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POTATO FAILURES.

A SECOND REPORT.

—BY—

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(2) Hyphae from a spore culture of **Corticium vagum,** B and C, var. **solani** Burt. Spores caught in potato agar and transferred to potato plugs on the fourth day. Drawings made on the twelfth day. The **Rhizoctonia** hyphae (No. 1) resemble those developed from the **Corticium** spores (No. 2) in every particular.

(3) The large, short, segmented hyphae from a sclerotium taken from a potato tuber.

(4) Large segmented hyphae from a spore culture of **Corticium vagum, B and C,** var. **solani** Burt. Spores caught in potato agar and transferred to potato plugs on the fourth day. Drawings made on the twelfth day. No difference can be observed in these (Nos. 3 and 4) hyphae.

PLATE I. (1)—Black felted layer of Hyphae. (2)—Sclerotia. (3)—Corticium or fruiting layer.

Potato Failures

SECOND REPORT.

By F. M. ROLFS, M. S.

PART I.

INTRODUCTION.

Line of Work.—Bulletin 70 of this Station gives the results of our experiments and study of *Rhizoctonia* of the potato for the year 1901. Work on this disease has been continued during the past two years. The practical value of corrosive sublimate and formalin solutions have been tested, over 120,000 pounds of seed tubers have been treated and the the influence of the treatment on the plants and crops carefully noticed. Seed selection has received considerable attention, and the influence of irrigation and cultivation on the development of the disease has also been studied. A fruiting stage of the fungus has been studied both in the laboratory and in the field.

Historical.—This disease is common to the fields of Europe, and has been reported from many localities in the United States. It is difficult to find a lot of tubers which are not more or less infected with it. Its origin is not known, however, its rhizoctonia and sclerotia stages were first reported by Kuhn, and European literature contains a number of publications on this malady. Its history in America is comparatively recent, dating back to only 1900. To my knowledge only four* publications on this potato disease have appeared in this country. Curiously enough the fruiting stage of this fungus has been overlooked, or at least never associated with the rhizoctonia and sclerotia stages, and some of our ablest workers have supposed it to be a sterile fungus; careful study, however, shows that it produces spores abundantly.

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*1 { Bulletin 186 N. Y. Cornell Exp. Station.
" 186 N. Y. Agr. " "
2 " 70 Colo. Agr. " "
3 and 4 Bulletins 139 and 145 Ohio Agr. Exp. Station.

DEVELOPMENT OF FUNGUS.

The fungus is truly a parasitic organism, flourishing in heavy, wet soils; and our observations during the past three years show that it produces fruit only on or near the living tissues of plants. Its development may be divided into the following stages:

The Rhizoctonia Stage.—Two forms of hyphal growth are constantly associated with the injuries resulting from this fungus —a light and a dark colored. The light form usually develops deeper in the tissues and is more actively parasitic and frequently produces a wet rot of the stem and old seed tubers, while the colored, or rhizoctonia proper develops more freely on or near the surface of the roots and tubers. The colored form is also frequently found growing in the soil some distance from the plants and is constantly associated with the fruiting stage of this fungus. (See Plate V., 1.)

The Sclerotia Stage.—The hyphæ give rise to dark irregular-shaped bodies which are made up of a mass of large, close-septate hyphæ. (See Plate V., 2.) These bodies are known as sclerotia. Experiments show that this stage is well adapted for tiding the fungus over unfavorable periods, and that it is a prominent factor in the dissemination of this disease. The sclerotia resemble closely particles of soil and are frequently mistaken for scales of dirt adhering to the tubers. When infected tubers are used for seed these Sclerotia produce hyphae which in turn injure and often kill the plants.

The Corticium Stage.—The young plants developed from seed tubers, which are more or less covered with the sclerotia stage, usually have their subterranean parts covered with a network of dark hyphæ. This dark network advances with the growth of the plant until it reaches the surface of the ground, where it changes into a grayish white fruiting layer, frequently entirely surrounding the base of the green stem and often extending up the stem for a distance of four inches. (See Plate I., 3.) The tips of the outermost hyphæ of this fruiting layer develop into basidae, which usually bear from two to four stregmata (See Plate III.), but in a few instances six have been observed. The spores are hyaline and usually ovate in form with apiculate bases; fifty spores taken just as they occurred on a green stem gave an average measurement of ten by six u. But mature spores after they had fallen measured twelve by eight u, the largest measuring fifteen by thirteen u, and the smallest nine by six u.

The hyphal characters, form of basidae, and structure of fruc-

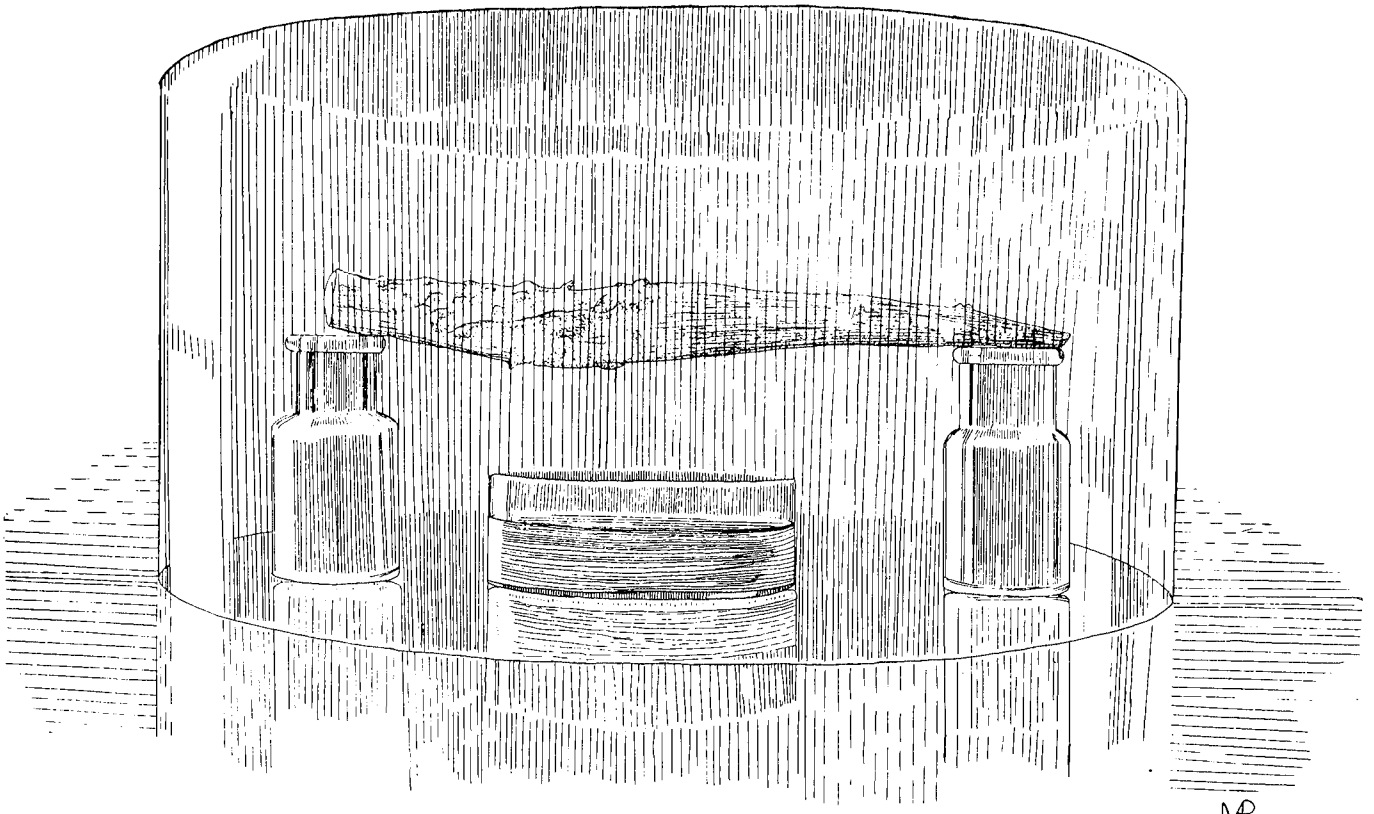

PLATE II. Arrangement for catching spores.

tification, show that it belongs to the well known species, **Corticium vagum* B. & C., but its parasitic mode of life, size and shape of spores, have been considered of sufficient distinction for a new variety and it is designated as *Corticium vagum* B. & C. var. *solani* Burt. This stage has been observed only on or near green potato plants. The fruiting layer does not adhere firmly to the stem and cracks and falls off very easily when the stem becomes too dry, consequently all traces of it usually disappear soon after the death of the plants.

From 225 pieces of stems covered with the fruiting layer placed in agar, 203 developed pure cultures of the *Rhizoctonia*; 15 *Fusarium* and 7 *Altenaria*. Cultures from this fruiting layer have been carefully watched during the past two years and they resemble in every way the pure cultures developed from the Sclerotia and pure cultures developed from hyphæ taken from a rotten tuber. All attempts in the laboratory to induce this fungus to develop spores on various culture media, have failed. However, if diseased tubers are planted in a suitable place they will produce plants on which the fruiting layer grows and develops spores abundantly.

The spores fall as soon as they are mature, consequently it is difficult to obtain cultures by the usual methods. The following plan was finally devised, which has proven quite satisfactory: A stem on which the fruiting layer had developed was suspended over a petri dish containing agar. The stem and dish were then covered with a sterile bell jar. (See Plate II.)

