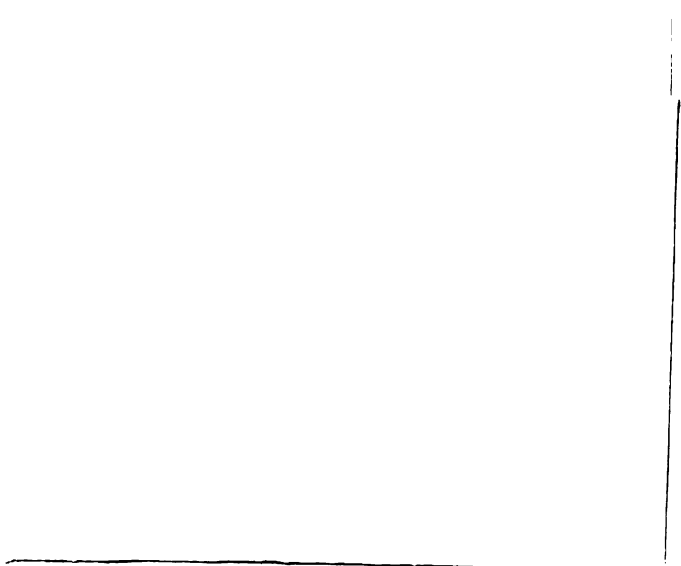




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Potato Culture Investigations.

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The potato as an article of food ranks second to no other agricultural product. It is found upon the table of the millionaire as well as upon the table of the peasant. The failure, or partial failure, of the crop over any large section of the country brings wide spread suffering. The famine in Ireland in 1846 was in a very large measure due to the destruction of the potato crop by the ravages of late blight. In our own country in recent years blight has frequently caused the destruction of the crop over considerable areas, and were it not for the facility with which crops are moved in this country great suffering would often be experienced in certain localities. During the present winter of 1901 - 2 thousands of bushels of potatoes have been imported from Europe, and this importation was made necessary because the potato growers of America have not learned the laws which apply in potato growing. The universal importance

of the crop, and a belief that the rules of potato culture were being violated led to the inauguration of the experiments herein discussed.

The potato crop stands second only to maize in being the most valuable agricultural contribution of America to the world. It is found that in the most densely populated countries of Europe, that where most intensive tillage is practiced the potato crop responds to the extra care given and the amount of food product is greater than that which would be furnished by any other crop on equal area. According to statistics obtained from the reports of the United States Department of Agriculture (Division of Statistics, Miscellaneous Series, Report No. 5 1893) we learn that "Germany is the greatest potato producing and consuming country in the world," the average annual production being nearly 900 000 000 bushels.. As grown in Germany the potato is given what we would term "garden" culture. As the potato is grown in the United States there is no other crop which will endure the neglect and yet produce a fair crop, and so far as we have learned no other crop responds more liberally to improved

conditions than does the potato.

The experiments herein described were inaugurated at the grounds of the Cornell University Agricultural Experiment Station in 1895, and during the first year the details of the work were in charge of Professor George C. Watson to whom we give credit for conducting the work during the first season. We also acknowledge the helpful advice at all times of Professor I. P. Roberts.

Object of the Experiment in 1895.

The experiments during 1895 were distinctively to determine the effects of tillage upon the yield of potatoes.

The Soil.

The land selected for the work was a gravelly loam which had been heavily cropped for previous years, the rotation having been wheat, clover, corn and oats. In 1894 the land was all planted to corn the fertilizer applied being about ten tons of mixed barn manure per acre, and evenly distributed over the entire area.

Preparation.

In the Fall of 1894 after the corn had been removed all plats were plowed. In the Spring of 1895 all plats were gang plowed, the soil was harrowed and the furrows were laid off at distances of forty inches. The furrows were opened deeply by means of a double mould board plow and the potatoes were planted on May 3rd, and 4th.

Size of Plats.

The plats were each one-twentieth of an acre in area and so laid off that six rows of potatoes could be grown upon each plat. Separating the outside rows upon each plat was a space of six feet and eight inches and in the center of this space, or three feet and four inches from the outside row on each plat, was planted a row of potatoes which was discarded at the time of digging. In all plat experiments, especially where the plats are of small area it is important that the outside rows of each plat be grown under the same conditions so far as possible as the other rows.

Seed Tubers used.

The seed tubers used were in every case good marketable potatoes. Not the largest but those of medium size being selected. They were cut so that there should be at least one good strong eye to the piece, and after the furrows were opened the seed pieces were dropped one piece in a place and pieces fourteen inches apart in the row.

Record of Planting

The record of planting the various plats was as follows:-

May 3--planted plats 21 and 22 to Rural New Yorker No.2.

May 4--planted plats 23 and 24 to Orphan.

May 4--planted plats 25 and 26 to Rural New Yorker No. 2.

May 4--planted plats 27 and 28 to American Wonder.

The seed was all dropped carefully in place by hand, and the covering was done by means of a hoe, about four inches of soil being placed over each piece, all being covered as uniformly as was possible.

Record of Tillage.

The first tillage given the potatoes was on the tenth of May, when a Freed's weeder was used. On the seventeenth of May the spike tooth harrow was used. Both of these cultivations were given before the plants had appeared above ground, and the work done by the harrow was especially valuable in loosening the surface soil. On May 23rd, May 29th, and June 6th, all plats were tilled with a spring tooth cultivator. Up to this time the treatment of all plats was alike but from now on the treatment varied. The following is a complete record of the tillage given after June 6th.

June 17- Plats 21, 23, 25, and 27, cultivated.

June 24- All plats cultivated.

July 2- Plats 21, 23, 25, and 27 cultivated.

July 9- All plats cultivated.

July 15- Plats 21, 23, 25 and 27 cultivated.

July 23- All plats cultivated.

July 29- Plats 21, 23, 25 and 27 cultivated.

August- All plats cultivated.

The tillage continued until the vines entirely covered

the space between rows when further tillage would have damaged the vines.

Records of Yields.

The record of yields from the various plats is shown in the following table.

Plat No.	Number of cultivations.	Yield per acre bushels.
21	13	378
22	9	415
23	13	319
24	9	414
25	13	304
26	9	311
27	13	350
28	9	330

The average of all plats receiving thirteen cultivations was 337 bushels. The average of all plats receiving nine cultivations was 367 bushels. These yields are high even though superior tillage was practiced. But the season was exceedingly favorable, the average yield per acre in New York being 122 bushels.

Conclusions from the work for 1895

The very satisfactory yields obtained leads to the conclusion that by thorough preparation of the soil and by giving the potatoes superior tillage the yield per acre may be considerably increased. There seems however to be a limit to profitable tillage for it is seen that better results were secured with nine cultivations than with thirteen. The reason for this is thought to be due to the fact that the thirteen cultivations kept the vines so frequently disturbed that the tubers were retarded in their development because of the injury done to the vines.

Potato Experiments in 1896

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Soil.

The soil upon which the potato experiments were conducted in 1896 was similar to that of 1895. Adjoining one-twentieth acre plats were selected for the work, and all the plats had been planted to corn in 1894 and 1895.

Preparation of Soil.

