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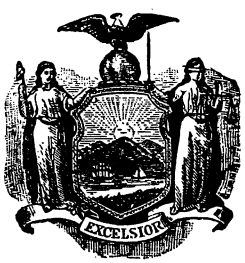
New York Agricultural Experiment Station.

GENEVA, N. Y.

POTATO SPRAYING EXPERIMENTS IN 1906.

F. C. STEWART, H. J. EUSTACE AND F. A. SIRRINE.



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*In Second Judicial Department: Riverhead, N. Y.

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BULLETIN No. 279.

POTATO SPRAYING EXPERIMENTS IN 1905.

F. C. STEWART, H. J. EUSTACE AND F. A. SIRRINE.

SUMMARY.

The fourth year of the ten-year series of potato-spraying experiments begun in 1902 is now completed. During 1905 the work was carried out along the same lines as in 1904. Seventy separate experiments are reported in this bulletin.

TEN YEAR EXPERIMENTS.

At Geneva, five sprayings increased the yield 119 1-3 bu. per acre, while three sprayings increased it 107 bu. The gain was due partly to prevention of late blight and partly to prevention of rot. At Riverhead, the gain due to five sprayings was 82 bu. per acre and to three sprayings, 31 1-3 bu. Here, the flea beetle was the chief enemy.

FARMERS' BUSINESS EXPERIMENTS.

In thirteen experiments, including 166 2-3 acres, the average gain due to spraying was 46½ bu. per acre; the average total cost of spraying, $4.25 per acre; the average cost of each spraying, 98 cents per acre; and the average net profit, $20.04 per acre.

VOLUNTEER EXPERIMENTS.

In fifty experiments, including 407 acres, the average gain due to spraying was 59½ bu. per acre. In 29 of these experiments the average total cost of spraying was $4.57 per acre; the average cost for each spraying, 92 cents; and the average net profit, $29.85 per acre.

SODA BORDEAUX VS. LIME BORDEAUX.

In comparative tests of efficiency of these fungicides, rows sprayed four times with lime bordeaux outyielded rows similarly sprayed with soda bordeaux by 9 bu. per acre in one test and by 35 bu. per acre in another test. For use on potatoes, soda bordeaux is not superior to lime bordeaux.

BORDEAUX WITH AND WITHOUT PARIS GREEN.

Potatoes are in no way injured by paris green properly

applied; viz., in moderate amount (one to two pounds per acre) with bordeaux mixture.

Bordeaux With and Without Arsenite of Soda.

Arsenite of soda may be safely used with bordeaux at the rate of one quart of the stock solution (Kedzie formula) to fifty gallons.

Cold vs. Warm Bordeaux.

Potato foliage was in no way injured by spraying on hot, sunny days with bordeaux having a temperature of 40 degrees to 54 degrees Fahr. It appears that no attention need be paid to the temperature of the water used in making bordeaux for spraying potatoes.

Potato Troubles in 1905.

In unsprayed fields the loss from blights, rot and flea beetles was at least fifty bushels per acre on the average. Most of this loss was due to late blight and the rot which follows it.

Does Spraying Prevent Rot?

The general tendency of spraying is to reduce the amount of rot. In most cases the reduction is very marked; in some cases there is no difference; and occasionally spraying increases the amount of rot. It depends on weather conditions and the thoroughness of spraying. But whatever the effect on rot, *sprayed plants always give a larger yield of marketable tubers.*

Spraying is Profitable.

Judging from the experiments thus far made it appears that spraying for blight is an operation which no potato grower in New York can afford to neglect. Thirty-three farmers' business experiments made during the past three years show an average net profit of $22.79 per acre due to spraying.

Directions for Spraying.

Commence spraying with bordeaux when the plants are 6 to 8 inches high and repeat at intervals of 10 to 14 days throughout the season, making, in all, five or six applications. When bugs are troublesome add paris green or other poison.

INTRODUCTION.

During the season of 1905 the Station continued the ten-year potato-spraying experiments begun in 1902. These experiments are designed to determine how much the yield of potatoes can be increased, on the average, by spraying with bordeaux mixture. The plan is to continue the experiments during ten consecutive seasons and take the average increase in yield as the index of the value of spraying potatoes in New York State. The experiments are to be conducted in two localities; namely, at Geneva and Riverhead. Two methods of spraying are to be compared as to their efficiency: Some rows are sprayed every two weeks regularly while others are sprayed only three times during the season. At each place the area of the experiment field is to be three-tenths of an acre each season. The rows sprayed every two weeks alternate with those sprayed only three times and with others not sprayed at all. For further details see Bulletins 221, 241 and 264.

Supplementary to the above experiments, the Station has conducted a series of business experiments similar to those made in 1903 and 1904.[1] Under the direction of the Station, fourteen farmers in different parts of the State have carried on experiments designed to determine the net profit in spraying potatoes in different ways under actual farm conditions.

A third line of effort has been the collection of the results of numerous volunteer potato-spraying experiments made by farmers. Fifty such experiments are reported in this bulletin. The most important feature of these experiments, as a whole, is the increase in yield due to spraying. However, several of them contain other points of special interest.

[1]For a detailed account of the business experiments in 1903 see Bulletin 241, pages 267-283; in 1904, Bulletin 264, pages 116-152.

SUMMARY OF RESULTS OBTAINED IN TEN-YEAR EXPERIMENTS PRIOR TO 1905:

TABLE I.—YIELD BY SERIES AT GENEVA IN 1902.[2]

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7 and 13	July 10, 23 and Aug. 12	317	41
II.	2, 5, 8 and 14	June 25, July 10, 23, 30, Aug. 12, 26 and Sept. 10	342	36
III.....	3, 6, 9 and 15	Not sprayed	219	4

Gain due to spraying three times, 98½ bu. per acre.
Gain due to spraying seven times, 123½ bu. per acre.

TABLE II.—YIELD BY SERIES AT RIVERHEAD IN 1902.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I	2, 5, 8 and 11	May 26, June 20 and July 12	295	20
II	1, 4, 7 and 10	May 26, June 3, 20, 30, July 11, 23 and Aug. 5	312	35
III.....	3, 6, 9 and 12	Not sprayed	267	40

Gain due to spraying three times, 27⅔ bu. per acre.
Gain due to spraying seven times, 45 bu. per acre.