Spores show considerable difference in their germinating power, frequently they germinate within a few hours after they fall on agar. Each spore usually pushes out one germ tube; occasionally, however, two tubes are formed. The tube as it emerges from the spore is constricted and reaches its normal size at from 10 to 15 mm. from the spore. The growth is comparatively slow during the first two days and septa are only occasionally observed. About the third day side branches develop and the septa become more noticeable. By the fifth or sixth day the hypæ have taken on many of the *Rhizoctonia* characteristics and branch freely. Sclerotia usually form on potato plugs in twelve days.

Over sixty pure cultures of *Rhizoctonia* have been obtained from the spores of the corticium stage and these cultures resemble those obtained from the sclerotia on tubers and those made from seed tubers rotted by the hyphæ of *Rhizoctonia*.

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* This fungus agrees well with the description of *Hyponochus solani*, Prill. & Dell., but several specimens of it were sent to Dr. E. A. Burt, and after carefully examining them he has concluded that it is a variety of *Corticium vagum* B. & C., for which he has suggested *Corticium vagum* B. & C. var. *solani*.

INJURIES.

Plant Injuries.—Young plants suffer severely from its invasions and are often completely cut off by it before they reach the surface of the ground. Its attacks on the subterranean stems may bring about an abnormal development of tubers, which is usually spoken of as "Little Potatoes," or the injuries may be of such nature as to interfere with the storage of assimilated food in the subterranean branches of the plant, thus bringing about an abnormal top development, and frequently green tubers form in the axil of the leaves. (See Bulletin 70, p. 5–7).

In an experiment with badly infested seed 32 per cent. of the plants were killed before they reached the surface of the ground; 17 per cent. of the plants that reached the surface failed to produce tubers, and only 50 per cent. of the seed planted produced plants that developed tubers large enough for No. 1's and many of these were scabby. On July 14, 55 per cent. of the living plants showed the corticium stage of this fungus. Seed selected from this lot, but free from the sclerotia stage, produced plants of which only 20 per cent. showed traces of the corticium stage. Plants in an adjoining experiment which were free from the rhizoctonia and sclerotia stages were also free from the corticium stage.

Scabbing of Tubers.—European investigation long ago attributed the pitting or scabbing of tubers to the attacks of *Rhizoctonia*. Our experiments and observations also show that its attacks on growing tubers frequently produce deep ulcers. Most of our scab is due to the attacks of this fungus. (See Bulletin 70, p. 11).

Rotting of Seed Tubers.—Observations show that seed tubers are frequently invaded by the light colored hyphæ of this fungus, which gradually turn the flesh watery and soft. If the tubers are rotted early in the season, the plants are not only cut off from their food supply before they become well established, but they also suffer more or less from the attacks of the fungus. Such plants usually do poorly and frequently die before the close of the season. Numerous attempts to produce wet rot by inoculating healthy tubers with both the sclerotia and rhizoctonia stages have failed; however, a dry rot has occasionally developed.

Five out of eight seed tubers infected with this fungus placed in sterilized sand on July 2, 1903, and examined three months later, were completely rotted by a wet rot produced by this fungus. The remaining three were also completely rotted at the end of the fourth month, while five check tubers which were free from the fungus remained sound.

Five cultures taken from the different parts of each of these

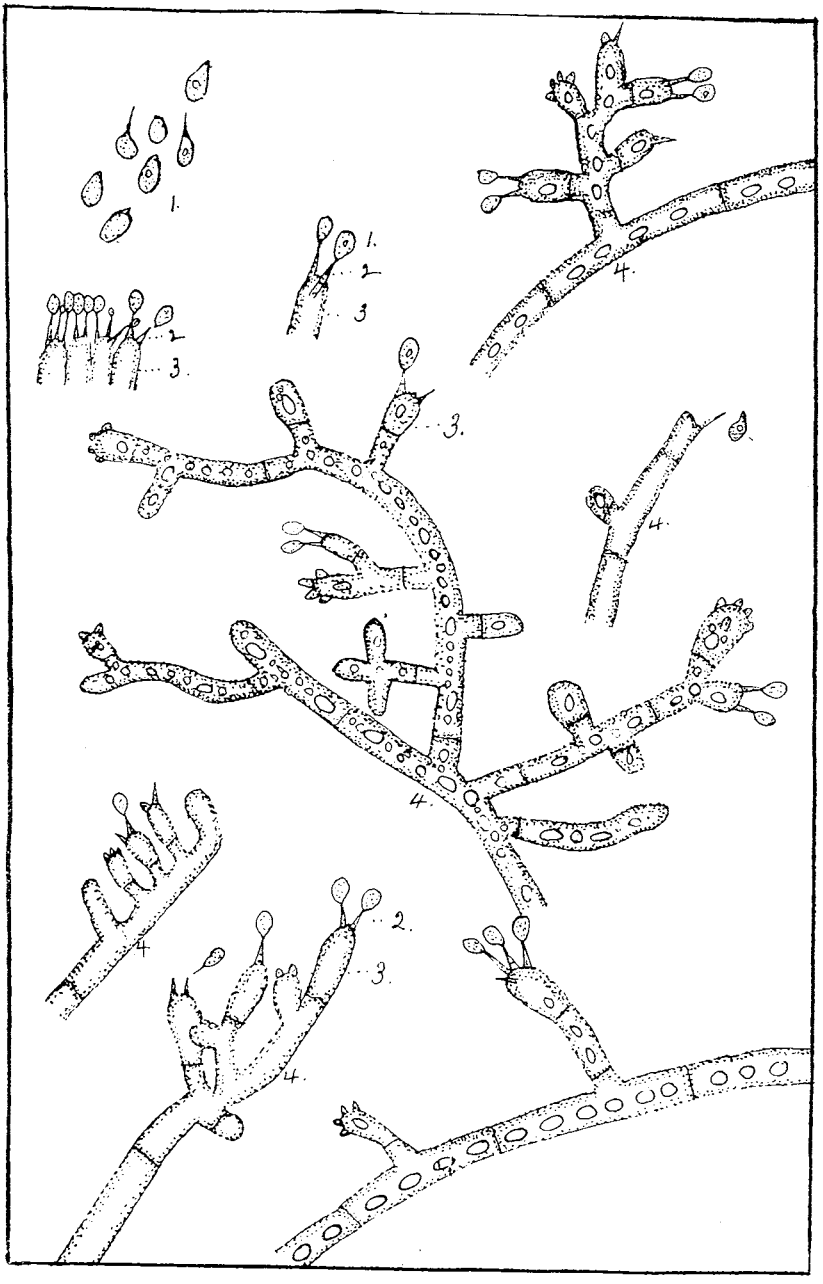

PLATE III. Hyphae, Basidia, Sterigmata and Spores of Corticium.

eight rotten tubers, making 40 cultures in all, produced pure cultures of *Rhizoctonia* in every instance.

SPREAD OF THE DISEASE.

Conditions have a marked influence on the development of this fungus. The soil and seed may be thoroughly infected and still the plants escape serious injury; on the other hand, mere traces of the disease under favorable conditions may develop and cause serious loss.

Rate of Growth at Different Temperatures.—Experiments show that pure cultures of this fungus on potato plugs and agar make very little or no growth in seven days, when kept at a temperature of about 40° F.; a slight growth at 55° F.; and a profuse growth at 72° F.

The Soil.—Some fields seem to be more favorable to the development of this fungus than others. A heavy, poorly drained soil seems to be most favorable for its development. Potatoes grown on heavy soils with good bottom drainage usually suffer less severely from this disease than those grown on poorly drained land.

It is not known how long this fungus will remain in the field when it once becomes thoroughly established, but observations of investigators show that it may live indefinitely on dead organic matter in the soil and on the roots and stems of various plants.

Influences of Heat and Moisture.—It has frequently been noticed that the corticium stage of the fungus develops freely on the surface of the ground under the potato plants and on the stems of the green plants when the ground is kept too wet during a spell of hot weather. This stage is of a light gray color and might easily be mistaken for alkali. However, some growers are quite familiar with it and know too well that its appearance on the ground under the plants indicates an over supply of water and a lack of air circulation at the base of the plants, and are well aware that if conditions are not improved the plants will be severely injured.

Laboratory work shows that a high temperature and plenty of moisture are necessary for the rapid development of this fungus. This possibly explains why extremely hot weather occasionally severely injures the plants in fields which have been thoroughly watered, while those in fields which have been sparingly watered and well cultivated remained apparently uninjured. In our experiments, when diseased plants were kept comparatively dry and well cultivated they did fairly well, but when such plants were over watered and the ground became too wet and soggy, the subterranean

parts of the plants were severely injured, and many of the tops showed marked sun scald injuries, which were followed by an invasion of *Altenaria* and many of the plants died before the close of the season.

The Seed Potato.—The sclerotia on the seed tubers is one of the principal means of disseminating this malady. It is almost impossible to find a lot of tubers entirely free from them, and some of our leading seed men send out seed tubers which are thoroughly infected. We have observed as high as 75 per cent. of infected tubers in lots offered for seed.

In storing seed careful attention ought to be given to temperature and moisture of the cellar. A comparatively dry cellar at a temperature of about 40° F. prevents the growth of this fungus, but infected tubers stored in a cellar which is warm and sufficiently damp give rise to a profuse development of both hyphae and sclerotia. A few diseased tubers in a lot of clean ones may greatly injure the seed value of the entire lot. (See Bulletin 70, p. 10).