In the fall of 1895 after the corn was harvested all plats were seeded to wheat as a cover crop. This seeding was done after harrowing the land and without plowing. The purpose of this cover crop was to protect the soil from erosion, to preserve the soluble plant food and to add to the humus of the soil when plowed under in the Spring. It is found in the latitude of New York there is no better cover crop for late seeding than wheat or rye. In the Spring of 1896 the land was plowed as

early as conditions would permit and immediately after being plowed was harrowed and rolled. Before planting the Acme harrow was used to loosen the surface soil. Rows were marked off at distances of forty inches and the furrows were opened by means of a double mould-board plow.

Planting.

The variety of potatoes planted was Rural New Yorker No.2. The tubers were from selected stock and were cut into large pieces with from two to three eyes to the piece. Pieces were dropped in the rows fourteen inches apart, and in covering them a cultivator with wide teeth was used to roll the soil over the potatoes. All plats were planted May 9, and the conditions as to soil treatment and seed used were alike except as hereafter noted as to fertilizer used. It is found that in cutting the seed tubers as they were cut in this experiment about sixteen bushels are required per acre. The record of cultivation and yields is shown in the following table.

 Record of potato plats for 1896.

Plat No.	Date of plant- ing.	No. of cultiva- tions.	Date of dig- ging.	Yield per acre Bushels.	Remarks.
6	May 9	7	Oct. 9	318.2	Fertilized with 200 lbs. muriate of potash and 300 lbs. of acid phosphate per acre.
7	"	7	"	310.5	Fertilized with 200 lbs. sulphate of potash and 300 lbs. of acid phosphate per acre.
8	"	7	"	350.3 :	Comparable.
9	"	11	"	338.1 :	
10	"	3	"	280. :	
11	"	3	"	299.7 :	Comparable.
12	"	7	"	341.6 :	
13	"	7	"	334.	Variety test.
29	"	7	"	360.6	Fertilized with 200 lbs. muriate of potash and 300 lbs. of acid phosphate per acre.
30	"	7	"	333.5	Fertilized with 200 lbs. of sulphate of potash and 300 lbs. of acid phosphate per acre.
31	"	7	"	346.5 :	Comparable.
32	"	11	"	339. :	
33	"	3	"	245.8 :	

Those marked "comparable" are to be studied for the effect of tillage only.

Tillage.

The first tillage was given on May 20th. before the plants had appeared above ground, and the implement used was a spike tooth harrow. The final cultivation was given on August 6th. at which time the large growth of vines made further working detrimental. In the experiments of 1895 all the plats were given excessive tillage and no check plats were provided for. As potatoes are usually cared for by the farmer they receive cultivation about three times and are then "laid by." In 1896 certain plats received only three cultivations, but the preparation of the soil was equally thorough for all the plats, and before the plants had appeared above ground more tillage had been given than is ordinarily bestowed upon the potato land during the entire season as the farmer usually grows the crop.

Remarks upon the Fertilizer used.

Four plats were treated with commercial fertilizer the object being to determine the effect upon the yield and also upon the quality of the tubers. Plat No. 6 received 200 pounds of muriate of potash and 300 pounds of

acid phosphate per acre; plat No. 7 received 200 pounds of sulphate of potash and 300 pounds of acid phosphate per acre. The yield from these two plats were not increased in the least by the application of fertilizer and so far as competent judges could determine there was no difference noticeable in the quality of those potatoes which were grown with muriate of potash as a fertilizer and those grown with the sulphate of potash. The fertilizer experiment was duplicated upon plats 29 and 30. Plat 29 gave an increased yield but upon one comparison no conclusion can be drawn. The quality of the potatoes was as good from one plat as from the other and as far as we have been able to learn ^{either or muriate} sulphate _{of} potash may ~~either~~ be used upon potatoes without effecting the quality of the tubers produced. As muriate of potash is usually from five to ten dollars per ton the cheaper, it would seem to be the best source of potash as a potato fertilizer.

Yields From the Various Plats.

The main object of the experiment was to determine the effect of tillage upon the yield of potatoes. For

this purpose various plats were treated alike in every way except as to the tillage given. Plats 8, 9 and 10 are comparable. Plat 8 was cultivated seven times, plat 9 was cultivated eleven times and plat 10 was cultivated but three times. Plat 8 which received the seven cultivations gave the best results. The indications were that upon plat 9, the tillage was over done and the results secured in 1895 point also to the same conclusion that in cultivating potatoes there is a limit to the number of times they may be profitably tilled. This is explained by the fact that when the vines get large and cover the space between the rows the extra tillage at that time seems to injure the vine and it is wise policy to discontinue cultivation at such times. Owing to this injury to the vines by late tillage it seems a good policy to have the space between the rows of considerable width and crowd the potatoes in the row. Plats 31, 32 and 33 confirm the conclusions reached upon the previously mentioned plats that the excessive tillage produced injury rather than benefit. In addition to the cultivation which was given all plats were sprayed four times with Bordeaux mixture and Paris green.

The claim is frequently made that while potatoes grown upon a small plat may yield very satisfactorily yet if they were grown upon a larger area the same good results would not hold true. To answer this objection in part a measured acre of potatoes was grown in 1895. The soil was a clay loam from which a crop of timothy and clover hay had been cut in 1895. During the winter of 1895 - 6 a top dressing of strawy manure was given the land and in the spring the straw was removed with the horse rake leaving only the fine material to plow under. In the Spring the land was fitted and the field was planted to potatoes, variety Rural New Yorker No. 2. This acre received six cultivations and yielded 314 bushels. The results show that what has been done upon small plats of one-twentieth acre each may be duplicated upon larger areas. The following summary shows the results for 1895 and 1896.

Average yield per acre for 1895.

Plats receiving 13 cultivations	337.5 bushels.
" " 9 "	307.5 "

Average yield per acre for 1896.

Plats receiving 11 cultivations,	335.9 bushels.	
" " 7 "	343.1	"
" " 3 "	275.2	"
The one ^{acre} field, 6 cultivations,	314.	"
Fertilized plats receiving 7 cultivations	330.7	"
Average yield per acre for New York state (United States Census), 1890	68.8	"
Average yield per acre for New York state, 1895,	122.	"
Average yield per acre for all plats and the one acre at Cornell University for 1895 and 1896,	333.34	"

The very satisfactory results obtained for two years in succession and without the application of fertilizer, except as noted, led to the investigation of the plant food contained in the soil for the purpose of determining if the total plant food was greater in amount than that usually contained in agricultural soils.

Roberts in "The Fertility of the Land" gives the analyses of forty-nine soils. Many of these analyses were made by Dr. R. C. Kedzie and are published in Michigan Agricultural Experiment Station Bulletin No. 99. The average of

these 49 analyses shows the following amount of total plant food contained in the surface eight inches of soil upon one acre.

Phosphoric acid, 4219 pounds.

Nitrogen, 3053 "

Potash, 16317 "

An analysis was made of the soil from plat No. 32 and there was found in the surface eight inches the following amounts of total plant food per acre.

Phosphoric acid, 2523 pounds.

