONS.—Some four hundred and twenty inoculations were carried out during the summer on plants ranging in maturity from those a few inches in height to those already bearing fruit. The points of inoculation were on the stem or petioles of the leaf, and our results have shown that, where the causal organism was present in the inoculum, there was apparently no difference in its pathogenicity when inoculated into any part of the plant above ground.

The method of inoculation used was to pierce the tissue with a sterilized platinum needle well smeared with the organism under test. Check inoculations were made on every tenth plant, the procedure being the same except for the smearing of the needle. Materials used for the inoculations were expressed juices from diseased plants and some twelve different bacterial forms which appeared fairly constantly in our isolations from diseased plants.

Nine inoculations each were also made on young egg plants and young peppers, but with no resultant infections.

The effect on plants growing in inoculated soil was tested also. Seven plants were chosen, all being about four inches high. Around these, the soil was thoroughly punctured with a flamed needle in such a way that wounds would be produced on the small rootlets. The soil was then moistened with a distilled water dilution of the bacteria. Of these seven plants, three took the disease. On a smaller number of checks, treated in the same manner except for the addition of bacteria to the distilled water, no disease occurred.

TRANSMISSION OF THE DISEASE BY SEED.—Seeds were taken from fruits matured on badly diseased plants. These were sown in the laboratory in sterilized soil. The plants are now about five inches high, but, to date, have shown no symptoms of the disease.

CULTURAL CHARACTERISTICS.—In these tests, the formulæ used were, for the most part, those recommended by Conn and Conn in their recent textbook "Bacteriology". Cultures were incubated at a temperature varying from 75° F. to 80° F., except those on gelatin, which were kept from 65° to 70° F.

Growth on plain agar is scanty, spreading, and somewhat raised in elevation, with smooth topography, opaque, light yellow at first, changing to a darker yellow, viscid in consistency, and having no effect on the colour of the medium. On old cultures a distinct iridescence is noticeable on the surface of the culture.

Gelatin Stabs. The line of puncture is filiform, spreading slightly after the seventh day. Liquefaction is slow, beginning on the fifth day, and reaching the bottom of the stab by the twenty-fourth day.

Growth in Broth is slow with clouding; no ring or pellicle is formed, but a small amount of slimy sediment appears.

Fermentation Tubes. Sucrose, lactose and dextrose broths—There is no production of gas; no ring or pellicle is formed in the open end of the tube; a slight cloudiness occurs in each broth; and a small amount of slimy sediment is deposited.

Milk Tubes. By the fourth day a yellow ring appears, followed by a yellow pellicle which gradually deepens in depth; a translucent liquid slowly forms beneath the pellicle and above the surface of the milk. By the twenty-

fourth day this is as much as one centimeter deep. Cultures of this age also show some sediment. No coagulation occurs and the milk gradually takes on a creamy colour.

Litmus milk. A yellow ring, pellicle, and also a translucent liquid occur, as in plain milk. The litmus is reduced and the tubes become a yellowish white.

Brom-Cresol-Purple Milk. Here also a ring, pellicle, and translucent liquid occur as in plain milk, but the colour of the indicator remains practically constant.

The results of these inoculations were as follows: Of 48 inoculations with expressed juices 35 infections resulted. From 64 inoculations with bacteria number one no infection occurred. In inoculations made from bacteria number two, 17 in number, no infection resulted. In each of sets of 9 inoculations made from numbers three, four, and five none of the twenty-seven inoculations showed infection. From bacteria number six, 54 inoculations also failed to produce any infection. Nine inoculations were made from number seven with the same result. Eighteen inoculations were made from number eight, nine from number nine, twenty-seven from number ten, and nine from number eleven, in none of which was there any evidence of infection. From number twelve, however, out of eight inoculations, three produced infection.

From this last culture, some fifty-four subsequent inoculations made on young tomato plants about four inches high at the time of inoculation, caused disease in every case, the plant in twenty-one cases being killed, in nineteen being nearly killed, and in the remaining fourteen showing distinct evidences of the disease.

In all cases excepting two, checks remained free. In the two cases where infection occurred, the check plants were in close contact with diseased ones, and, as the disease developed in the checks several weeks after neighbouring inoculated plants were severely attacked, it would appear that infection spread from the diseased plants to the checks.

Reduction of Nitrate. This test was made according to recommendations of Dr. Erwin F. Smith in "Bacteria in Relation to Plant Diseases". Nitrates were found to be not reduced.

Growth on Potato Cylinders. The nature of the growth was moderate, spreading, light yellow at first, becoming darker, somewhat slimy, smooth in surface, and forming water at the bottom of the tube. There was no surface growth, but the tube became milky.

Diastatic Action. Tests were made as recommended in Rolf's bulletin on "A Bacterial Disease of Stone Fruits", Cornell Memoir No. 8, p. 410. *The Iodine Test* gives a purple to red solution, both in the liquid drained from the bottom of the plug, and also from the scraped surface where bacterial growth takes place.

Morphology.—The bacterium is a short rod, ·5 to 1·3 microns in length, with rounded ends; it is non-motile and gram positive. No spores were observed. It stains readily in Loeffler's methylene blue and in carbol fuchsin. No capsules were observed.

Relationship of the Organism.—Following the key in Bergen's "Manual of Determinative Bacteriology," the organism coincided in practically all respects with that described as *Phytomonas michiganense* (*Aplanobacter michiganense*), the only outstanding difference being that starch is hydrolized, whereas Bergen records the opposite.

Comparing the morphological ad cultural characters with those described by Dr. Erwin F. Smith for *Aplanobacter michiganense*, it is considered that the organisms are identical.

ADDITIONAL WORK

In addition to the above, experimental work has been carried out on the use of different disinfectants on pruning wounds, the control of an apple canker occurring at Okanagan Centre and Winfield, the control of collar rot in one orchard of the Experimental Station, the transmission of potato mosaic, and the control of phoma rot on stecklings, in storage. There have also been added to our blight resistant pear varieties and species, eleven varieties and one new species, on all of which tests are being carried out from time to time.

OTTAWA: Printed by F. A. ACLAND, Printer to the King's Most Excellent Majesty, 1925.