Insect Injuries.—Frequently the larvae of insects make tunnels of considerable depths into both the stems and young tubers. The hyphae of this fungus frequently enter such wounds and may extend the injury.

Infected Plants.—This disease may be carried on the roots and stems of the various cultivated plants and weeds which grow on infected soil. (See Bulletin 70, p. 4). Infected stems and roots often find their way into barn yard manure and compost heaps; thus the manure may become the source of general infection to clean fields. Infected potato stems are frequently left scattered in the field after harvest; these are blown about by the wind and many of them finally find their way to other fields and thus become the means of general infection to new fields.

REMEDIAL MEASURES.

The Soil.—When a field has once become thoroughly infected with this fungus, it is cheaper to put it in other crops for at least three years. Evidence indicates that root crops should be avoided; cereals which are probably not attacked by the fungus should be sown on infected ground and all weeds should be kept down. Comparatively dry and loose soils, especially if they have a gravelly sub-soil, are less favorable for the development of the fungus than heavy soils. Losses from this disease are often lessened by giving careful attention to the physical condition of the soil.

Cultivation.—Too much care cannot be given to the preparation of the soil. Plowing under a green crop on infected ground from seven to eight inches deep just before planting gives good

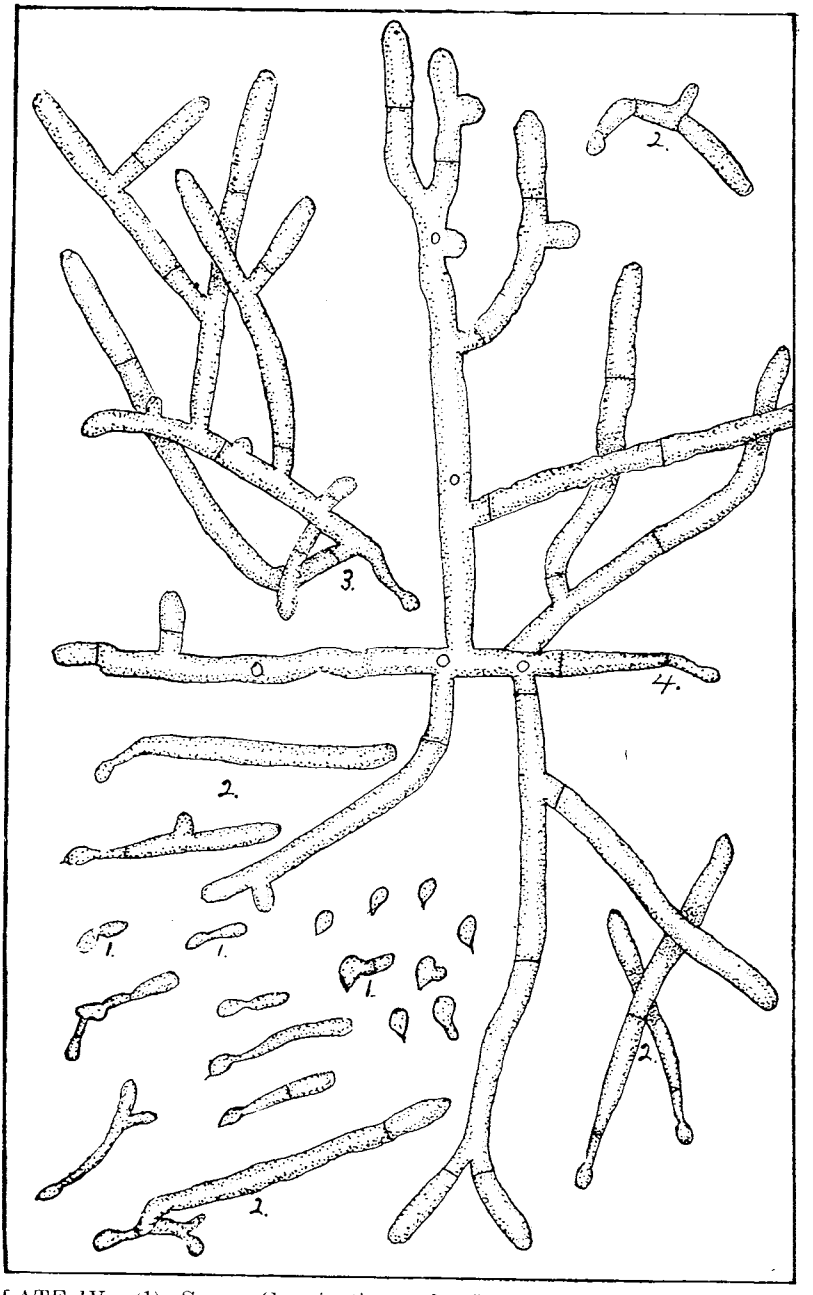

PLATE IV. (1)—Spores Germinating. (2)—Growth of Hyphae in two days (3)—Growth in three days. (4)—Growth in five days.

results. The ground ought to be thoroughly pulverized before planting. After the seed is planted great care should be exercised to prevent the soil from forming a crust. The potato plant does best in a well aerated soil. The crust not only tends to weaken the plant by cutting off its air supply, but it also frequently delays the shoots in reaching the surface of the ground; and if such plants are infected with this disease they suffer severely and are frequently killed before they reach the surface of the ground. (See Bulletin 70, p. 6). Even after the plants are up and well-established the formation of crust on the soil ought to be carefully guarded against, since it seems to furnish better conditions for the development of this disease. Observations indicate that fields which are sparingly watered and thoroughly cultivated suffer less from this fungus and the tubers are much freer from scabs.

The Runs.—Deep runs are better than shallow ones, since they give better circulation of air at the base of the plants, and they also enable the grower to supply the roots with an abundance of moisture, while the soil near the surface, where the tubers form, can be kept comparatively dry and thus avoid conditions which favor the rapid development of this fungus.

Late Planting.—Late planting frequently gives better results than early planting. This may possibly be due to the wet weather early in the spring which makes the conditions favorable for the growth of the fungus. Later the weather becomes settled and the ground can be kept well cultivated and the moisture of the soil is more easily controlled. A loose, open soil favors the growth of the potato plant and seems to check the rapid development of this disease.

Old Stems.—Infected potato and weed stems are often left scattered about in the field after harvest, and these are blown about by the wind and many of them are lodged in irrigating ditches, where they usually remain until the following summer, and as soon as the fields are irrigated, many of the stems are carried by the water into new fields and thus may become the principal means of infection. The burning of all vines and weeds after harvest is an excellent practice.

The Seed Potato.—A careful study of seed potatoes shows that it is almost impossible to find a lot of seed of which at least a few are not more or less infected with this disease. Observations indicate that seed tubers are usually the principal means of spreading this disease. (See Bulletin 70, p. 9). Too much care cannot be given to seed selection.

Tubers keep best in a dry, well ventilated dugout which is kept at about 40° F. Seed tubers ought to be stored in compara-

tively small lots and kept at as even a temperature as possible. Spreading the tubers on the cellar floor where they are exposed to the light and air five or six weeks before planting is a good practice. This treatment usually produces strong, hard sprouts after planting, which develop rapidly and are better able to resist the attacks of fungi.

Developing a Disease Resistant Variety.—Different varieties vary greatly in their suceptibility to disease when grown under the same conditions. Even plants of the same variety often show considerable difference in their power to overcome disease. It is possible that by crossing plants which show marked disease-resisting power, a desirable variety might be originated, and later be gradually improved by constantly selecting seed tubers from the plants which show the greatest disease-resisting power.

Seed Selection.—Prof. *Bolley's work on potatoes indicates that small tubers from a vine which produced mostly large tubers of desirable form and size, have greater seed value than large, poorly shaped tubers from a strain of potatoes which habitually produced small tubers. His experiments also indicate that when pieces of equal weight from small and large tubers of the same vine were planted, there was not sufficient difference in the yield to be noticeable under farm conditions, providing all tubers were normally mature. Our experiments and observations agree quite closely with those made by Prof. Bolley, but it has been observed that elongated and ill shaped tubers are usually developed on diseased vines.

Carefully selecting smooth, round tubers and rejecting all those showing any signs of infection, gave excellent results. In selecting tubers for seed, the disease-resisting power of the plant should also receive careful consideration. Diseased plants are not only apt to produce abnormally developed tubers, but the tubers ars also usually infected. Such seed often produces weak plants, which frequently suffer severely from the attacks of fungi. *Success or failure depends much on the quality of seed tubers used.*

No commercial grower can afford to use seed without knowing something of its past history. Those who "import seed" will find it cheaper in the end to pay more for seed and buy only from men who are known to give careful attention to the quality of their seed.

Some of our most successful growers have obtained good results from carefully selecting home grown seed just before or at digging time. This practice requires some ability and involves a little extra expense. As stated before, the size of the seed tuber

* N. D. Agr. Exp., Bulletin 30.