Nitrogen, 2049 "

Potash, 8042

It will be seen from a comparison of the analyses that the potato soil contains only about one-half the amount of plant food found in the usual soil. In the usual analysis of a soil the gravel is not taken into consideration and only that part is analyzed which passes through a sieve of 50 meshes to the inch. In the case of the potato soil we found that 41.85 per cent of the soil was so coarse it would not pass through a sieve of 18 meshes to the inch. This coarse soil or gravel was analyzed

and in the surface foot upon an acre of land the amount of potential plant food was found to be as follows,

Phosphoric acid, 4008 pounds.

Potash, 11329 "

Every time this land was tilled some of this gravel was broken down and plant food was liberated, and to this fact must in part be ascribed the beneficial effects secured by the intensive tillage given the potatoes. The soil is within the area of glacial drift and the rocks from which the mineral portion of the soil is made were rich in potash, and this is seen now in the fully decomposed or fine soil and in the partly disintegrated material or gravel.

Conclusions from work of 1896.

1 - Tillage is of value not only in destroying weeds and conserving moisture but it actually serves to make plant food available.

2 - Tilling seven times during the period of growth gave best results. In all cases a large amount of tillage was given in soil preparation and this serves to produce a satisfactory yield upon all plats.

3 - Commercial fertilizer does not always increase the yield. The amount of plant food a growing crop can make use of depends in part upon the moisture supply. During the present season the tillage liberated all the plant food that could be used with the amount of moisture present.

4 - Muriate or sulphate of potash may either be used without affecting the quality of the potatoes.

5 - Spraying with Bordeaux mixture and Paris green protected the foliage from beetles and from blight, and it is of importance that the foliage be kept healthy at all times.

Potato Investigations in 1897.

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During the years of 1895 and 1896 the conditions which prevailed throughout New York were favorable for large yields of potatoes and enormous crops were produced. But the year of 1897 was radically different. Potato blight caused the entire destruction of the crop over large areas, and in other sections where the crop was not entirely destroyed it was greatly injured. The result was that while in 1896 potatoes had netted the farmers not more than five to ten cents per bushel the price for the 1897 crop was from fifty to seventy-five cents per bushel. It seems to be a quality of human nature that when all crops prosper there is but little demand for information, but let adverse conditions come and there is immediately a great call for information as to how the adverse conditions may be overcome. It is no great credit to grow a good crop in a good season when all things

are favorable. Every body else grows a good crop and as a result the price for the product is low.

Objects of the Experiments in 1897.

The general objects were the same as during 1895 and 1896, to determine the effect of improved soil conditions upon the potato crop. In addition to the soil conditions, tests were also made of the efficiency of spraying with Bordeaux mixture to prevent blight.

Preparation of the Land.

After the removal of the crop in the fall of 1896 the land was plowed and sown to oats and peas as a cover crop. The oats and peas made a good growth and served a useful purpose in preventing soil erosion in conserving the soluble plant food, and when plowed under in the Spring humus was added to the soil. The peas being legumes added somewhat to the nitrogen content of the soil. The spring plowing was done April 2, and 3, and between those dates and the time of planting the soil was stirred frequently with the Acme harrow. Thus the moisture which had been stored up by fall and winter rains was not

wasted by evaporation and was largely retained for the potato crop.

Selecting "seed" Tubers.

The "seed" used was selected with special care and consisted of good marketable potatoes. These are cut so that each piece shall have from two to three buds upon each piece, but if there is but one bud it is considered sufficient. The bud end of the potato is not discarded but is always divided so too many shoots may not start from one hill. In cutting seed tubers the size of each piece is of more importance than the number of buds upon each piece. While a single bud may produce good results when all conditions are favorable, yet it is the exception that all conditions are favorable and the prudent planter must provide for the adverse conditions. The potato is a perennial as it grows under natural conditions, and the purpose of the enlarged underground stem or the tuber, is to serve as a storehouse for food upon which the tender plants will feed before they are sufficiently strong to draw from the soil. A good sized seed piece then should be planted and where this is done a strong vigorous shoot

is likely to result.

Planting the Potatoes.

All plats were planted on May 7. The rows were marked off at distances of forty inches and were opened deeply with a shovel plow, and then the seed was dropped, one piece in a place, and pieces fourteen inches apart in the row. Better results seem to follow by planting closely in the row and having the rows about forty inches apart. The covering of the potatoes was done with a hand hoe as it was thought more uniform covering could be secured, but this practice has since given away to what is considered a better method. The treatment given the various plats and the results are shown in the following table.

Plat No.	Variety.	No. of cul- tivations.	No. of times sprayed with For- deaux and Paris Green.	Total yield per acre bushels.
34	Carmen No. 3	8 level	4 times	384
35	" "	"	"	357
36	" "	5 level	"	349
37	" "	"	"	325
38	" "	5 hilled	"	288
39	Rural New Yorker No. 2	5 level	No times	234
40	" "	"	4 times	305
41	" "	7 level	"	347
42	Rose of Sharon	"	"	320
43	" "	5 level	"	311

Several points of interest are shown by the above table. Plats 34, 35 and 36 received the same treatment in every way except as to tillage. Plat 34 had been treated differently from the other plats during 1896. It was sown to spurry (*Spergula arvensis*) and the growth was plowed under, so that no crop was removed from the plat in 1896. This gave it some advantage over the other plats and it responded by giving the largest yield secured upon any

plat.. It is a matter worthy of notice in connection with the growth of the spurry that though the entire crop was plowed under deeply, and a cultivated crop has been grown upon the land every year since, that in 1901 the plat was well covered with spurry plants which had come from the original seeding, or from plants which had escaped cultivation and developed seed. Upon all plats except 34 forage crops were grown in 1896.

Attention is called to the results on plats 37 and 38. These two plats were treated alike in every respect except that at the last time of cultivating plat 37 was left level and plat 38 was hilled. The result shows a yield of thirty-seven bushels more per acre on the plat left level than on the plat hilled. If in any season the hilling would have shown good results it should have been during the present season. Rain was abundant and at no time during growth was it apparent that the plants were suffering because of lack of moisture. The reason ordinarily given for hilling potatoes is that it is done to keep tubers from growing out of the ground and becoming sunburned. If the land be properly fitted and the planting properly done the potatoes will not grow out of

the ground. On the plat where level culture was given no potatoes were thrown out because of sunburning. The potato loves a moderately cool, moist soil and the hilling process is not adapted to produce these conditions. In the case of the two plats mentioned above, the falling off in yield of potatoes on the plat receiving hill culture means the present season a loss of \$24.00 per acre, as the potatoes were sold direct from the field for sixty-five cents per bushel.

The general results with culture verify the results obtained in 1896, i.e. that in the ordinary season about seven to nine cultivations with a fine toothed implement are likely to give best results. As the vines of the potato spread so as to cover a portion of the space between the rows the cultivating implement should be made narrower so that it will not come into too close contact with the plants.

It has been stated that during 1897 the potato blight was especially severe and that throughout the entire state the potato crop was injured and in many localities entirely destroyed. Plat No. 39 was not sprayed with Bordeaux mixture but the potato beetles were kept in

check with Paris green applied with gypsum. Plat No.40 with which plat No. 39 is comparable was sprayed with Bordeaux mixture and Paris green four times. The yield upon plat 39 was 234 bushels per acre while the yield upon plat 40 was 305 bushels per acre. This difference of 71 bushels per acre can only be accounted for by the spraying of one plat and not spraying the other. Plat 39 was badly affected with the late blight, while upon plat 40 there was no evidence of blight. The money loss per acre upon the plat not sprayed was over \$40.00. The cost of spraying an acre four times would not have exceeded six dollars. In addition to the fungus enemies of the potatoes as the early and late blights there are insect enemies which must be cared for or they will destroy the crop.