TABLE III.—YIELD BY SERIES AT GENEVA IN 1903.[3]

Series.	Rows.	Dates of spraying.[4]	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7, 10 and 13	July 14, 28 and Aug. 26	262	—
II.....	2, 5, 8, 11 and 14	July 7, 21, Aug. 7, 21 and Sept. 3	292	10
III.....	3, 6, 9, 12 and 15	Not sprayed	174	20

[4]The dates of spraying in Table IV on page 263 of Bulletin 241 are incorrect.

Gain due to spraying three times, 88 bu. per acre.
Gain due to spraying five times, 118 bu. per acre.

[2]For details of the ten-year experiments in 1902 see Bulletin 221.
[3]For details of the ten-year experiments in 1903 see Bulletin 241.

TABLE IV.—YIELD BY SERIES AT RIVERHEAD IN 1903.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7 and 10	June 5, July 22 and Aug. 7	246	45
II.....	2, 5, 8 and 11	June 5, 24, July 7, 22 and Aug. 7	263	10
III.....	3, 6, 9 and 12	Not sprayed	207	10

Gain due to spraying three times, 39½ bu. per acre.
Gain due to spraying five times, 56 bu. per acre.

TABLE V.—YIELD BY SERIES AT GENEVA IN 1904.[5]

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7, 10 and 13	July 13, 27 and Aug. 15	344	30
II.....	2, 5, 8, 11 and 14	July 8, 22, Aug. 1, 15 and 29	386	40
III.....	3, 6, 9, 12 and 15	Not sprayed	153	25

Gain due to spraying three times, 191 bu. per acre.
Gain due to spraying five times, 223 bu. per acre.

TABLE VI.—YIELD BY SERIES AT RIVERHEAD IN 1904.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7 and 10	June 14, July 21, and Aug. 9	257	58
II.....	2, 5, 8 and 11	June 14, 27, July 11, 26, Aug. 9 and 22	297	45
III.....	3, 6, 9 and 12	Not sprayed	201	25

Gain due to spraying three times, 56½ bu. per acre.
Gain due to spraying six times, 96⅓ bu. per acre.

[5]For details of the ten-year experiments in 1904 see Bulletin 264.

DETAILS OF THE TEN-YEAR EXPERIMENTS IN 1905.

SOIL, PLANTING, CULTIVATION, ETC.

At Geneva.—The plat of land used was the same as that used for this experiment in 1903. It was a heavy clay loam containing some gravel. The surface drainage was good. During the season of 1904 it was seeded with red clover. The seed potatoes were of the variety Rural New Yorker No. 2 selected from sprayed rows in the experiment of 1904. They were planted May 16 in rows three feet apart and with the hills 15 inches apart in the row. The cultivation was barely sufficient to keep down weeds. No doubt, considerably larger yields would have been obtained if the plants had received the proper amount of cultivation.

At Riverhead.—The land used at Riverhead was a level plat of sandy loam on the farm of Mr. G. F. Downs. The soil was of better quality and less sandy than that used for the experiment in former years and more nearly representative of the soil of eastern Long Island. In 1904 the land grew cauliflower. The seed potatoes were of the variety Green Mountain planted by hand, April 25 and 26, in rows three feet apart with the hills 15 inches apart in the row. The plants were given good cultivation throughout the season.

PREPARATION AND APPLICATION OF THE BORDEAUX MIXTURE.

Both at Geneva and at Riverhead the bordeaux mixture used was approximately of the 1-to-8 formula and applied very thoroughly with a knapsack sprayer as in former years.

DATES OF SPRAYING.

At Geneva: Series I.—The rows of this series, 1, 4, 7, 10 and 13, were sprayed three times with bordeaux mixture—July 3, August 7 and 25. At the time of the first spraying the plants averaged about one foot in height. Some hills were badly infested with bugs, but the majority of the plants were yet uninjured. Paris green was applied with the bordeaux at the rate of one-half pound to fifty gallons. This application was so

effective in ridding the plants of bugs that it was unnecessary to use poison again. Consequently, the second and third sprayings were made with bordeaux alone at such times as seemed best for the control of blight.

Series II.—This series consisted of rows 2, 5, 8, 11 and 14, The plants were sprayed with bordeaux mixture five times—June 29, July 13 and 27, and August 12 and 24. At the time of the first spraying the plants were 7 to 10 inches high. The bugs were just commencing to hatch, so paris green was used with the bordeaux at the rate of one-half pound to fifty gallons. On July 13 when the second spraying was made it was necessary to use poison a second time. There were then more bugs on this series than on either Series I or III. Evidently, the first application of poison was made a little too early for the best results on bugs. No poison was used in the last three sprayings.

Series III.—Series III consisted of rows 3, 6, 9, 12 and 15. It was the intention not to use any bordeaux on these rows, but row 3 was accidentally sprayed once with bordeaux on August 24. The plants on this series were kept free from bugs by three applications of paris green in lime water (one-half pound to fifty gallons) made July 3, 13 and August 12.

At Riverhead: Series I.—This series consisted of five rows—Nos. 1, 4, 7, 10 and 13, which were sprayed with bordeaux mixture three times; namely, on June 14, July 18 and August 11. Paris green, at the rate of one pound per acre, was applied three times. The first application was made with bordeaux mixture in the first spraying of June 14 and the other two in lime water on June 30 and July 14.

Series II.—This series consisted of five rows—Nos. 2, 5, 8, 11 and 14. They were sprayed with bordeaux mixture five times; namely, on June 14, 30, July 14, 28 and August 11. Paris green was used only in the first two sprayings at the rate of one pound per acre.

Series III.—Series III consisted of five rows—Nos. 3, 6, 9, 12 and 15. These rows received no bordeaux. Paris green in lime water was applied three times (June 14, 30 and July 14) at the rate of one pound per acre.

RESULTS OF THE TEN-YEAR EXPERIMENTS IN 1905.

AS SHOWN BY THE CONDITION OF THE FOLIAGE.

At Geneva.—When the plants were 3 to 6 inches high they were slightly injured by flea beetles before spraying was commenced. Later, about August 1, the beetles again appeared in larger numbers and during the next month injured the unsprayed rows of Series III considerably. The plants of Series II, on the contrary, were scarcely affected, showing very plainly the beneficial influence of bordeaux in controlling the flea beetle. On Series I, where the spraying was less thorough, they caused some damage.