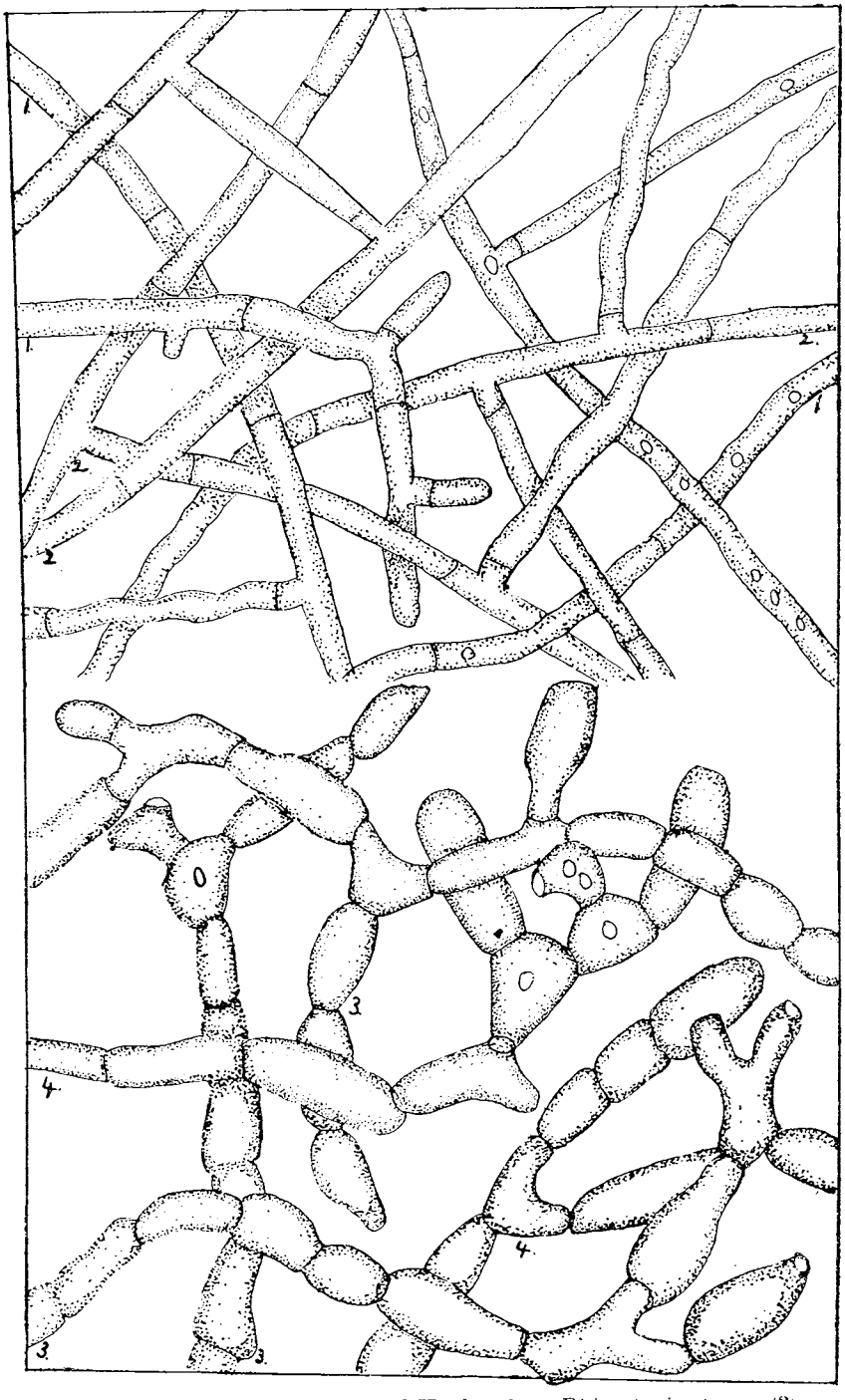

PLATE V (1)—Long Segmented Hyphae from Rhizoctonia stage. (2)—Large, Short Segmented Hyphae from a Sclerotia.

does not necessarily indicate its seed value, and unless the selecting is done in the field, the test will usually be in favor of the larger seed, since No. 2's are most likely to have a poor form and come from vines which produced mostly small tubers.

Another method which gives evidence of considerable practical value is to set aside each year five or ten acres of land for the growing of seed potatoes. The soil of such tract ought to be fertile and free from the various diseases which attack the potato plant. The tubers used in planting the seed tract are carefully selected each year from the seed plat of the previous year. The surplus seed is used for planting the general crop and in this way a strain of pedigree potatoes is gradually developed.

Corrosive Sublimate and Formalin Treatments.—The practical value of these solutions has been carefully tested. Our experiments indicate that these treatments may prevent the scabbing of tubers and improve the appearance of the crop, but usually they cut down the total yield per acre when the treated seed is planted on infected ground. However, the corrosive sublimate treatment gave marked gains when the treated seed was planted on new ground and the per centage of infected tubers in the crop was much lower. Formalin gave less favorable results, is more expensive, and weakens when exposed to the air; consequently it is difficult to keep the solution at standard strength when the dipping is done on a large scale.

Sulphur.—Thoroughly covering infected seed with sulphur at planting time apparently had very little influence on the growth of this fungus. The plants were more or less injured by the fungus, and the crop of tubers was thoroughly infected with it.

Lime.—Using lime at the rate of 3,000 pounds to the acre did not apparently check the development of this fungus. The plants did poorly, and the crop of tubers was also thoroughly infected with the fungus.

CONCLUSION.

The corticium or fruiting stage of this fungus develops freely on the green stems of the infected plants. However, it is evident that the sclerotia which are so common on the stems and tubers are also prominent factors in disseminating this disease.

Experiments indicate that treating infected seed with the standard formalin solution usually improves the appearance of the crop, but apparently weakens the plants and is apt to be the means of cutting down the total yield of tubers per acre.

The corrosive sublimate solution improved the appearance of the crop and gave marked gains when the treated seed was planted on new land. A weak solution, one ounce to ten gallons of water, gave better results than the standard when the seed was dipped in sacks and planted on old potato land.

Liming the soil at the rate of 3,000 pounds to an acre apparently did not check the disease.

Thoroughly covering the seed with sulphur also gave negative results.

The burning of all vines and weed stems as soon as the crop is harvested is an excellent practice.

Carefully selecting clean, smooth, round seed from a lot of tubers comparatively free from disease gave excellent results.

The shape and appearance of tubers give a hint as to their seed value, but their crop record and care of tubers after they are harvested are also important factors to be considered in selecting seed. Cull seed is a poor investment for a commercial grower at any price.

Spreading the seed tubers on a root house floor, where they were dry and more or less exposed to the air and light for five or six weeks before planting gave good results.

Seed tubers keep best when stored in small lots in comparatively dry, well aerated cellars which are kept at a temperature of about 40° F.

Good seed is one of the essential factors in successful potato culture; still various soil conditions seem to be fully as important. This is especially true where the soil is infected with this fungus. Observations indicate that diseased plants growing in soils well supplied with plant food are usually more successful in resisting the attacks of the fungus than those growing in soils more or less deficient in their chemical composition.

Poorly aerated soils are also more favorable for the development of this fungus. Soils which have a tendency to bake or form crusts need frequent cultivation. This is especially true while the plants are young. Plants which are thoroughly cultivated and carefully irrigated are apparently better able to overcome the attacks of this fungus and the tubers are usually free from scab.

Too much attention cannot be given to watering. If the rows are too long the field ought to be divided into sections, so as to be able to apply the water more evenly, and thus prevent part of the field from becoming too wet and soggy. Apply less water and irrigate more frequently. If the ground bakes or forms a crust, cultivate the field as soon as it becomes sufficiently dry. Keep the soil well aerated if possible.

Deep runs are also usually more desirable than shallow ones, since by this means the roots can be supplied with plenty of moisture and at the same time prevent the soil where the tubers are forming from becoming too wet, and they also furnish a better circulation of air at the base of the plants, thus making the conditions less favorable for the development of this fungus.

PART II.

DETAIL OF EXPERIMENTS.

Experiment I.—During the winter of 1900, Mr. J. G. Coy of Fort Collins, called our attention to the peculiar shape of the potato tubers grown on his place during the previous summer, apparently a mixture of Rose Seedling and Queen of the Valley. Many of the tubers were long and pointed, a good lot of what growers call "run out seed."

In the spring of 1901, seed was carefully selected from the No. 2's of the above lot, all diseased and "run out" tubers were rejected, and the seed was treated with corrosive sublimate.

The plants came up nicely but most of them blighted badly and were killed two weeks before frost. The field yielded 150 sacks of tubers per acre, and the tubers were much better than those harvested in 1900. Nine hundred and eighty pounds of the No. 2's of this crop were used as seed in the experiments of 1902. All tubers were carefully sorted and washed. The diseased and badly "run out" tubers were placed in the poor lot and are known as cull seed. There were 254 pounds of poor and 796 pounds of good seed. All the culls and 434 pounds of the better seed were treated with a solution of 8 oz. of formalin to 15 gallons of water.

The field selected for these experiments is located on the river bottom just east of town, the soil is of a black sandy loam. The field was plowed in early spring, and the seed was planted on April 25th. The rows were placed 36 inches apart and the pieces were placed at intervals of about 15 inches in the row and 4 inches deep.

The plants came up uniformly, and those of Plats IV and VI were sprayed five times. The ground was kept in almost perfect condition and the plants looked unusually promising until about July 27th, when the field was thoroughly water. From this time on the soil was compact and soggy, making the condition favorable for the development of Corticium. The roots of many of the plants were killed. The leaves and stems soon showed marked signs of sun scald. These injuries were soon followed by an attack of Altenaria, which resulted in the complete destruction of all the unsprayed plants by August 18th. The sprayed plants fared a little better, but they, too, were severely injured and were all dead and dry by August 25th. There were very few, if any, pointed tubers found in selected seed lots. In this experiment a sack of potatoes is estimated at 100 pounds.