In the Spring there appears first the little leaf flea-beetle (*Crepidodera cucumeris*). This is a small black beetle which sucks the foliage and while it does not eat the leaf, yet the tissue at the point of injury dies and the leaf soon has the appearance of being filled with shot holes. These injured places make favorable resting places for the spores of blight; the leaf is

injured in vitality, and anything which injures the vigor of the plants makes them more susceptible to attacks of blight. The only remedy we have found effective in combatting the little leaf flea-beetle is Fordeaux mixture. While it does not kill the beetles yet in some way it is obnoxious to them and for several years we have successfully combatted them by thoroughly spraying with Fordeaux mixture in the early spring. The plants are protected from the early blight, and if Paris green is put in the Fordeaux mixture, as it should always be, the Colorado potato beetle (*Doryphora decemlineata*) is successfully combatted at the same time. The successful potato grower must provide means for spraying his entire acreage of potatoes if he would guarantee success.

Hilled Culture compared with Level Culture.

As potatoes are usually grown in New York they are planted shallow, and then at about the third cultivation an implement is used which ridges or hills up the soil around the plants and tillage then ceases for the season. This practice seems very firmly fixed. The reasons usually given for this practice are that it covers the

potatoes deeply and keeps them from becoming sunburned; that the weeds do not bother after the hilling as they do when the ground is left level; that potatoes do not rot so badly when they are given hill culture and that when it comes to digging, the work is much more easily performed than when level tillage is practiced. There is some truth in all these statements, but the entire truth is not expressed by them. The prime object of potato growing is to produce potatoes and all of these other points are simply incidental. Plots 37 and 38 were treated alike in every ^{way} except that plot 37 was cultivated five times and the land left level, while plot 38 was ridged at the last working. The yield from the plot receiving level tillage was 325 bushels per acre and from the hilled plot the yield was 288 bushels per acre. This difference of 37 bushels per acre can only be accounted for by the difference in the treatment of the soil. We believe the popular notion about hilling potatoes upon a dry upland soil is erroneous, and that the main object is lost sight of. If the land is properly fitted before potatoes are planted and the potatoes are planted deeply the potatoes will not grow out of the

ground except in rare cases. The weeds do not grow so rapidly where ridged culture is given because the ridging burys the weeds deeply and then the surface of the ridge becomes dry and weeds do not start again. Conditions which are favorable for the growth of potatoes are favorable for the growth of weeds and vice versa. It seems ^{are} to be true that where the land is ridged the potatoes not so subject to the rot. This is possibly due to the fact that the spores which cause rot are supposed to fall from the potato tops to the ground. If the ground is ridged these spores have a tendency to be washed to the centre of the space between rows and thus may be accounted for the fact that ridging seems to prevent potato rot. If however the potatoes are thoroughly sprayed with Bordeaux mixture the blight may be guarded against and the necessity for ridging obviated. The matter of digging will be quickly settled when potato growers demand implements which will dig potatoes not ridged. Manufacturers will meet the demand of the farmers, and already we have diggers which are guaranteed to dig potatoes under all conditions. All of the objections to level tillage do not outweigh the fact that by means of it more potatoes may

be raised if proper care is given the plants.

One Acre Potato Field.

In addition to the series of experimental plots which have been described, one acre of potatoes was planted on the land where 314 bushels of potatoes had been harvested in 1896. Previous to 1896 this land had been subjected to a regular four years' rotation of wheat, meadow, corn and oats. In the Fall of 1895 a light application of strawy manure was applied and then the straw was all raked off in the Spring before plowing the land for potatoes. The yield in 1896 was 314 bushels. Without any additional manure or fertilizer the land was again planted to potatoes in 1897, and a yield of 273 bushels obtained from the acre. Five cultivations and four sprayings were given, the first three sprayings being with Bordeaux mixture and Paris green and the last being with Bordeaux alone. This field was somewhat neglected owing to the wet August and the weeds were permitted to grow. While it was late in the season when the weeds were allowed to grow, there is no question but what the yield of potatoes was materially decreased by them. To see what

effect weeding would have, four rows were cleared of the large weeds by hand and it was found upon harvesting that the weeding had increased the yield at the rate of 30 bushels per acre. The whole potato field should have been kept perfectly free from weeds until the time of harvesting. A source of material loss to the potato crop is frequently due to the fact that in late Summer and early Fall the weeds are allowed to grow.

Potato Experiments in 1898.

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Details of Experiment.

The land selected for the experiment in 1898 was a portion of the series of plats upon which the experiments had been conducted in previous years. The soil is gravelly and porous and especially subject to injurious effects from droughts. The potato crop grown in 1898 was the fifth crop removed from the land since any fertilizer or manure had been applied. The soil was beginning to show a deficiency of humus owing to the intense culture which had been given and the slight returns of organic matter. While cover crops of crimson clover, wheat or rye had been used, yet necessarily the growth had been restricted and the amount available to plow under in the Spring had been small. The result of this deficiency of humus was shown in the tendency of the soil to become hard and compact under the effects of beating rains. In order to keep a soil permanently in good physical

condition, it is absolutely necessary that organic matter be returned in some way either by green manuring or the use of barn manures.

Previous treatment of the Soil.

The plats entering into the experiments had been cropped heavily for five years since any manures were applied with the exceptions noted below. In the Winter of 1893 -4, about ten tons of mixed barn manure were applied per acre. In 1894 all plats were planted to corn which was one of the regular crops in the four years rotation. Previous to 1894 the rotation which had been practiced was wheat, meadow (clover and timothy) corn and oats. The crops which have been produced upon the various plats since 1894 are shown in the following table.

Plat No.	Crop 1894	Crop 1895	Crop 1896	Crop 1897	Crop 1898
21	Corn	Potatoes	Corn	Oats	Potatoes
22	Corn	Potatoes	Corn	Corn	Potatoes
23	Corn	Potatoes	Corn	Oats	Potatoes
24	Corn	Potatoes	Corn	Oats	Potatoes
25	Corn	Potatoes	Corn	Oats & Peas	Potatoes
26	Corn	Potatoes	Corn	Oats & Barley	Potatoes
27	Corn	Potatoes	Corn	Peas	Potatoes
28	Corn	Potatoes	Corn	Barley	Potatoes
29	Corn	Used for roadway	Potatoes fertilized	Barley	Potatoes
30	Corn	Potatoes	Potatoes fertilized	Oats	Potatoes
31	Corn	Corn	Potatoes	Oats	Potatoes
32	Corn	Corn	Potatoes	Oats & peas	Potatoes

Record of Planting in 1898.

The land was plowed in early Spring to a depth of about ten inches. Shortly before the time for planting the land was replowed with the gang plow, the furrows being turned to a depth of about four inches. The surface was then thoroughly pulverized with the harrow. The rows

were marked off at distances of forty inches and furrows were opened by means of a shovel plow to a depth of about five inches. If the land has been plowed shallow it will be impracticable to open the furrows to such a depth.