Early in August tip-burn began to appear on the unsprayed rows and continued to increase until it became quite prominent. Strange to say, the sprayed rows were almost entirely free from it. Tip-burn is a physiological disorder and it is difficult to explain why spraying should prevent it. Possibly the unsprayed rows suffered more because they had been more injured by flea beetles.

Early blight, *Alternaria solani,* was almost entirely absent.

Late blight, *Phytophthora infestans,* was first found on the unsprayed rows August 12. It spread slowly. In fact we regarded this as a rather mild attack. However, as a result of the combined attack of flea beetles, tip-burn and late blight the unsprayed rows (excepting row 3) died fully two weeks earlier than the sprayed rows of Series I and II. Row 3, having been sprayed once by mistake, remained green a few days longer. The contrast in appearance between the sprayed and unsprayed rows was very marked but not as striking as in 1904. It was probably greatest about September 21, at the time the photograph shown in Plate I was taken. Between Series I, sprayed only three times, and Series II, sprayed five times, there was no apparent difference in foliage. On September 26 each series still retained somewhat less than one-half of its foliage. By October 3 practically all of the plants were dead.

At Riverhead.—In the experiment at Riverhead late blight did no damage whatever, not even to the unsprayed rows. Flea beetles and early blight were the chief enemies fought. According to their usual habit, flea beetles appeared while the plants were small, about June 10, and again, in hords, when the plants were full grown about the middle of July. On July 29 there was a marked difference between the foliage on Series II and that on Series I and III. Series I and III were severely injured by flea beetles, but thorough spraying had prevented most of the injury on Series II. Here again, the value of bordeaux mixture as a remedy for the flea beetle was clearly shown.

Early blight appeared about August 1. It did some damage to Series II, but considerably more to Series I and III. Unlike the experiment at Geneva, we had here much better foliage on Series II, sprayed five times, than on Series I, sprayed three times.

AS SHOWN BY THE YIELD.

At Geneva.—The potatoes were dug by hand October 21 At this time the unsprayed plants had been dead over a month and the sprayed plants about 18 days.

The product of each row was carefully sorted into three grades —marketable, rotten and culls. According to our usual method, all sound tubers larger than a hen's egg were graded as marketable.

TABLE VII.—YIELDS IN THE EXPERIMENT AT GENEVA.

Section.	Row.	Treatment.	Yield per row.[6]		Yield per acre.			
			Marketable.	Culls.	Marketable.		Culls.	
			Lbs.	*Lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
	1	Sprayed 3 times	280	39	233	20	32	30
A.....	2	Sprayed 5 times	269	42	224	10	35	—
	3	Unsprayed[7]	191	47	159	10	39	10
	4	Sprayed 3 times	258	38	215	—	31	40
B.....	5	Sprayed 5 times	295	40	245	50	33	20
	6	Unsprayed	130	28	108	20	23	20
	7	Sprayed 3 times	284	38	236	40	31	40
C.....	8	Sprayed 5 times	270	39	225	—	32	30
	9	Unsprayed	154	34	128	20	28	20
	10	Sprayed 3 times	271	38	225	50	31	40
D.....	11	Sprayed 5 times	292	45	243	20	37	30
	12	Unsprayed	153	42	127	30	35	—
	13	Sprayed 3 times	285	48	237	30	46	40
E.....	14	Sprayed 5 times	302	46	251	40	38	20
	15	Unsprayed	148	42	123	20	35	—

[6] Rows 290.4 feet long by three feet wide making the area of each row exactly one-fiftieth acre. Concerning the loss from rot see page 165.

[7] It will be observed that Row 3 gave the largest yield of any unsprayed row. This is owing to it having been sprayed once by mistake. Hence, in computing the average yields all three rows of Section A should be rejected.

Comments on the table.—(1) In Sections A and C the three-sprayed row outyielded the five-sprayed row. The reason for this is unknown but it is certainly not due to the spraying.

(2) In every section both of the sprayed rows greatly outyielded the unsprayed row.

(3) In different sections the yields of rows treated in the same way varied considerably. This has happened also in all three of the previous experiments. It can not be avoided. Confidence is to be placed only in averages.

(4) Leaving Section A out of consideration (because of the error on Row 3) there were fewer culls on the unsprayed than on the sprayed rows. On the unsprayed rows the average yield of culls was 30 bu. 25 lbs. per acre while on both of the sprayed series the average was 35 bu. 25 lbs. per acre. This is somewhat

unusual. As a rule there are more culls on the unsprayed rows. In the ten-year experiment at Geneva in 1904 there were more than twice as many culls on the unsprayed rows as on the sprayed.

Yield by series.—The four rows sprayed three times constitute Series I and the average yield of these four rows makes the yield of Series I. The yields given for Series II and III have been computed in the same manner. The yield by series is shown in the following table:

TABLE VIII.—YIELD BY SERIES AT GENEVA.

Series.	Rows.[8]	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	4, 7, 10 and 13	July 3, August 7 and 25	228	45
II.....	5, 8, 11 and 14	June 29, July 13, 27, August 12 and 24	241	15
III.....	6, 9, 12 and 15	Not sprayed	121	52

[8] The rows of Section A (Nos. 1, 2 and 3) have been omitted because of error.

Increase in yield due to spraying three times, 107 bu. per acre.

Increase in yield due to spraying five times, 119⅓ bu. per acre.

This year the difference in yield between Series I, sprayed three times, and Series II, sprayed five times, was less than ever before, being only 12½ bushels per acre. Considering that there was no apparent difference in the foliage no marked difference in yield was to be expected.

Loss from rot.—The loss from rot was greater than in any of the preceding experiments. Owing to the fact that some of the affected tubers were in an advanced stage of decay it was impossible to determine accurately the loss from rot, but on each row the approximate weight of rotten tubers was ascertained. It was found that on Series I, sprayed three times, the loss from rot was at the rate of 6 bu. 40 lbs. per acre; on Series II, sprayed five times, 6 bu. 15 lbs. per acre; while on Series III, not sprayed, it was 47 bu. 30 lbs. per acre. In other words *spraying reduced the loss from rot by 41 bushels per acre.* Such was the situation at digging time. It sometimes happens that potatoes apparently sound at digging time subsequently decay in storage.