Plat I Check—The seed of this lot was sorted with the greatest care. All diseased and injured tubers were rejected. Those which were long and pointed, or showed signs of "running out" were also rejected. The ground was quite dry at planting time, yet the plants were not long delayed in reaching the surface of the ground. This lot gave a yield of 212 sacks per acre. No "run out" tubers were observed in this plat at harvest time.

Plat II—The seed in this experiment was selected with the same care as that of the preceding plat. But it was treated in a solution of formalin on April 18th and planted on April 23rd. These plants reached the surface of the ground on time. This plat occupied the lowest part of the field; consequently the subterranean parts of these plants suffered more from the invasion of Corticium than those of the preceding plat. These plants were also the first to blight. This plat gave a return of 185 sacks per acre, making a yield of 26 pounds of tubers for every pound of seed planted,—a loss of 12%. No "run out" tubers were found in this plat at digging time.

Plat III—The culls taken from the two preceding lots were used in this plat. It was treated in a solution of formalin on April 18th and planted on April 23rd. The plat was also located on low ground, and these plants were the first to blight. An average yield of 130 sacks per acre was obtained from this plat—18 pounds of tubers for every pound of seed tubers planted—a loss of 39%. Many long and pointed tubers were taken from this plat.

Check Plat IV—The seed of this lot was sorted with the greatest of care. All diseased and injured tubers were rejected. The plants were sprayed five times with Bordeaux mixture. This experiment gave a return of 254 sacks per acre,—a return of 36 pounds of tubers for every pound of seed planted, making a gain of 40 sacks per acre from spraying. No "run out" tubers found in this lot at harvest time.

Plat V—This seed was also carefully selected and treated in a formalin solution on April 18th and planted on April 23rd. The plants reached the surface of the ground about the same time as check plants, and they were sprayed five times with Bordeaux mixture. This plat was located on the highest part of the field, consequently some of the plants suffered more or less for moisture. This plat gave a return of 193 sacks per acre,—a return of 27 pounds of tubers for every pound of seed tubers planted, making a loss of 24%. No "run out" tubers were taken from this crop. Spraying increased this yield 8 sacks per acre.

Plat VI—This seed was the last of the culls taken from the preceding lots. It was treated in a formalin solution on April 18th and planted on April 23rd. The plants came up irregularly, and many of them blighted early in spite of the fact that they were carefully sprayed five times. This plat gave a yield of 161 sacks per acre,—a return of 23 pounds of tubers for every pound of seed planted, a loss of 36%. Many "run out" tubers were taken from this crop. Spraying increased their yield 31 sacks per acre.

Results.—1. In the three experiments where the plants were sprayed five times with Bordeaux mixture, gains of 20%, 5% and 25% respectively were obtained.

2. Dipping clean, slected seed in formalin gave a loss of 12% in the first experiment and 23% in the second.

3. Cull treated seed compared with good treated seed gave a loss of 55 sacks per acre in the first experiment and 32 sacks in the second.

TABLE I., SHOWING RESULTS OF EXPERIMENT NO. I.

Plat No.	TREATMENT.	Number pounds of Seed Tubers Planted	Number pounds of Tubers Harvested	Pounds Harvested from every pound of Tubers Planted	Loss from Dipping	Number of Sacks per Acre
I.	Check	152	4605	30.29		212
II.	Dipped in Formalin Solution	217	5725	26.38	12%	185
III.	Cull Seed Dipped in Formalin Solution	64	1185	18.5	39%	130
IV.	Check, Plants Sprayed 5 Times	140	5070	36.22		254
V.	Seed Dipped in Formalin Solution, plants sprayed 5 times	217	5985	27.58	24%	193
VI.	Cull Seed Dipped in Formalin Solution, plants sprayed 5 times	190	4380	23.05	36%	161

Experiment II—The experiments given in this table were made by C. H. Bliss on old potato ground in 1902. It represents the results of experiments carefully conducted on an extensive scale, to test the practical value of these seed treatments. Great care was exercised to have the soil, watering and cultivation as nearly the same as possible. A short rotation of wheat, alfalfa and potatoes has been practiced on this place. The standard formalin treatment was used in the first three of these experiments. A weak solution of corrosive sublimate in the fourth, and a strong solution of corrosive sublimate in the last. All the treated seed was dipped in sacks.

Experiments I and III gave a loss of 11 and 10% respectively, while Experiment II gave a gain of only 3%. The weak solution of corrosive sub-

limate gave no result in one case, while in the other it gave a gain of 16%. A strong solution, on the other hand, gave a loss of 21%.

Results.—1. These experiments indicate that formalin has no marked value when the treated seed is planted on old potato ground.

2. A weak solution of corrosive sublimate has a slight value, but a strong solution is injurious when the treated seed is planted on old potato land.

TABLE II., SHOWING RESULTS OF EXPERIMENT NO. II.

Plat Number	VARIETY	TREATMENT	Number of Rows	Total Number of Sacks	Number of Sacks to the Row	Per cent of gain or loss.
I.	Pearl	Check	5	45	9	
		Formalin	6	48	8	11% loss
II.	Pearl	Check	3	24½	8	
		Formalin	4	33	8¼	3% gain
III.	Pearl	Check	4	40	10	
		Formalin	4	36½	9	10% loss
IV.	Rural New Yorkers	Check	6	40	6⅔	
		Corrosive Sublimate, weak solution	8	62	7¾	16% gain
		Corrosive Sublimate, weak solution	4	26½	6⅔	Neither gain or loss
V.	Rural New Yorkers	Check	4	27	6¾	
		Corrosive Sublimate, strong solution	4	21½	5¼	22% loss

Experiment III—These experiments were conducted by C. H. Bliss in 1902; they were also made to test the practical value of treating seed when such seed is planted on old potato ground. Home grown Rural New Yorker seed was used in this experiment. A short rotation of potatoes, wheat and alfalfa has been practiced on this place. A fair crop of alfalfa was plowed under in the spring before planting. The ground was plowed about nine inches deep and the seed was planted four inches deep on May 22. The cultivations and irrigations were the same in all the plats. The runs were made about eight inches deep.

This was an exceptionally poor season for this section, and the returns given in this table are considerably below an average crop. A sack of tubers is estimated at 100 pounds.

Plat 1 Check—The seed in this plat was rough and more or less covered with sclerotia of Corticium. This plat occupied slightly the best soil. The plants all suffered some from the attack of this fungus. Six hundred pounds of seed gave a return of 8,270 pounds of tubers. The tubers were rough and of a poor quality.

Plat II—The seed of this plat was the same as that used in check. It was treated in a solution of one ounce of corrosive sublimate to 8 gallons of water, 1½ hours on May 15th and planted on May 22nd. The plants were backward from the start and never fully overtook the check plants. All plants were more or less diseased, and the quality of the tubers was no better than those of the check plat. Six hundred pounds of seed gave a return of 6,545 pounds of tubers, making a yield of about 11 pounds of tubers for every pound of seed planted—a loss of 20%.

Plat III—All the seed in this plat was free from sclerotia; however, most of the tubers were more or less covered with hyphae. The plants

reached the surface of the ground about the same time as those of the check plat. They all suffered some from this disease, and the crop was of a poor quality and many of the tubers were covered with sclerotia. Six hundred pounds of seed gave a return of 7,555 pounds of tubers for every pound of seed planted, a loss of about 8%.

Results.—1. Diseased seed treated with the standard corrosive sublimate solution and planted on old potato ground gave a loss of 20%.

2. Seed free from the sclerotia stage, but more or less covered with the rhizoctonia stage, planted on old ground, gave a loss of 8%.

TABLE III., SHOWING RESULTS OF EXPERIMENT NO. III.

Plat Number	TREATMENT	Number Pounds of Seed Planted	Pounds of Potatoes Harvested	Yield in Pounds for every Pound of Seed Planted	Per Cent. of Loss	Number of Rows to the Acre
	Check	600	8270	13.75		5
	Treated	600	6545	10.9	20%	5
	Selected Seed	600	7555	12.59	8%	5

Experiment IV—The following experiments were made by S. A. Bradfield in 1902 to test the value of treating diseased seed with corrosive sublimate when such seed is planted on old potato ground. A short rotation of wheat, alfalfa and potatoes has been practiced on this place for a number of years. A fair crop of alfalfa was plowed under in the spring before planting. The soil in this field is of a black loam, slightly sandy; it slopes gradually to the south and east. The runs between the rows were from seven to eight inches deep, which made it possible by carefully watering to supply the roots with plenty of moisture, and at the same time to prevent the soil in which the tubers developed from becoming too wet and soggy. Second year's Divide Pearl seed was used in these experiments.

Plat I Check—This plat was located on lower and in slightly better soil than the other two experiments. All the tubers were more or less covered with sclerotia of Corticium. The seed was planted about May 18th. Five hundred and six pounds of seed yielded 11,553 pounds of tubers, giving a return of 23 pounds of tubers for every pound of seed planted. These tubers were smaller, and were more or less covered with sclerotia. Careful observation also showed that this lot also contained the most scabby tubers.