The "seed" was from first class stock, large, marketable potatoes only being used. These were cut into pieces containing from one to three eyes to the piece. The pieces were dropped in the furrows directly after the furrows had been opened, one piece being put in a place and at distances fourteen inches apart in the row. The shovel plow was again used and a furrow was opened in the middle of the space left when the first furrows were opened. This second use of the shovel plow served to cover the potatoes, the earth being ridged up directly over the potato row. The planting was done on May 10. The soil was then left undisturbed until May 28. The ridges which were left over the seed potatoes covered them to about the depth of eight inches. By May 26, the weed seeds which were in the surface soil had germinated and the whole surface was covered with tiny weeds. A spike tooth harrow was fitted with a piece of 2 x 4 scantling placed diagonally across underneath the frame

and held in place by the harrow teeth. The harrow thus rigged was used upon the potato plats, being first run lengthwise of the rows and then crosswise. The weight of the driver upon the harrow was necessary in order to make it do the leveling as required. The benefit derived from this treatment was very marked. All weeds were destroyed, the surface crust was broken, all clods and stones were removed from above the row and deposited in the center of the space between rows, the surface was leveled and in every way the conditions were made favorable for the rapid growth of the potatoes, and the plants appeared above ground in three or four days.

The treatment which the various plats received during the season and the yield from each plat are shown by the following tabular statement.

Plat No.	Date planted	Variety of potatoes.	No. of cultures.	No. of spray- ing.	Date of digging.	Yield per acre bushels.
21	May 10	Endurance	6 level.	7	Oct 18	398.6
22	"	Carman No.3	6 "	7	" 18	344.8
23	"	" "	3 "	7	" 18	303.3
24	"	" "	3 "	7	" 17	340.
25	"	" "	3 hilled	7	" 17	327.5
26	"	" "	6 level	7	Sept.29	310.5
27	"	" "	3 "	7	" 29	289.6.
28	"	" "	3 "	7	" 29	289.8
29	"	" "	6 "	7	" 29	213.6
30	"	" "	6 "	0	" 29	206.1
31	"	Rose of Sharon	6 "	7	" 29	118.6
32	"	Endurance	6 "	0	" 29	232.

Observations upon the above Table.

The variety Endurance which was grown upon plat 21 and 32 was claimed to be proof against blight. While plat 21 was sprayed with Bordeaux mixture Plat 32 was not sprayed and it seemed to have strong resisting powers. The results from tillage were not so marked as in some

previous years. The difference between the level and the killed culture as shown on plats 24 and 25 was only 13 bushels per acre. During July there prevailed a severe drought. At times the soil was found upon examination to have only four per cent moisture in the surface foot. This condition without doubt seriously injured the crop, but the plants were able to maintain themselves and when the rain came in August growth was renewed. During the dry weather the soil showed the effect of the heavy cropping to which it had been subjected. The humus had been depleted and it was unable to hold moisture even though thorough tillage was practiced. The importance of keeping the soil well supplied with humus at all times was emphasized.

Field potatoes 1898.

An area of 1.01 acres, the larger part of which had been devoted for several years to the raising of mangold wurzels, was planted to potatoes May 28. The land was fitted similarly to the manner described on the plats. fertilized Part of this land had been [^]for several years with annual applications of barn manures, and had been brought into

good condition.

Preparation of the Seed.

About three weeks before the potatoes were planted the seed was cut. It was the purpose at the time of cutting the seed to plant the potatoes within a few days, but almost continuous rain delayed the work until the end of May. The potatoes which had been so long cut, had been very much weakened in vitality, having heated and moulded somewhat. They were planted, however, and the stand secured was very poor, a considerable portion of the field having to be replanted.

The furrows for the potatoes were opened with a double moldboard plow, the rows forty inches apart and the potatoes were dropped one piece in a place at distances of 14 and 18 inches apart. The double mold-board plow was then used in covering the potatoes and the soil was left ridged up above the rows. As a portion of the field was a clay loam soil and rather wet at the time of planting, the harrow was used within one week and the ridges were leveled down and clods were pulverized before they became too hard and dry to crush easily. The soil

was warm and moist and the potatoes came up quickly.

About the time they were breakin, through the surface the weeder was used with good results. It broke the crust and destroyed weeds that could not be reached with the cultivator. Bordeaux mixture with Paris green was used five times and five cultivations were given. The yield from the field containing 1.01 acres was 216 bushels, or a yield of 214 bushels per acre.

Lessons drawn from the Acre of Potatoes.

Seed should not be cut for any considerable period before planting. If it becomes necessary to delay planting for some considerable time after potatoes are cut, the cut pieces should be dusted with plaster and spread out in a moderately moist, cool place. At least they should not be allowed to heat, neither must they be allowed to become dry.

If planting is done very early in the Spring the ridges may be permitted to remain for ten days to two weeks before harrowing down. If planting is done somewhat late the ridges should be harrowed within one week after planting. In the case of the early planting there

is usually enough moisture present so that the ridging may temporarily prove a benefit by enabling the soil to become warm. In the case of late planting all the moisture should be conserved, and this is best done by leveling the ridges.

Several causes contributed to the low yield on the acre field, chief among which were seed which had become weakened in vitality thus necessitating replanting, late planting, excessive drought in July, followed by excessive rains. While the land had been receiving fairly liberal applications of manure and was in a good state of fertility, yet the causes above mentioned conspired to produce but little more than half the crop which should have been produced under favorable conditions.

Potato Investigations in 1899

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The Summer of 1899 was exceedingly hot and dry, so abnormal were these conditions that we deem it worth while to present the following tables giving the records of rainfall and temperature during the growing season.

Record of Rainfall.

Month	Rainfall inches.	Departure from the normal inches.
April.	1.45	- 0.75
May	2.90	- 1.16
June.	1.99	- 1.59
July.	3.46	- 0.29
August.	2.31	- 0.97
September.	2.16	- 0.84
October.	2.34	- 0.71

Record of Temperature.

Month.	Average temperature.	Departure from the normal.
April.	48.7 ^o Fahr.	+ 4.2 ^o Fahr.
May.	58.1 ^o "	+ 0.7 ^o "
June.	67.8 ^o "	+ 1.1 ^o "
July.	70.8 ^o "	+ 0.6 ^o "
August.	71.4 ^o "	+ 3.4 ^o "
September.	59.2 ^o "	+ 1.9 ^o "
October.	54.1 ^o "	+ 4.4 ^o "

It will be seen that there was a deficiency in rainfall for each month and that the entire deficiency was 6.31 inches. This fact of itself would have been sufficient to account for unsatisfactory conditions. But combined with this deficiency of rainfall was high temperature. The combined effect of these two conditions accounts for a low yield of potatoes in 1899 which good tillage was not able to overcome.

Soil Conditions.

The plats on which the potatoes were grown were a part of the permanent series which have been heretofore

described. The soil was gravelly and has become deficient in humus and the effect of this deficiency was plainly seen in the crop. All plats were one-twentieth of an acre in area and in planting unless otherwise noted the method described as practiced in 1898 was pursued. It should be remembered in studying the following table of results that no manure has been applied to the land since 1894.