This happened in the ten-year experiment at Geneva in 1904. (See foot note on page 112 of Bulletin 264). In order to determine the extent of such loss in the 1905 experiment the tubers from each of three rows (Rows 8, 9 and 10) were stored in crates in a good cellar from October 21 until December 9 and then examined. In the four and one-half bushels of tubers from Row 8 there were only two affected tubers; in two and one-half bushels from Row 9 there were also two affected tubers while in the four and one-half bushels from Row 10 not a single tuber showed signs of rot. The potatoes were not sorted more carefully at digging time in 1905 than in 1904. Our opinion is that in 1904 the potatoes were dug too soon after the tops died.

At Riverhead.—In the experiment at Riverhead the potatoes were dug on September 16 and sorted into two grades, marketable tubers and culls, in the same manner as at Geneva.

TABLE IX.—YIELDS IN THE EXPERIMENT AT RIVERHEAD.

Section.	Row.	Treatment.	Yield per row.[9]		Yield per acre.			
			Marketable.	Culls.	Marketable.		Culls.	
			Lbs.	*Lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
A.....	1	Sprayed 3 times	295	22	270	25	20	1
	2	Sprayed 5 times	327	20	299	45	18	20
	3	Not sprayed	244	26	223	40	23	50
B.....	4	Sprayed 3 times	272	23	249	20	20	45
	5	Sprayed 5 times	335	23	307	5	20	45
	6	Not sprayed	255	20	233	45	18	20
C.....	7	Sprayed 3 times	285	16½	261	15	15	7
	8	Sprayed 5 times	335	15	307	5	13	45
	9	Not sprayed	248	18	227	20	16	30
D.....	10	Sprayed 3 times	271	17	248	25	15	35
	11	Sprayed 5 times	314	25	287	50	22	55
	12	Not sprayed	205	18	187	55	16	30
E.....	13	Sprayed 3 times	257	20	235	35	18	20
	14	Sprayed 5 times	345½	15½	316	42	14	12
	15	Not sprayed	256	23½	234	40	21	32

[9]Originally, the rows were 290.4 feet long. Owing to the influence of nearby trees plants near the west end did not thrive and so it was believed that the test would be a fairer one if this portion of the field was left out of consideration in making up the yields. The yields given are for rows 264 feet long by three feet wide, 55 rows being required to make an acre.

PLATE I.—ROWS 8, 9 AND 10 IN TEN-YEAR EXPERIMENT AT GENEVA.

FIGURE 1.—MARKETABLE TUBERS.

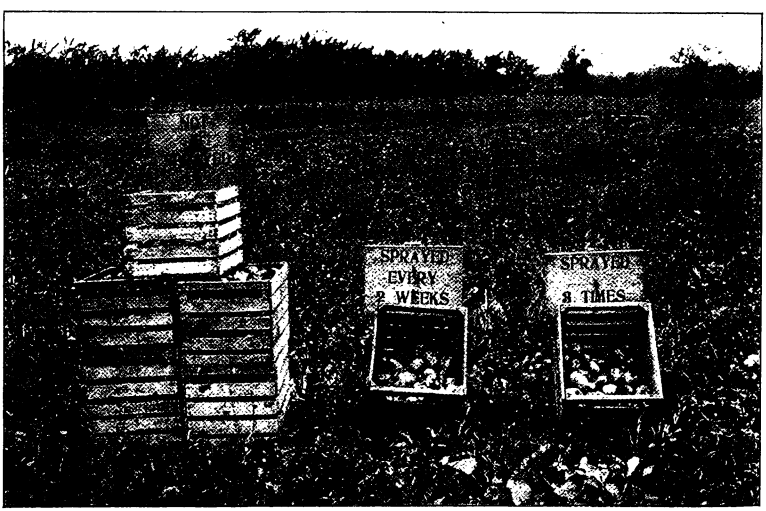


FIGURE 2.—ROTTEN TUBERS.
Spraying reduced the loss from rot by 41 bu. per acre.

PLATE II.—PRODUCT IN TEN-YEAR EXPERIMENT AT GENEVA.

Comments on the table.—As in previous years, the gain from spraying in this experiment was smaller than in the experiment at Geneva. On the average, five sprayings gave markedly better results than three sprayings. In each section both of the sprayed rows outyielded the unsprayed row and the row sprayed five times outyielded the row sprayed three times.

TABLE X.—YIELD BY SERIES AT RIVERHEAD.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
I.....	1, 4, 7, 10 and 13	June 14, July 18 and Aug. 11	253	—
II.....	2, 5, 8, 11 and 14	June 14, 30, July 14, 28 and Aug. 11	303	41
III.....	3, 6, 9, 12 and 15	Not sprayed	221	38

Increase in yield due to spraying three times, 31⅓ bu. per acre.
Increase in yield due to spraying five times, 82 bu. per acre.

Loss from rot.—There was no trace of rot in this experiment, not even on the unsprayed rows.

FARMERS' BUSINESS EXPERIMENTS.

OBJECT OF THE EXPERIMENTS.

Many farmers question the reliability of the results obtained in experiments like the Station ten-year experiments described in this bulletin. They doubt that such results can be obtained in ordinary farm practice. The common objections to the experiments are: (1) They are on too small a scale (three-tenths of an acre); (2) the spraying is done more thoroughly than farmers would do it; (3) it is difficult to determine accurately the expense of the spraying; (4) the idea is prevalent that the Station potatoes are given extra good care in order that large yields may be obtained.[10]

To satisfy this demand for experiments of a more practical kind the Station decided to conduct a series of farmers' business experiments so managed as to show the actual profit in spraying potatoes under farm conditions. This work was commenced in 1903 with six experiments.[11] In 1904, fourteen such experiments were made and in 1905 the same number. The results have been of such general interest, that it has been decided to make several of these business experiments each season during the remaining six years in which the potato spraying experiments are to be continued.

METHODS.

The methods employed have been essentially the same as in previous years. In the spring of 1905 the Station arranged with fourteen farmers in different parts of the State to keep an account of their spraying operations on potatoes. An accurate record was kept of all the expense of the spraying including labor, chemicals and wear of machinery. In each experiment strips of three to seven rows were left unsprayed for comparison. These rows received no bordeaux mixture but were treated with poison to protect the plants from bugs. In four of the experi-

[10]For a discussion of these objections see Bulletin 221, pages 257-261.