Plat II—The seed of this plat was more or less covered with sclerotia, but they were treated with a solution of one ounce of corrosive sublimate to eight gallons of water for 1½ hours nine days before they were planted. These plants were five days late in reaching the surface of the ground. A careful examination of plants from various parts of this plat showed plainly that most of the plants had their subterranean parts covered with the hyphae of this fungus. Six hundred pounds of seed gave a return of 11,161 pounds of tubers, making 18½ pounds of potatoes for every pound of seed planted, but the tubers were cleaner, larger and better in every way than those in the Check plat.

Plat III—This seed was taken from the same lot of tubers as those in the other experiments. All tubers having sclerotia on them were rejected, but many of the tubers were scabby and all of them were more or less covered with the hyphae. This experiment occupied the highest and probably the poorest ground. Five hundred and four pounds of seed gave a return of 10,574 pounds, making 21 pounds of tubers for every pound of seed planted. A loss of 9%. However, the tubers were larger and cleaner than those of the Check plat.

Results.—1. Diseased seed treated with corrosive sublimate gave a loss of 20%.

2. Seed free from the sclerotia stage, but more or less covered with the rhizoctonia stage gave a loss of 9%. The tubers were larger and of a better quality.

TABLE IV., SHOWING RESULT OF EXPERIMENT NO. IV.

Plat Number	TREATMENT.	Number Pounds of Seed Tubers Planted	Total Number of Pounds of Tubers Harvested	Yield in Pounds for every Pound of Seed Tubers Planted	Loss	Yield in Sacks per Acre
I	Check	506	11553	23		137
II.	Seed Treated with 1 oz. Corrosive Sublimate to 8 gallons of water	600	11161	18½	20%	111
III.	Washed and all tubers containing sclerotia rejected	504	10574	21	9%	126

Experiment V—The experiments in the following table were conducted by E. R. Bliss in 1902. They were made on old potato ground, but the field had been in alfalfa during the previous two years, and a fair crop of alfalfa was plowed under in the spring before planting. The seed was treated with formalin on May 20 and planted about May 24. The rows compared were of the same length, and the cultivation and irrigation in all the experiments were the same. A sack of tubers in these experiments is estimated at 100 pounds.

Lot 1, Plat I Check—Sixty pounds to the row of Prolific seed from the Divide were used in this plat. The soil in this plat was slightly better than that of the treated seed plat; otherwise the conditions were the same; only a few deceased plants were observed in this plat. This plat gave a return of 26 pounds of tubers for every pound of seed planted, a yield of 158 sacks per acre.

Plat II—Sixty pounds to the row of Prolific Divide seed were use in this plat. It was dipped in sacks in a solution of eight ounces of formalin to fifteen gallons of water for two hours. No diseased plants were observed in this plat and the crop of tubers was clean and smooth. Twenty-four pounds of seed were harvested for every pound of seed planted, making a return of 144 sacks per acre—a loss of 10%.

Lot II. Plat I Check—Fifty pounds to the row of Pearl first year's Wisconsin seed were used in this plat. It was planted May 30th. The soil, cultivations and irrigations were as nearly the same in these plats as it was possible to have them. Thirty-three pounds of tubers were harvested for every pound of seed planted—a return of 199 sacks per acre.

Plat II—Fifty pounds to the row of first year's Wisconsin Pearl were planted in this plat, which had been treated in sacks with a solution of eight ounces of formalin to sixteen gallons of water for two hours. One thousand two hundred pounds of this seed were planted on May 24th, and the remaining 2,640 pounds on May 26th. No diseased plants were observed in this plat and the tubers were clean, smooth and free from disease. One pound of seed gave a return of 30 pounds of tubers—a yield of 179 sacks per acre, making a loss of 10%.

Lot III. Plat I Check—Forty pounds to the row of second year Wisconsin Pearl seed were used in this plat. There were some deceased plants observed in this plat, but on the whole the plants were strong and vigorous. One pound of seed gave a return of 25 pounds of tubers—a yield of about 150 sacks per acre.

Plat II—Forty pounds to the row of second year Wisconsin Pearl seed were used in this lot. It was treated in sacks with a solution of eight ounces

of formalin to sixteen gallons of water for two hours. Each pound of seed gave a return of 21 pounds of tubers, making a yield of about 128 sacks of tubers per acre—a loss of 14⅛%.

Results.—1. Divide Prolifiic seed treated with standard formalin solution gave a loss of 10%.

2. First year's Wisconsin Pearl seed treated in standard formalin solution gave a loss of 10%.

3. Second year's Wisconsin Pearl seed treated in a standard formalin solution gave a loss of 14%.

TABLE V., SHOWING RESULTS OF EXPERIMENT NO. V.

Variety, Where Raised	TREATMENT	Number Pounds of Seed Tubers to row	Number Pounds of Tubers Harvested from a Row	Number of Rows in Acre	Yield in Pounds for every Pound of Seed Planted	Gain or Loss	Number of Sacks per Acre
Prolific, Divide Seed	Check	60	1580	10	26.33		158
	Formalin Treatment	60	1440	10	24.00	10% Loss	144
Pearl, Wisconsin Seed First Year	Check	50	1660	12	33.20		199
	Formalin Treatment	50	1490	12	29.80	10% Loss	179
Pearl, Wisconsin Seed Second Year	Check	40	990	15	24.75		149
	Formalin Treatment	40	850	15	21.25	14⅛% Loss	128

Experiment VI—The experiments given in the following table were made by the Agricultural Department in 1901. Rose Seedling seed was used which had been stored in a damp cellar. Many of the tubers were more or less covered with Corticium hyphae. This seed was removed from the cellar about June 1st, and placed in a dry room until June 12th, which thoroughly dried all the tubers. The field on which this seed was planted has been under cultivation for a number of years. It was plowed late in the spring and the seed was planted on June 12th. None of the plats were watered, still nearly all of the plants remained green until killed by frost.

Plat I Check—These plants were more or less diseased, but most of them looked strong and healthy until killed by frost. The fruiting stage of this fungus was observed on many of the plants. One hundred and forty pounds of seed gave a return of 767 pounds of tubers, a yield of 5 33-100 pounds of tubers for every pound of seed planted, or about 32 sacks per acre.

Plat II—This seed was of the same grade as the check lot. It was treated with corrosive sublimate one week before it was planted. These plants were a little slow in reaching the surface of the ground, but they soon looked fully as strong and vigorous as the checks. Very few scabby or diseased tubers were found in this lot. One hundred and one pounds of seed produced 539 pounds of tubers, a return of 5 17-50 pounds of tubers for every pound of seed planted, making about 32 sacks per acre, no gain over check.

Plat III—This seed was also of the same grade as the check lot, but it was treated with formalin a week before it was planted. The plants came up fully as well as those of the check plat and apparently were as strong and vigorous. One hundred and five pounds of seed gave a return of 466 pounds of smooth clean tubers, a yield of 4 11-25 pounds of tubers for every pound of seed planted, making a loss of 17%. About 27 sacks of tubers to the acre.

Plat IV—This seed was carefully selected, rejecting all tubers containing sclerotia, but all of the seed tubers were more or less covered with the hyphae. Eighty pounds of seed gave a return of 475 pounds of tubers, a

return of six pounds of tubers for every pound of seed planted. The tubers were all more or less covered with the sclerotia, but were not so badly scabbed as the tubers of the check plant. This plat gave a return of 36 sacks per acre.

Plat V—This was the poorest lot of seed, about 30% of the tubers failing to produce plants which reached the surface of the ground. The plants did poorly and many of those that reached the surface of the ground died before the close of the season. Thirty-five pounds of seed gave a return of 107 pounds of small, rough tubers,—a yield of a little over three pounds of tubers for every pound of seed planted, making a loss of 42%, a return of about 19 sacks per acre.

Results.—1. Success or failure in potato culture in this section of the state depends much upon the water supply.

2. The corrosive sublimate seed treatment gave no marked results when the treated seed was plantd on land which had been under cultivation for a number of years.

3. The formalin seed treatment gave a loss of 17% when such seed was planted on ground which had been under cultivation for a number of years.

4. Carefully selecting seed, free from sclerotia stage, gave a gain of 11%.

TABLE VI., SHOWING RESULTS OF EXPERIMENT NO. VI.

Plat Number	TREATMENT.	Number Pounds of Seed Potatoes Planted	Total Number of Tubers Harvested	Yield in Pounds for every Pound of Seed Tubers Planted	Gain or Loss	Yield in Sacks per Acre
I.	Check	140	767.30	5.33		32
II.	Treated with Corrosive Sublimate	101	539.50	5.34		32
III.	Treated with Formalin	105	466.50	4.44	17% Loss	27
IV.	Seed free from Sclerotia, but more or less covered with hyphae	80	475.50	5.94	11% Gain	36
V.	Cull Seed	35	107.70	3.08	42% Loss	19

Experiment VII—Rose Seedling seed was used in this experiment which was raised by the Agricultural Department from tubers bought on the market in the spring of 1901. Many of the tubers were covered with the hyphae and sclerotia of Corticium. This seed was planted on an old berry plantation, located on a knoll sloping toward the south and west. The soil is of a sandy loam, and has been well cultivated and manured during the past five years. It was plowed 8 inches deep in early spring and planted on May 6. The rows were planted 40 inches apart, the pieces being put at intervals of about 9 inches and 5 inches deep.