Record of Results in 1899.

The following table gives a record of the methods of treatment for each plat and also the yields.

Record of Plats 1899.

Number of Plat.	Date planted.	Variety of potatoes.	Number of culti- vations.	Number of sprayings.	Yield per acre, bush- els.
Shallow planted.	33 May 6	Endurance	9	6	209
	34 May 6	Endurance	9	6	201
	35 May 6	Endurance	9	6	192
	36 May 6	Endurance	9	0	144
	37 May 6	Endurance	3	6	188
Filled Level	38 May 6	Endurance	6	6	169
	39 May 6	Endurance	9	6	174
	40 May 6	Endurance	3	6	194
	41 May 6	Endurance	3	6	195
	42 May 6	Endurance	6	6	233
	43 May 6	Endurance	9	6	241

The average yield of potatoes for New York state in 1899 was 88 bushels per acre. It will be seen by a study of the table that the yields upon the plats for a year were not as large as they were in previous years.

The most marked result of the experiment was the yield upon plat No. 36. This was planted the same as

was plat 35, and was treated the same in every way during the season except that while the potatoes on plat No. 35 were sprayed with Bordeaux mixture and Paris green six times during the season the potatoes upon plat 36 received no Bordeaux mixture the Paris green necessary to kill the potato beetles being put on dry with gypsum. During the season of growth the results of the spraying were not apparent. So far as one could judge from the appearance of the vines the spraying had not produced any benefit. When the time for digging came, however, the plat which had not been sprayed with Bordeaux mixture yielded considerably less than the plat with which it was compared.

Between plats 40 and 41 there was no marked difference. Plat 40 was hilled while plat 41 was level. In our experiments heretofore we have found that the level culture has almost invariably given the better results. With the farmers throughout the potato growing section of New York state the custom is almost universal of growing potatoes by what is known as the "hilling" method. The average of all our results show that level tillage under ordinary conditions gives most satisfactory results.

Report of Potato Field, 1899

In our experiments we have considered it wise to devote an area to potatoes other than upon the permanent series of plats. Upon the field area in all cases has been made a test of the methods found most satisfactory upon our experimental plats. The area of the field was .476 acre. The soil was a loam bordering on a clay loam not what is considered choice potato soil. In 1898 the land was in a meadow, a crop of mixed clover and timothy hay having been cut. Afterwards the land was pastured so that what second growth was made of the clover and timothy was removed. In the early Spring the land was plowed and harrowed. The potatoes were planted May 9th. The rows were marked off three feet apart and the potatoes were dropped in the open furrow at distances of fifteen inches. During the drought of the growing season it was found that the potatoes suffered. Apparently the rows were too close, and from a careful observation of the potatoes during the growing season better results would likely have been secured had the rows been 40 inches apart instead of 36 inches. The following tabular statement shows the treatment given and the yield per acre.

Date planted.	No. of cultivations.	Times sprayed.	Date of harvest	yield per acre.

May 9.	5	5	Oct. 6	202 bus

The area of potatoes grown, being nearly one-half acre, and the yield show that even in a comparatively poor year for potatoes a fair yield may be obtained if proper conditions of soil are secured.

Lessons for the year 1899.

The most striking results were obtained in the spraying tests upon plats 35 and 36. In every way they were treated alike except that plat 35 was sprayed and plat 36 was not. The results were not apparent until the potatoes were harvested and weighed. Then it was found that the sprayed plat yielded at the rate of 48 bushels more per acre than the plat not sprayed. This would much more than pay for the extra labor involved. The tillage experiments were not marked in results as in former years.

Potato Investigations in 1900.

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The drought which prevailed in 1899 was repeated in 1900 with even more severity. So abnormal were the conditions that we present herewith the records of rainfall and temperature for the growing season of 1900

Record of Rainfall.

Month.	Rainfall inches	Departure from the normal inches.
April.	1.68	- 0.52
May.	1.51	- 2.25
June.	1.98	-1.60
July.	2.41	- 1.34
August.	2.93	- 0.35
September.	0.94	- 2.06

The total rainfall for the six months given was 10.00 inches below the normal, or the deficiency expressed

in tons was 1130 tons of water upon the acre.

Record of Temperature.

Month.	Average temperature.	Departure from the normal.
April.	45.4	+ 0.9
May.	57.1	+ 0.3
June.	67.0	+ 0.3
July.	72.0	+ 1.8
August.	72.3	+ 4.3
September.	64.9	+ 3.8

For every month except May the temperature was above the normal. During August and September the departure was most marked and when cool weather should have prevailed for best condition of the potatoes it was abnormally warm. These conditions are stated because they offer an explanation in part of most of the results secured.

Plat Experiments in 1900.

The plats were all one-twentieth of an acre in area and the soil a gravelly loam. For six years it has

been subjected to intensive tillage without the application of manures. The details of soil preparation and of planting were similar to those of other years. The results of the seasons plat work are given in the following table.

Record of Plats for 1900.

Number of Plat.	Date planted.	Variety of potatoes.	Number of culti- vations.	Number of sprayings.	Yield per acre bush els.
21	May 11	Carman No. 3	5	4	105
22	May 11	Carman No. 3	5	0	135
23	May 11	Carman No. 3	5	4	98
24	May 11	Carman No. 3	3	4	93
25	May 11	Carman No. 3	3	4	104
26	May 11	Carman No. 3	3 hilled	4	103
27	May 11	Carman No. 3	4	4	99
38	May 11	Sir Walter Raleigh	5	5	129
39	May 11	Sir Walter Raleigh	4	3	124
40	May 11	Sir Walter Raleigh	3	3	116
41	May 11	Sir Walter Raleigh	4	3	147
42	May 11	Sir Walter Raleigh	4	3	139
43	May 11	Sir Walter Raleigh	4	3	125

The average yield of potatoes for New York State in 1900 was 81 bushels per acre. While the yield was not low compared with the crop generally produced by the farmers of this section of the state, yet it was low compared with former yields reported. We have already

under the report of climatic conditions explained in part the reason for the falling off.

Proper Soil conditions must be maintained.

The results obtained this year give us an opportunity to answer a question which has been asked many times concerning our experimental work with potatoes. The question is "Do you recommend the practice of growing potatoes year after year upon the same land without the uses of manure or fertilizers?" We do not recommend the practice, and many have mistaken the real object of our work. We have attempted to demonstrate that plant food can be made available by thorough and judicious tillage and that more often the failure or partial failure of a crop is due to lack of moisture rather than to lack of plant food. Where the soil is in proper physical condition the moisture may be conserved through an extreme drought by means of frequent shallow surface tillage. But if the soil has become deficient in humus no amount of tillage is able to make good the deficiency. If all conditions are favorable as to rainfall and temperature the humus problem is not so important, but if it is

expected to carry a crop successfully through a season of drought as was the Summer of 1900, the soil must be abundantly supplied with humus or otherwise it will part with its moisture and the crop will suffer. Intensive tillage for best results through a series of years must be accompanied with the use of farm manures or green manuring. This is especially true of potatoes where best results are secured in a moist, cool soil. Abundance of humus favors both these conditions, so it is possible that the lesson from the potato plats in 1900 is as important as when larger yields were secured in previous years.