[11]Details of the business experiments in 1903 were published in Bulletin 241, pp. 267-282; and those of the experiments in 1904 in Bulletin 264, pp. 116-152.

ments there was but a single unsprayed strip; in nine experiments there were two unsprayed strips; and in one experiment there were three of the unsprayed strips. Hence, so far as concerns the increase in yield due to spraying, these fourteen experiments really included 23 separate tests. All work connected with the spraying was done by the farmers themselves in such manner as they deemed best.

In the fall, the tubers on one or more of the unsprayed rows were carefully weighed. The same was done with one or more sprayed rows on either side. In this manner it was determined how much the yield had been increased by spraying. In all except one case, a representative of the Station was present when the test rows were dug and assisted with the weighing. The length and width of the rows were carefully measured, the Station representative assisting with this, also. Accordingly we can vouch for the accuracy of the yields reported.

It was our intention to visit each of the experiments two or three times during the spraying season for the purpose of taking notes, but this was found impracticable for the three experiments in the northern part of the State. On this account there is a regrettable lack of information concerning the prevalence of blight and insects in some of the experiments.

The experiment fields varied in size from six to twenty-one acres, the total acreage of the fourteen experiments being 166 2-3 acres. As far as practicable they were placed in localities where the potato is a leading farm crop. In eleven of the experiments the test rows were in plain view from a public road so that the results could be seen by passersby.

The method of spraying in the Hebron experiment was one we call the two-hose-and-three-men method. In the other thirteen experiments the spraying was done with horse sprayers of several different kinds covering three to seven rows at each passage.[12]

[12] Nothing is said in this bulletin concerning the relative merits of different potato sprayers. It has been our aim to have the leading potato sprayers represented in the experiments, but this is not a comparative test of spraying machinery. The larger gain or larger net profit obtained in some experiments than in others is not necessarily due to a difference in the kind of sprayer used. It is impossible to make close comparisons because the conditions in the different experiments vary greatly. The Sta-

THE GOWANDA EXPERIMENT.

This experiment was made by E. T. Ryder, Gowanda, Cattaraugus County. Ten acres of potatoes, variety Rural New York No. 2, were sprayed with bordeaux and paris green four times on the following dates: June 28 and 29, July 7 and 8, July 14 and 15 and August 2 and 3. The spraying outfit used consisted of a one-horse, home-made, two-wheeled cart carrying a Spramotor barrel spray pump and a Spramotor potato spraying attachment rigged to cover three rows at a time with four nozzles per row. (See Plate III, fig. 1). The pumping was done by the driver. Water for making the bordeaux was conveniently obtained from a small stream at one end of the field.

Six rows 1150 feet long were left unsprayed. These rows were treated four times with paris green in water applied with the sprayer on the same dates that bordeaux and paris green were applied to the sprayed portion of the field. Bugs were kept well under control on the sprayed and unsprayed rows alike.

The items of expense of spraying the ten acres four times were as follows:

216	lbs. copper sulphate @ 5½c.	$11.88
1½	bbl. lime @ $1	1.50
4½	gals. stock solution of arsenite of soda @ 16c.	.72
14	lbs. paris green @ 25c.	3.50
80	hrs. labor for man @ 15c.	12.00
40	hrs. labor for horse @ 7½c.	3.00
Wear on spraying outfit		5.00
Total		$37.60

The total cost of spraying was $3.76 per acre or 94 cents per acre for each application.

As late as July 28 there was no apparent difference between the sprayed and unsprayed rows. During August late blight attacked the unsprayed rows causing considerable damage. Before the plants were killed by frost, on September 14, there

tion is obliged to decline to answer the question, which is the best potato sprayer? We can only say that there are now upon the market several good, practical potato sprayers. The excellent results obtained in the business experiments during the past three years are proof of this.

was a marked contrast between the sprayed and unsprayed rows.

The test rows were dug and weighed October 6. Owing to lack of time only 500 feet of the rows was dug. The rows used for comparison were one of the middle two unsprayed rows, the second sprayed row on one side and the first sprayed row on the other side. The yields were as follows:

Second sprayed row on the west, 326 lbs. marketable tubers.
First sprayed row on the east,[13] 196 lbs. marketable tubers.
Average of two sprayed rows, 261 lbs. marketable tubers.
One of the middle two unsprayed rows, 169 lbs. marketable tubers.
Yield, sprayed, 133 bu. 46 lbs. marketable tubers per acre.
Yield, unsprayed, 87 bu. 37 lbs. marketable tubers per acre.
Gain, 46 bu. 9 lbs. marketable tubers per acre.

Spraying increased the yield at the rate of 52.5 per ct.

The yield of small potatoes or culls was at the rate of 59 bu. 58 lbs. per acre for the sprayed and 52 bu. 17 lbs. per acre for the unsprayed, making a difference of 7 bu. 41 lbs. per acre in favor of the sprayed. Usually the greater yield of culls is on the unsprayed rows.

There was no loss from rot either on the sprayed or on the unsprayed rows.

At 60 cents per bushel, the market price of potatoes in Gowanda at digging time, 46 bu. 9 lbs. of potatoes would be worth $27.69. Subtracting $3.76, the cost of spraying per acre, we have left *a net profit of $23.93 per acre.*

THE GAINESVILLE EXPERIMENT.

This experiment was made by Brainerd & Beaumont, Gainesville, Wyoming County, who conducted a similar experiment for the Station in 1904. A field of sixteen acres (variety, Sir Walter Raleigh and Carman No. 3 mixed) was sprayed seven times on the following dates: June 29-30, July 7-8, July 14-15, August 2, 10, 16 and 26. The sprayer used was the "Aroostook" power sprayer covering 5 rows at each passage.[14]

[13]As a general rule the second rather than the first sprayed row should be used, but it was not possible in this case as the second sprayed row had been dug previously by mistake.

[14]For an illustration of the sprayer used in the Gainesville experiment see Bulletin 264, Plate VII, fig. 1.

Poison (arsenite of soda) was used with the bordeaux in the first five sprayings.

Five rows 240 feet long were left unsprayed. Although paris green was applied to these rows on the same dates that poison was used on the sprayed rows and twice more, between times, bugs caused slightly more damage here than on the sprayed rows. It is unquestionably true that bugs are more easily controlled when the poison is used with bordeaux.