The plants of this experiment were sprayed three times with Bordeaux mixture. There was very little difference in the appearance of the plants in the various plats at any time during the season. The water was low in the ditch during the later part of the summer, so this field was irrigated but twice. The plants on the higher soil suffered some from sun scald. Altenaria was also found on some of the plants, but it apparently developed only on those which had an injured root system. The weight of a sack of tubers is estimated at 100 pounds.

Plat I Check—This seed was stored in the dugout all winter. Many of the tubers were more or less covered with the sclerotia of Corticium. The tubers were cut on May 5 and planted on the following day. These plants did quite well, but a number of diseased plants were observed in this plat

during the summer, and many diseased tubers were found in this plat at harvest time. It gave an average yield of 147 sacks of tubers per acre.

Plat II—This seed also contained many diseased tubers, but it was treated with corrosive sublimate one day before planting. The plants were five days late in reaching the surface of the ground. A few diseased plants were observed in this plat during the summer, but the tubers were clean, smooth and free from both scab and sclerotia. This plat gave a return of 213 sacks of tubers per acre, a gain of 66 sacks per acre.

Plat III—This seed was treated with corrosive sublimate on December 9th. After it became thoroughly dry it was again sacked and placed in the dugout until May 6th, when it was cut and planted. The plants were a week late in reaching the surface of the ground, but they did nicely and no diseased plants were observed in this plat. The tubers were clean, smooth and free from both scab and sclerotia. This plat gave a return of 160 sacks of tubers per acre, a gain of 13 sacks per acre over check.

Plat IV—This seed was taken from the dugout on December 9th, and treated with corrosive sublimate one hour and then placed on the floor until thoroughly dry, when it was sacked and placed in the dugout until May 5th, when it was again placed in a solution of corrosive sublimate for one hour. It was cut and planted on May 6th. The plants were 8 days late in reaching the surface of the ground. They did nicely, however, and no diseased plants were observed in this plat. The crop was clean, smooth and free from both scab and sclerotia. This plat gave a return of 143 sacks of tubers per acre, a loss of 4 sacks per acre over check.

Plat V—This seed was exposed to the light 23 days, five months before planting. It was then stored in the dugout until May 6th, when it was cut and planted. The plants reached the surface of the ground a few days in advance of those of the check plat. A number of diseased plans were observed in this plat, but no scab or sclerotia was observed on the tubers at harvest time. This seed gave a return of 196 sacks of tubers per acre, a gain of 49 sacks per acre.

Plat VI—This seed was stored in the dugout all winter. On May 5th all the stem ends were removed; otherwise the seed was treated like that of the check plat. No difference was noticed in the appearance of the plants in these two plats. Some of the tubers contained a few sclerotia at harvest time. This plat gave a return of 153 sacks of tubers per acre, a gain of 6 sacks per acre.

Results.—1. The standard corrosive sublimate treatment gave an increased yield of 45%. The tubers were larger, cleaner and better in every way.

2. Treating seed with corrosive sublimate five months before planting gave an increased yield of 9%. The tubers were also larger, cleaner and better than those of the check plat.

3. Treating the seed with a solution of corrosive sublimate, standard strength, one hour, five months before planting, and again one hour one day before planting, gave a loss of 2%, but the tubers were clean, smooth and free from disease.

4. Exposing the seed to the light 23 days five months before planting apparently increased the yield 35%.

5. Rejecting the stem end piece did not give marked results.

TABLE VII., SHOWING RESULTS OF EXPERIMENT NO. VII.

Plat Number.	TREATMENT.	Number Pounds of Seed Tubers Harvested	Total Number Pounds of Tubers Harvested	Yield in Pounds for every Pound of Tubers Planted	Gain or Loss	Yield in Sacks per Acre
I.	Check	111	1809	16.30		147
II.	Treated with Corrosive Sublimate 1 day before planting	90	2125	23.61	45% Gain	213
III.	Treated with Corrosive Sublimate 5 months before planting	109	937	17.77	9% Gain	160
IV.	Double Corrosive Sublimate Treatment	112	1783	15.90	2% Loss	143
V.	Seed Exposed to Light 23 days, 4 months before planting	104	2267	21.79	35% Gain	196
VI.	Stem End Rejected	89	1514	17.00	4% Gain	153

Experiment VIII—Rose Seedling seed was used in this experiment which was from the No. 1's of last year's experiment. It was planted on April 9th. The plants came up nicely and they were irrigated twice, still, most of them remained green until killed by frost. Some showed marked sun scald injuries early in the season, which were soon followed by early blight.

The field used in this experiment had been under cultivation for the past seven years. The soil is of a heavy clayey loam. This field has received very little manure during the past five years. The soil was too heavy for a desirable potato field.

Plat I Check—The largest tubers from last year's check plat were used for seed in this lot. Most of the plants remained green, but some of them had their subterranean parts badly injured and developed marked sun scald injuries. Three hundred and nine pounds of seed gave a return of 1,716 pounds of tubers, or 5½ pounds for every pound of seed planted.

Plat II—This seed was selected from the No. 1 of a lot which had been treated with formalin last year. They were treated with corrosive sublimate on April 30, and planted on May 9. These plants reached the surface of the ground about as soon as those of the check plat. No diseased plants were observed in this plat. Three hundred and thirty-four pounds of seed gave a return of 2,616 pounds of clean tubers, a yield of 7.8 pounds of tubers for every pound of seed planted, making a gain of 41% over check.

Plat III—This seed was selected from the No. 1's of last year's experiments. Only clean, round, smooth tubers were used. All long and all flat tubers were rejected. The soil of this plat was in a better condition than the soil of the other plats. No diseased plants were found in this plat, and the tubers were fully as clean and smooth as those of the treated lot. Two hundred and forty-six pounds of seed yielded 2,807 pounds of tubers, a return of 11½ pounds of tubers for every pound of seed planted, giving a gain of 106% over check.

Plat IV—Seed in this lot was selected from the various lots of last year's experiments. Only the long, smooth tubers were used. The plants were not so strong and vigorous as those of Plat III, but no diseased plants were observed in this plat. The tubers were all long, but only a few pointed ones were found at harvest time. One hundred and ninety-three pounds of seed gave a return of 1,283 pounds of tubers, a yield of 6½ pounds of tubers for every pound of seed planted, making a gain of 20% over check.

Plat V—This seed was selected from the No. 1's of the previous year's experiments. At least 20% of them had a few sclerotia of Corticium on them. Many diseased plants were observed in the plat and the crop was rough and

scabby. Two hundred and eighty-one pounds of seed gave a return of 1,531 pounds of tubers, a yield of 5½ pounds of tubers for every pound of seed planted, making a loss of 2%.

Plat VI—This seed was selected from the culls of last year's experiments. Only the round tubers were used. One hundred and seventy-five pounds of seed gave a return of 982 pounds of tubers, a yield of 5⅗ pounds of tubers for every pound of seed planted, an increase of 2% over check.

Results.—1. Treating diseased seed with corrosive sublimate, standard strength, increased the yield 41%.

2. Carefully selecting perfect shaped tubers gave a gain of 106% of smooth, round tubers.

3. Carefully selecting clean, long tubers gave a gain of 20%, but the tubers were all long and ill shaped.

4. Cull seed gave a loss of 2%. The tubers were rough and scabby.

5. Small, round seed gave a gain of 2% over check and the crop was fully as good in every way.

TABLE VIII., SHOWING RESULTS OF EXPERIMENT NO. VIII.

Plat Number	TREATMENT	Number Pounds of Seed Tubers Planted	Total Number of Pounds of Tubers Harvested	Yield in Pounds for every Pound of Seed Planted	Gain or Loss	Yield in Sacks per Acre
I.	Check	309	1716	5.55		39
II.	Corrosive Sublimate, 1 oz. to 8 gallons of water	334	2616	7.83	41% Gain	55
III.	Large Selected Seed	246	2807	11.41	106% Gain	80
IV.	Long Pointed Seed	193	1283	6.64	20% Gain	46
V.	Diseased Seed	281	1531	5.44	2% Loss	38
VI.	Small Round Seed	175	982	5.61	2% Gain	39

Experiment IX—These experiments were conducted in a field which had been planted in currents during the previous four years. It slopes toward the west and the soil is a heavy clay, but it has been well manured and cultivated for a number of years. It was plowed 8 inches deep in early spring and on May 6th planted with Rural New Yorker seed. These tubers were exceptionally clean. They were taken from a lot of tubers which was raised from mountain seed in 1901 by the Agricultural Department. The rows were planted 40 inches apart, the pieces being placed at intervals of 15 inches, and 5 inches deep. The plants in this experiment came up uniformly, and were all sprayed three times with Bordeaux mixture, which kept their foliage in good condition until killed by frost on the night of September 11th.

The water was unusually low in the ditch during the latter part of the season, consequently the plants in all of these plats suffered more or less from lack of moisture. All the plats were watered twice excepting Plat V, which was watered three times. The return from this plat shows plainly that if the field had been properly watered the yield would have been much larger. The plants in this experiment were carefully watched during the entire season, and we observed only a few diseased plants in these plats. The tubers were clean, smooth and free from scab.

Plat I Check—The seed in this lot was taken from the dugout on December 9th and was placed in water two hours and then placed on the floor

of the Horticultural Building until thoroughly dry, when it was sacked and placed in the dugout. On May 6th it was cut and planted. The plants came up nicely and remained strong and vigorous all the season, giving an average yield of 142 sacks per acre of clean, smooth tubers.