Record of the Field Area in 1900.

The area of the potato field was one acre. During the Winter of 1899 - 1900 a light application of farm manure was given the land, probably about ten tons of coarse manure were applied to the acre. The land was plowed and fitted in the early Spring and was planted to potatoes May 12th. The potatoes were planted in rows 40 inches apart and were covered deeply, the land being left in ridges over the seed pieces. Ten days after planting the land was harrowed twice over. After the

harrowing the growth of the plants was very rapid. We believe the practice of harrowing potato land after the potatoes are planted and before they are up is very important. The land may often be harrowed two or three times with profit. This method of procedure, however, can only be safely adopted where the potatoes are covered deeply, not less than four inches. The following tabular statement gives the record of the acre of potatoes for 1900.

Planted.	Variety.	No. of Cultivation.	No. of Spraying.	Date of Digging.	Yield per acre.
May 12.	17 rows to Carman No. 3 1 row to Endurance. 1 row to Hemisphere.	5	4	Sept. 24	200 bush.

While the total yield from the acre was 200 bushels the row of the variety, Endurance, yielded at the rate of only 143 bushels per acre. The row of the variety Hemisphere which was directly adjoining the Endurance yielded at the rate of 232 bushels per acre. The yield was satisfactory considering the season. The yield

would likely been somewhat larger had harvesting been delayed for ten days or two weeks. But inasmuch as the crop could be sold directly from the field at sixty cents per bushel it was harvested and sold. The considerable difference in yield between the potatoes grown upon the experimental plats and upon the one acre area can only be accounted for by the fact that the soil upon the one acre had received manure and was in much better physical condition. During the entire season the variety Hemisphere appeared more vigorous than did the other varieties.

Lessons from the Season's Work of 1900

Thorough preparation of the soil and intensive tillage are not sufficient. The soil is able to take up and retain moisture only when the humus content is maintained. So much emphasis has in recent years been laid upon the importance of thorough tillage that some have overlooked the fact that tillage unless accompanied by use of farm manures or green manuring may lead to dire results. Intensive tillage promotes rapid oxidation of the organic matter of the soil, and while the danger is ordinarily slight, tillage may be overdone. The man who

cultivates his potatoes every two or three days during a dry time may do them more harm than good. Shallow surface tillage every two weeks conserves moisture during a drought as well as does tillage every day, and does not make such severe demands upon the soil humus. In case of a rain the surface of the soil should be tilled soon, even though it has just previously been tilled. But after it is loosened it should be left alone for two weeks or more, unless rain makes the renewal of the surface mulch necessary. What is true with reference to potatoes is equally true concerning other intro-cultured farm crops, and in orchard management where conditions are similar to those which obtain in Central New York.

Experiments with Potatoes, 1901.

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The land selected for potatoes this year is a loamy soil bordering on clay loam, and a part of the area was planted to potatoes in 1900. It is soil which would be considered in good condition for the production of grass or grain, but for the production of potatoes of the best quality it is not ideal. In the Fall of 1900, after the crop for the year had been removed, wheat was drilled in upon the entire area. The wheat made a good growth and served well as a cover crop, and was plowed under May 9th, 1901, and the land was measured and staked off in areas of one-twentieth acre each. Twenty-three of these plats were devoted to potatoes. The rows were forty inches apart and the seed tubers were dropped one in a place and 15 inches apart in the row.. The Spring of 1901 was markedly different from that of 1900. During the months of March, April and May there was a surplus of rainfall above the normal of 2.68 inches. This amount

stated in inches fails to convey to the mind of the casual reader the amount of water which fell upon every acre during the three months in addition to the usual normal rainfall. It represents a surplus of 302.84 tons of water upon every acre. This amount of water upon land already well nigh saturated greatly retarded the work in the Spring, interfered with cultivation of the crop as in many cases the soil was stirred when it was too wet. The season as a whole was fairly satisfactory though the above mentioned conditions were unfavorable to the highest yield.

The following table shows the results obtained from a test of planters.

No. of plat.	Date planted.	Variety.	No. of cultivations.	No. of spray-ings.	Yield per acre Bushels.	Remarks.
1	May 16.	Carman No.3	6	2	229.	Planted with Jewett's Improved Potato Planter
2	May 16	Carman NO.3	6	2	263.	Planted with Eureka Planter.
3	May 16	Carman No.3	6	2	264.	Seed tubers dropped by hand and covered with shovel plow.
4	May 16	Hemisphere	6	2	245.	Planted with Jewett's Improved Potato Planter
5	May 16	Hemisphere		2	289.	Planted with Eureka Planter.
6	May 16	Hemisphere	6	2	274.	Seed tubers dropped by hand and covered with shovel plow.

The following table shows results secured from various meth-

ods of planting and care.

7	May 16	Hemisphere	4	2	276.	Planted the usual Cornell way.
8	May 16	Hemisphere	3	2	284.	Planted u'l Cornell way tilled 3 times, level.
9	May 16	hemisphere	3	2	259.	Planted u'l Cornell way tilled 3 times, hilled.
10	May 16	Hemisphere	6	2	272.	Planted Cornell way, and pruned vines to 1 stem.
11	May 16	Hemisphere	6	2	293.	Opened furrows deep, covered shallow first and worked soil toward plan
12	May 16	Hemisphere	6	2	282.	Planted usual cornell way.

Table following showing results secured with Carman No.3
Potatoes.

No. of Plat.	Date plant- ed.	Variety.	No. of cultiva- tions.	No. of spray- ings.	Yield per acre Bushels.	Remarks.
13	May 16	Carman No.3	4	1	227.	Planted usual Cornell way. Sprayed but once.
14	May 16	Carman No.3	4	2	247.	Planted usual Cornell way.
15	May 16	Carman No.3	4	2	246.	Planted usual Cornell way. Hilled.
16	May 16	Carman No.3	4	2	250.	Planted usual Cornell way.
17	May 16	Carman No.3	6	2	238.	Planted Cornell way.
18	May 16	Carman No.3	6	2	229.	Planted Cornell way.
19	May 16	Carman No.3	6	0	146.	Planted Cornell way.
20	May 16	Carman No.3	6	2	199.	Furrows opened deep but seed covered shallow at first, soil worked toward plants.
21	May 16	Carman No.3	6	2	230.	Seed tubers planted in shallow furrows and covered lightly.
22	June 12	Carman No.3	4	2	162.	Planted late otherwise Cornell way.
23	June 17	Carman No.3	4	2	197.	Planted late with Robbins' Potato Planter.

Lessons from Potato Experiments, 1901.

The average yield from all the plats which were planted on May 16 was at the rate of 200 bushels per acre. On plat planted on June 12 yielded at the rate of 162 bushels and another plat planted on June 17 yielded at the rate of 197 bushels per acre. While we will not draw any definite conclusions from these results, it simply confirms our opinion heretofore expressed, that for best results with potatoes they should be planted in the early Spring and should have the entire season in which to grow. Many farmers plant late in the season in order to avoid in part the ravages of the "potato bug," and there is no question about there being some advantage in this respect. But if continued experiments demonstrate that early planting and thorough spraying will increase the crop from 50 to 100 bushels per acre over late planting and little or no spraying it would seem a wise policy to plant early and protect the plants by spraying. A study of the table will reveal that the plats which received the most tillage did not in every case give a larger yield than those plats receiving a less amount of tillage. The season was so wet that in some cases in order to carry out

our experiments, tillage was given when the soil was too moist and the results were not always beneficial.