The expense account included the following items:

748 lbs.	copper sulphate @ 5 4-5c.	$43.38
680 "	lime @ 3-4c.	5.10
58 "	white arsenic @ 4 2-3c.	2.71
118 "	sal soda @ 1c.	1.18
112 hrs.	labor for man @ 15c.	16.80
79 "	labor for team @ 15c.	11.85
Wear on sprayer		5.60
Total		$86.62

The total cost of spraying was $5.41 per acre or 77 1-3 cents per acre for each application.

Mr. Brainerd reports that up to August 7 there were no signs of late blight. By August 16 the unsprayed rows were considerably blighted and there were traces of the disease on the sprayed rows also. The unsprayed rows were practically dead by September 1 while the sprayed rows remained green until frost which occurred on the night of September 13. Mr. Brainerd holds that the actual benefit from spraying is greater than experiments of this kind show. Small quantities of spray drift onto the unsprayed rows and furnish some protection against blight, so that they remain green longer than the unsprayed fields in the same locality. According to our observations this is usually the case and we believe that Mr. Brainerd's opinion is a correct one.

The test rows were dug and weighed on October 4 with the following results:

Second sprayed row on the west, 217 lbs. marketable tubers.
Second sprayed row on the east, 217 lbs. marketable tubers.
Average for the two sprayed rows, 217 lbs. marketable tubers.
Middle unsprayed row, 153 lbs. marketable tubers.

Yield, sprayed, 225 bu. 2 lbs. marketable tubers per acre.
Yield, unsprayed, 157 bu. 40 lbs. marketable tubers per acre.
Gain, 67 bu. 22 lbs. marketable tubers per acre.

Spraying increased the yield of marketable tubers 42.7 per cent.

The yield of culls was 24 bu. 22 lbs. per acre for the sprayed and 43 bu. 33 lbs. per acre for the unsprayed making a difference of 19 bu. 11 lbs. per acre in favor of the unsprayed.

There was practically no loss from rot either on the sprayed or the unsprayed.

On the date of digging the test rows the market price of potatoes in Gainesville was 43 cents per bushel of 62 pounds. At this price the value of the increase would be $28.04 per acre. Subtracting from this $5.41, the cost of spraying, we have left *a net profit of $22.63 per acre.* However, the actual profit in this experiment was considerably greater than this. Most of the crop was stored and afterward sold at 58 cents per bushel and upward.

THE ARKPORT EXPERIMENT.

Conducted by Taylor Bros., Arkport, Steuben County. These gentlemen are extensive potato growers, growing and spraying 55 acres of potatoes in 1905. However, the experiment here described was confined to one field of six acres. The variety was Sir Walter Raleigh. The potatoes were sprayed four times —July 1, 6, 10 and 25. The machine used was a one-horse, Aspinwall power potato sprayer carrying eight nozzles and covering four rows at each passage. Bugs being exceedingly troublesome, paris green was used with the bordeaux in all five sprayings at the rate of one pound per acre.

Three unsprayed rows 1450 feet long were left as a check. These were treated with paris green as many times and on the same dates as the sprayed rows, but they were slightly more damaged by bugs than were the sprayed rows. Taylor Bros. state that bugs were unusually difficult to control. They found the paris green more effective when used with bordeaux than when used alone.

The expense of spraying six acres four times was as follows:

144 lbs. copper sulphate @ 6½c.	$ 9.36
144 " lime @ ½c.	.72
26 " paris green @ 20c.	5.20
20 hrs. labor for man and horse @ 30c.	6.00
Wear on sprayer	2.40
Total	$23.68

The total cost of spraying was $3.95 per acre or 98½ cents per acre for each application. However, when it is considered that four applications of paris green for bugs would have been required anyway it will be seen that the actual extra expense of the spraying for blight was only the cost of the copper sulphate which was $9.36 or $1.56 per acre.

Up to August 1 there was not even a trace of late blight in the experiment field. At that time there was no difference between the sprayed and unsprayed rows except that the latter seemed to have been slightly more injured by bugs. We did not see the experiment after August 1 and have no definite information as to the cause of the increased yield on the sprayed rows.

The potatoes having been planted early, matured early. The test rows were dug September 7. They were sorted and weighed by Mr. S. H. Cridler of Arkport, no representative of the Station being present. The yields were as follows:

Second sprayed row on the west, 882 lbs. marketable tubers.
Middle unsprayed row, 674 lbs. marketable tubers.
Yield, sprayed, 147 bu. marketable tubers per acre.
Yield, unsprayed, 112 bu. 20 lbs. marketable tubers per acre.
Gain, 34 bu. 40 lbs. marketable tubers per acre.

Spraying increased the yield of marketable tubers 30.8 per cent.

No record was kept of the yield of culls. There was no rot.

On October 12 the market price of potatoes in Arkport was 50 cents per bushel. At this price, 34 2-3 bushels of potatoes would be worth $17.33. Subtracting $3.95, the cost of spraying, we have left *a net profit of $13.39 per acre.*

Owing to early planting, the potatoes must have been nearly mature before blight became epidemic. This probably explains the small gain in this experiment.

THE ATLANTA EXPERIMENT.

Conducted by T. S. Darling, Atlanta, Steuben County. As this experiment covered two fields of four acres each, of different varieties and planted at different times it was thought best to leave an unsprayed strip in each field. The spraying in both fields was done with a "Watson" one-horse, four-row power sprayer. In the earlier sprayings, only one nozzle was used while in the later sprayings two nozzles per row were used. We believe this a good practice. Water for making the bordeaux was hauled to the field in barrels on a wagon a distance of about one-half mile. A separate account was kept with each field.

Field No. 1.—This field contained four acres of the variety Carman No. 1. It was sprayed four times—July 7, 20, August 1 and 14. One nozzle per row was used in the first three sprayings and two nozzles per row in the last one. In the first three sprayings paris green was applied with the bordeaux.

Three rows 335 feet long were left unsprayed. Paris green was applied to these rows frequently so that bugs did not injure them.

The items of expense were as follows:

110	lbs. copper sulphate @ 7c.	$ 7.70
115	" lime	1.45
2½	" paris green @ 20c.	.50
7½	" paris green @ 25c.	1.88
10½	hrs. labor for man and horse @ 25c.	2.63
Wear on sprayer		2.00
Total		$16.16

The total cost of spraying was $4.04 per acre or $1.01 per acre for each application.

The test rows were dug and weighed on September 29th, a Station representative assisting with the work.