Plat II—This seed was treated with a solution of one ounce corrosive sublimate to eight gallons of water on December 9th. After the tubers had been soaked one hour they were placed on the floor until dry, when they were sacked and stored in the dugout. On May 5th they were again treated with corrosive sublimate for one hour and cut and planted on the following day. The plants were a little later in reaching the surface of the ground, but six weeks later they were fully as large and vigorous as those of the check plat. No diseased plants or tubers were found in this plat. This plat gave an average yield of 144 sacks per acre of clean, smooth tubers, a gain of 2 sacks per acre over check.

Plat III—The seed in this plat was taken from the dugout on December 9th, and treated two hours with a solution of eight ounces of formalin to sixteen gallons of water. The tubers were then placed on the floor until the following day, when they were sacked and placed in the dugout until May 6th, when they were cut and planted. The plants reached the surface of the ground on time, and were strong and vigorous until killed by frost. No diseased tubers were observed when the crop was harvested. This plat gave a gain of 13 sacks per acre, but this gain was probably due to seepage water from the lawn thoroughly soaking six of the rows on the night of August 3rd. These tubers were unusually good.

Plat IV—This seed was taken from the dugout on December 7th, and placed on the basement floor of the Horticultural Hall, where it was fully exposed to the light On the 30th of December it was again sacked and placed in the dugout. On May 6th it was taken out, cut and planted. These plants reached the surface of the ground possibly a little in advance of the check, but they showed no marked gain over the the check plants at any time. This plat gave an average yield of 144 sacks to the acre of clean, smooth tubers, a gain of two sacks per acre over check.

Plat V—This seed was selected and treated just the same as that of the check plat, but the plants were carefully irrigated three times. No diseased plants or tubers were taken from this plat. The plants remained green and vigorous until killed by frost. This plat gave an average yield of 197 sacks per acre of good, large tubers, a gain of 55 sacks per acre over the check.

Results.—1. Dipping clean, healthy seed tubers in a solution of corrosive sublimate, standard strength, for one hour, five months before planting, and again for one hour just before planting, apparently had no influence on the seed when such seed was planted in new ground.

2. Clean, healthy seed treated in a solution of eight ounces of formalin to sixteen gallons of water for two hours, five months before planting, gave no marked result when such seed was planted in new ground.

3. Exposing clean, healthy seed to the light 23 days, five months before planting, gave no marked results.

4. Three thorough waterings gave 38% larger returns than two waterings.

TABLE IX., SHOWING RESULTS OF EXPERIMENT NO. IX.

Plat Number	TREATMENT	Number Pounds of Seed Tubers Planted	Total Number of Pounds of Tubers Harvested	Yield in Pounds for every Pound of Seed Planted	Gain	Number of Sacks per Acre
I.	Check, irrigated two times	64	1298½	20.29		142
II.	Corrosive Sublimate, 1 hr., 12-9-01, again 5-5-02, Irrig'td. twice	105	2167	20.63		144
III.	Treated with Formalin 2 hrs. 12-9-01. Irrigated 2 times	115	2554	22.20	9%	155
IV.	Seed exposed to light 23 days. Irrigated 2 times	70	1437	20.52		144

Experiment X—The seed in the following experiment was taken from the Rural New Yorker No. 1's of last year's experiments. It was planted on heavy, clayey ground which had been a plum orchard for a number of years, but it had been well cultivated and manured during the previous five years. The water supply in the ditch gave out early in the season and the field received but two waterings.

The ground was plowed eight inches deep in the early spring and the seed was planted five inches deep. The plants came up nicely and their foliage remained green until killed by frost.

Plat I—Check—The tubers of this lot were smooth and clean, not a scabby or diseased tuber was observed in the lot. The plants were strong and healthy. Three hundred and forty-eight pounds of seed gave a return of 3,042 pounds of clean, round tubers, a yield of 8.7 pounds of tubers for every pound of seed planted.

Plat II—The seed from which these tubers grew was treated with corrosive sublimate and this seed was also treated with corrosive sublimate. It was an evcellent lot of seed. The plants were strong and vigorous and the foliage remained perfect until killed by frost. Three hundred and sixty-three pounds of seed gave a return of 3,429 pounds of tubers; 9.44 pounds of tubers for every pound of seed planted, a gain of 8½%.

Plat III—All the long and flat tubers were rejected from this lot, only the clean, round and perfect shaped tubers were used. Two hundred and seventy pounds of seed gave a return of 3,141 pounds of tubers, a yield of 11.63 pounds of tubers for every pound of seed planted, making a gain of 33⅓% over check.

Plat IV—The tubers in this lot were taken from the No. 1's of last year's crop, but all of them were ill-shaped and more or less scabby. Two hundred and fifty pounds of seed gave a return of 1,559 pounds, a yield of 6.24 pounds of tubers for every pound of seed planted, giving a loss of 28% when compared with check.

Results.—1. Good, healthy seed treated with corrosive sublimate and planted in new soil gave a gain of 8½%.

2. Carefully selected seed gave a gain of 33⅓%.

3. Selecting all the poorest shaped, scabby and diseased seed and planting it on new ground gave a loss of 28⅓%.

4. The difference between best and poorest seed being 62%.

TABLE X., SHOWING RESULTS OF EXPERIMENT NO. X.

Plat Number	TREATMENT	Number Pounds of Seed Tubers Planted	Total Number Pounds of Tubers Harvested	Yield for Every Pound of Seed Planted	Gain or Loss	Yield in Sacks per Acre
I.	Check	348	3042	8.70		60
II.	Corrosive Sublimate, 1 oz. to 8 gals. of water	363	3429	9.44	8½% Gain	66
III.	Good Selected Seed	270	3141	11.63	33⅓% Gain	81
IV.	Poor Selected Seed—Culls	250	1559	6.24	28⅓% Loss	44

Experiment XI—These experiments were undertaken in 1903 to test the value of selecting seed and the value of treating inferior seed with corrosive sublimate solution. An exceptionally badly diseased lot of Rural New Yorker seed was secured for this test. These experiments were planted on an old plum orchard containing a heavy, clayey soil, but it had been well manured and cultivated for the past five years. The soil was plowed eight inches deep in early spring and the seed was planted four inches deep on April 9th. The plants did poorly from the first. The water was turned out of the main ditch during the fore part of the season so the field was irri-

gated but twice. The runs were only about four inches deep, making it impossible to supply the water properly.

Plat I—Check—These tubers were rough and scabby and all of them were more or less covered with the hyphae and sclerotia of Corticium. The plants came up very unevenly and 32% of this seed failed to produce plants which reached the surface of the ground, Seventeen per cent. of those that grew, developed small worthless tubers. Only 57% of the seed planted produced plants which developed large tubers, and these were scabby and of a poor quality. On July 24th the plants in this plat were carefully examined and it was observed that 55% of the plants had their main stems covered with the fruitage stage of this fungus. Three hundred and twenty-five pounds of seed gave a return of 1,240 pounds of tubers. A yield of 3⅘ pounds of tubers for every pound of seed planted. A return of 23 sacks to the acre.

Plat II—This seed, like that used in the Check plat, was scabby and more or less covered with the hyphae and sclerotia. It was treated with corrosive sublimate, standard strength, seven days before it was planted. These plants were about eight days later than those of the Check plat and they also came up very unevenly. Twenty-six per cent. of the seed failed to produce plants which reached the surface of the ground. Ten per cent. of those that grew failed to develop large tubers. Only 67% of the seed planted developed salable tubers. They were clean and quite free from scab. Fifteen per cent. of the plants in this lot showed traces of the fruiting stage. Two hundred pounds of seed gave a return of 1,080 pounds of tubers. A return of 5⅖ pounds of seed for every pound of seed planted. Giving a gain of 41% over Check, or about 32 sacks to the acre.

Plat III—This seed was carfeully selected. All tubers containing sclerotia were rejected. However, many of these were rough and scabby, and all of them were more or less covered with the hyphae. These plants also came up very unevenly. Seventeen per cent. of the seed planted failed to produce plants which reached the surface of the ground. Twenty-eight per cent. of those that reached the surface failed to develop normal tubers. Seventy per cent. of this seed produced plants which developed fair-sized tubers. These tubers were rough and more or less covered with both hyphae and sclerotia. Twenty per cent. of the plants showed traces of the fruiting stage. One hundred and fifteen pounds of seed produced 497 pounds of tubers. A return of 4 8-25 pounds for every pound of seed planted. The yield being nearly the same as that of the Check.

Results.—1. Diseased tubers are frequently prominent factors in producing crop failures.

2. The fruiting stage of this fungus apparently develops more freely on plants grown from tubers containing many sclerotia.

3. Carefully selecting seed free from sclerotia, but more or less covered with the hyphae of this fungus did not check its injuries to any marked extent, but the fruiting stage of the fungus developed less freely on the plants from the selected seed.

4. The standard corrosive sublimate treatment apparently checks the development of this disease when the treated seed is planted in new soil.

TABLE XI., SHOWING RESULTS OF EXPERIMENT NO. XI.

Plat Number	TREATMENT	Number Pounds of Seed Tubers Planted	Total Number Pounds of Tubers Harvested	Yield for Every Pound of Seed Planted	Gain	Yield in Sacks per Acre
I.	Check	325	1240	3.81		23
	Treated, Corrosive Sublimate 1 oz. to 8 gals. of water, 1½ hrs.	200	1080	5.40	41%	32
	Selected free from Sclerotia	115	497	4.32	13%	26