While all plats were apparently free from blight the plat No. 13 which was sprayed but once with Bordeaux mixture yielded 227 bushels of potatoes per acre and the adjoining plat No. 14 treated the same in every way except it was sprayed two times, yielded at the rate of 247 bushels per acre. Plat No. 19 received no Bordeaux mixture and yielded at the rate of 148 bushels per acre while the adjoining plat No. 18 treated the same in every way except that it was sprayed twice yielded at the rate of 229 bushels per acre. Whether the results were entirely due to the spraying we cannot say. All the plats were protected from the potato beetles and there was no evidence of either early or late blight. In our work with Bordeaux mixture the treatment was very thorough. It was thought better to spray two times and do the work thoroughly, rather than to spray more frequently and do the work not so well. Even though we sometimes need not spray with Bordeaux mixture to protect from blight we have always to fight the potato beetles. By using Paris green in connection with the Bordeaux we are enabled to

protect the plant from both fungus and insect foes. We are not satisfied with our spraying apparatus and are looking for some power sprayer which will prove satisfactory with potatoes.

Pruning Vines not Beneficial.

Pruning potato vines to one main stalk has been recommended occasionally in the agricultural press in recent years. Upon plat No. 10 the vines were pruned. This plat yielded at the ^{rate} of 272 bushels per acre, while on plat No. 12 which was treated the same in every way except that the vines were not pruned yielded at the rate of 282 bushels per acre. Evidently pruning does not increase the yield.

Potato Machinery, Planters.

Three different potato planters were tested upon the Experimental plats, the Jewett's Improved, the Eureka and the Robbins. While none of the planters mentioned are perfect yet all possess valuable features. The automatic droppers while placing the seed as evenly as it is ordinarily placed when dropped by hand should be supplemented by some attachment by means of which an

occasional skip may be supplied by the driver. While we do not attempt to draw any conclusions as to the relative merits of the various planters tested, based upon only one seasons trial yet there are some essentials which any potato planter must possess in order to be entirely satisfactory upon all soils. These essentials are first, furrow for the seed tubers should be opened to any desired depth; second, seed pieces must be dropped with absolute regularity; third, ability to cover the seed deeply or shallow according to the nature of the soil. If a machine is not able to meet these requirements it should not be purchased. In addition there should be simplicity of construction, and strength of frame that the necessity for repairs may be slight.

Spraying Apparatus.

It is probable that one reason why the practice of spraying potatoes has not been more generally adopted is due to the fact that the machinery for the work has not fully met the demands. Where potatoes are grown upon large areas of 20 acres or more, power sprayers, where the pumping is done by an engine may be used successfully and

and economically. But where a small area of only two to five acres is grown there are few who will go to the expense of purchasing a power sprayer. To pump by hand power is not always satisfactory but for small areas it is the best method where an engine cannot be purchased. We see no reason why some enterprising young man in a community could not do a good business by investing in a small gasoline engine and a complete spraying outfit for the purpose of spraying all the potatoes in the community. This is now done in many cases in orchard management and could be done with potatoes equally well. In our experiments extending over six years the evidence is strong in favor of thorough spraying with Bordeaux mixture and Paris green. When the practice is generally adopted by the farmers, machinery will be found to meet the demands.

The situation is well summed up by one grower of our acquaintance who remarked, "By the use of the potato planter, the weeder, the harrow, the wheel cultivator and the potato digger I can now grow four acres of potatoes at less expense than I could formerly grow one acre.

Conclusions.

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As a result of experiments extending over a period of six years we are firmly of the opinion that no other crop responds more readily to improved conditions than does the potato. Thorough fitting of the soil before planting is of prime importance. While careless methods are often practiced and a fair crop of potatoes results, yet the man who would insure a crop and not have it dependent entirely upon climatic conditions must so far as possible make all soil conditions favorable.

Upon a well fitted thoroughly drained soil deep planting is desirable. The land should be harrowed repeatedly before the potato plants appear above ground.

During the average season about seven cultivations give best results.

Level tillage is preferable to ridged or hill culture.

Spraying with Bordeaux mixture and Paris green is a necessity not only to protect potatoes from bugs and blight but to preserve the general vigorous condition of the foliage.

Early planting is preferable to late planting where provision has been made to spray thoroughly.

Spraying from three to four times with Bordeaux mixture is sufficient to protect the foliage.

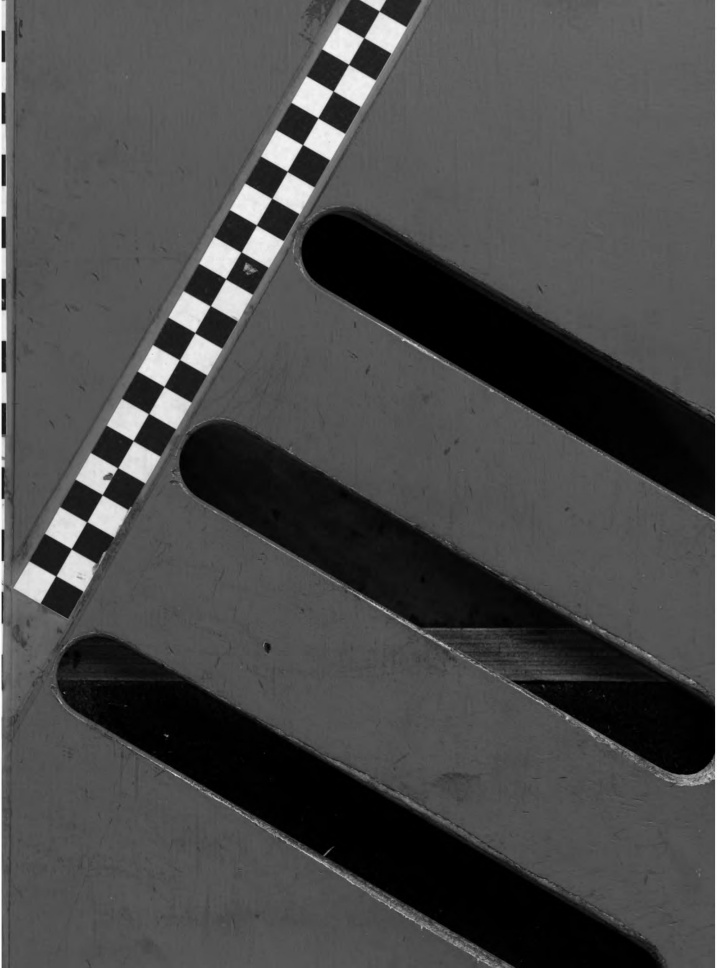
Tubers should be selected for seed and those only used which come from the most fruitful hills.

By practicing the methods herein outlined but modified to suit local conditions, there will be no necessity of importing from Europe hundreds of thousands of bushels of potatoes but the market can be entirely supplied by the American farmers.

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