The yields were as follows:

Second sprayed row on the north, 133 lbs. marketable tubers.
Second sprayed row on the south, 132 lbs. marketable tubers.
Average of two sprayed rows, 132½ lbs. marketable tubers.
Middle unsprayed row, 71 lbs. marketable tubers.
Yield, sprayed, 107 bu. 35 lbs. marketable tubers per acre.

Yield, unsprayed, 57 bu. 56 lbs. marketable tubers per acre.
Gain, 49 bu. 39 lbs. marketable tubers per acre.

Spraying increased the yield 85.7 per ct. There were but few rotten tubers.

The yield of culls was 9 bu. 15 lbs. per acre for the sprayed and 33 bu. 44 lbs. for the unsprayed, making a difference of 24 bu. 29 lbs. per acre in favor of the unsprayed. Owing to the premature death of the plants on the unsprayed rows many tubers failed to attain marketable size.

At 50 cents per bushel the market price of potatoes in Atlanta the day the test rows were dug, the value of the increase would be $24.82. Subtracting $4.04, the cost of spraying, we have left *a net profit of $20.78 per acre.*

Field No. 2.—This field also contained four acres of the variety Sir Walter Raleigh planted several days later than Field No. 1. It was sprayed only three times—July 18, August 1 and 24. One nozzle per row was used in the first two sprayings and two nozzles per row in the last one. Paris green was applied with the bordeaux only in the first two sprayings.

Three rows 626 feet long were left unsprayed. These rows were treated with paris green frequently so that bugs did no harm, but in one application the plants were slightly injured by the paris green.

The expense of the spraying was as follows:

74	lbs. copper sulphate @ 7c.	$ 5.18
75	" lime	1.00
7	" paris green @ 25c.	1.75
7½	hrs. labor for man and horse @ 25c.	1.88
Wear on sprayer		2.00
Total		$11.81

The total cost of spraying was $2.95 per acre or 98 cents per acre for each application.

The test rows were dug September 29 with the following results:

Second sprayed row on the north, 226 lbs. marketable tubers.
Second sprayed row on the south, 231 lbs. marketable tubers.
Average of two sprayed rows, 228½ lbs. marketable tubers.

Middle unsprayed row, 140 lbs. marketable tubers.
Yield, sprayed, 99 bu. 56 lbs. marketable tubers per acre.
Yield, unsprayed, 61 bu. 14 lbs. marketable tubers per acre.
Gain, 38 bu. 42 lbs. marketable tubers per acre.

In this experiment, also, there was practically no loss from rot. Spraying increased the yield of marketable tubers 63.2 per ct.

The yield of culls was 5 bu. 31 lbs. per acre for the sprayed and fourteen bushels for the unsprayed, making a difference of 8 bu. 29 lbs. per acre in favor of the unsprayed.

At 50 cents per bushel the value of the increase in this experiment would be $19.35. After deducting $2.95, the cost of spraying we have left *a net profit of $16.40 per acre.*

Combining the results obtained in the two fields there is an average gain of 44 bu. 10 lbs. per acre and *an average net profit of $18.59 per acre.*

The gain in both these experiments seems to have been due chiefly to protection against late blight. There was no trace of the disease in either experiment on August 1, but it appeared soon after and wrought serious injury to the unsprayed rows. Mr. Darling states that the sprayed rows lived about four weeks longer than the unsprayed. The contrast was very marked.

THE SPENCERPORT EXPERIMENT.

This experiment was made by F. E. Gott, Spencerport, Monroe County. Mr. Gott conducted a similar experiment for the Station in 1904. In 1905 the experiment field contained fourteen acres planted with three different varieties. Owing to washing out and rotting of the "seed" in several places the crop on about four acres was practically worthless. In spraying it was necessary to drive the sprayer over nearly the whole of the fourteen acres, but in going across the bare areas the spray was shut off. This makes it difficult to determine accurately the expense of the spraying. Mr. Gott is of the opinion that the total expense, $24.40, should be considered as being the result of spraying ten acres three times. This would make the total expense per acre $2.44 or 81 cents per acre for each application. The items are as follows:

108 lbs. copper sulphate @ 6¼c.	$ 6.75
1 bbl. lime	1.25
48 hrs. labor for man @ 15c.	7.20
24 " labor for team @ 30c.	7.20
Wear on sprayer	2.00
Total	$24.40

The spraying outfit was the same one used in the 1904 experiment; namely, a home-made, two-horse rig spraying three rows at a time with one nozzle per row.[16] Two men are required to operate it—one to pump and one to drive. The dates of spraying were August 7, 23, 25 and September 6.

Three rows 664 feet long and of the variety White Giant were left unsprayed.

Before spraying was commenced one application of paris green was made, wherever needed, over the whole field including the unsprayed rows. Further than this no poison was required either on the sprayed or the unsprayed rows.

As late as September 1 there was no difference between the sprayed and unsprayd rows, but by September 15 there was a marked contrast, the unsprayed rows being practically dead while the sprayed rows were still green. On September 23 the test rows were photographed (See Plate V). At that time the unsprayed rows were dead and the stalks of the plants mostly dry while the nearby sprayed rows on the west still retained one-third to one-half their foliage. For some unexplained reason the sprayed rows on the east side of the unsprayed strip were considerably less green than those on the west. Still there was much contrast as is plainly shown in the photograph.

Not having an opportunity to examine the field after the outbreak of blight until September 23 the writers are in doubt as to the nature of the disease which killed the unsprayed rows. Tip-burn and early blight were certainly factors and probably late blight, *Phytophthora infestans,* also, played an important part although there was little evidence of it on the plants September 23.

[16]For an illustration of the spraying outfit used in the Spencerport experiment see Bulletin 264, Plate VII, fig. 2.

The test rows were dug October 30 and the yields found to be as follows:

Second sprayed row on the west, 468 lbs. marketable tubers.
Second sprayed row on the east, 278 lbs. marketable tubers.
Average of two sprayed rows, 373 lbs. marketable tubers
Middle unsprayed row, 227 lbs. marketable tubers.
Yield, sprayed, 135 bu. 53 lbs. marketable tubers per acre.
Yield, unsprayed, 82 bu. 42 lbs. marketable tubers per acre.
Gain, 53 bu. 11 lbs. marketable tubers per acre.

Spraying increased the yield of marketable tubers 64.3 per ct. There was no rot worth mentioning either on the sprayed or unsprayed rows.

The yield of culls was at the rate of 10 bu. 53 lbs. per acre for the sprayed and 16 bu. 23 lbs. per acre for the unsprayed rows, making a difference of 5½ bushels per acre in favor of the unsprayed.

Why there should have been such a wide difference in yield between the two sprayed rows is not known. Mr. Gott states that so far as he knows the two rows had an equal chance in all respects. Although they were sprayed alike the west row remained green somewhat the longer.

At 60 cents per bushel, the market price at digging time, 53 bu. 11 lbs. of potatoes would be worth $31.91. Subtracting $2.44, the cost of spraying, there is left *a net profit of $29.47 per acre.*

As the bulk of the crop was sold within a short time after digging at an average price of about 70 cents per bushel, the actual net profit was about one-sixth greater than is shown by the figures given above.

THE CORTLAND EXPERIMENT.

This experiment was made by Geo. H. Hyde, Cortland, N. Y. It included six acres of potatoes in two fields. Three unsprayed rows were left in each field. The spraying was done with a "Watson" one-horse, four-row power sprayer like the one used in the Atlanta experiment. Both fields were sprayed five times, with one nozzle per row in the first three sprayings and two nozzles per row in the last two. The bordeaux used in the first three sprayings contained five pounds of copper sulphate and

six pounds of lime to each fifty gallons (5-6-50 formula) while that used in the last two sprayings was of the 6-6-50 formula. In both fields paris green was used with the bordeaux only in the first two sprayings. The items of expense for spraying six acres five times were as follows:

300 lbs. copper sulphate @ 6c.	$18.00
1 bbl. lime	1.30
22 lbs. paris green @ 18c.	3.96
25 hrs. labor for man @ 15c.	3.75
20 hrs. labor for horse @ 12½c.	2.50
Wear on sprayer	9.45
Total	$38.96

The total cost of spraying was $6.50 per acre or $1.30 per acre for each application.

It will be observed that the cost of spraying in this experiment is considerably higher than in the Atlanta experiment (page 175) in which the same kind of a sprayer was used and nearly the same acreage sprayed. This is chiefly owing to the larger quantity of copper sulphate used and the larger allowance for wear of sprayer.

Field No. 1.—This field contained four acres of potatoes of the variety World's Superior, planted May 15. The dates of spraying were July 7, 11, 27, August 9 and 21. Three rows 439 feet long were left unsprayed. Paris green was applied to these rows five times—three times with a powder gun and twice in the form of spray—the first two applications being made on July 7 and 11 the same dates on which paris green was used with the bordeaux mixture on the sprayed rows.

The test rows were dug with a potato digger October 5. The yields were as follows:

Second sprayed row on the west, 458 lbs. marketable tubers.
Second sprayed row on the east, 467 lbs. marketable tubers.
Average of two sprayed rows, 462½ lbs. marketable tubers.
Yield, sprayed, 254 bu. 55 lbs. marketable tubers per acre.
Yield, unsprayed, 51 bu. 15 lbs. marketable tubers per acre.
Gain, 203 bu. 40 lbs. marketable tubers per acre.

The yield of culls was remarkably small being only 4 bu. 58 lbs. per acre for the sprayed and 9 bu. 55 lbs. per acre for the unsprayed.

There was no rot whatever in this field either on the sprayed or unsprayed rows. The crop as a whole was an unusually satisfactory one. The tubers were uniformly smooth, clean, of good size and shape and perfectly sound.

Field No. 2.—This field contained two acres of the variety Norcross, planted May 20. The dates of spraying were July 7, 11, 24, August 4 and 18. Three rows 831 feet long were left unsprayed. They were treated five times with paris green in the same manner and on the same dates as the unsprayed rows in Field No. 1. The test rows were dug October 5 with a potato digger. The yields were as follows:

Second sprayed row on the west, 604 lbs. marketable tubers.
Second sprayed row on the east, 649 lbs. marketable tubers.
Average of two sprayed rows, 626½ lbs. marketable tubers.
Middle unsprayed row, 138 lbs. marketable tubers.
Yield, sprayed, 82 bu. 25 lbs. marketable tubers per acre.
Yield, unsprayed, 40 bu. 11 lbs. marketable tubers per acre.
Gain, 142 bu. 14 lbs. marketable tubers per acre.

In this experiment there was a little rot and there was somewhat more of it on the sprayed than on the unsprayed rows. The small and rotten tubers were weighed together, the yields being 12 bu. 31 lbs. per acre for the sprayed and 10 bu. 38 lbs. per acre for the unsprayed.

Combining the results obtained in the two fields we have an average gain of 172 bu. 57 lbs. marketable tubers per acre. However, all of this gain should not be attributed to spraying. The conditions in this experiment were unusual. The sprayer failing to arrive from the factory as soon as was expected, bugs became very numerous in both fields before any spraying could be done. The first spraying was made July 7 with bordeaux and paris green. A second spraying was made on July 11. These two applications checked the bugs so effectually that the sprayed rows required no more poison during the remainder of the season. But on the unsprayed rows it was different.

Although in both fields the unsprayed rows, also, were treated with paris green on July 7 and 11, by means of a powder gun, the bugs continued their depredations; and even by three additional applications of paris green (once with a powder gun and twice with a hand sprayer) the bugs were only partially controlled. In spite of all that could be done the unsprayed rows in both fields were ruined by bugs. Most of the damage was done by mature beetles which bit off the leaf stalks to such an extent that the ground was covered with the fallen leaves. Mr. Hyde is of the opinion that spraying drove the beetles to the unsprayed rows causing these rows to be more severely attacked than they would have been had no spraying been done. Such may have been the case. Our personal observations were too few to enable us to express a positive opinion on the subject. Whatever the true explanation, the fact stands out prominently that two applications of paris green with bordeaux gave full protection against bugs where five applications by ordinary methods utterly failed.

Neither early blight nor flea beetles were important factors in this experiment. Late blight probably hastened the death of the unsprayed rows, particularly in Field No. 2; but most of the injury was due to bugs.

Because of the uncertainty as to what part of the gain in this experiment should be credited to spraying, the results have not been used in making up the averages on page 201. Had this experiment been included, the average gain due to spraying in the business experiments would have been 55½ bushels per acre. Mr. Hyde is satisfied that the spraying was highly profitable. He believes that it doubled his yield.

THE CASSVILLE EXPERIMENT.

This experiment was conducted by P. S. Doolittle, Cassville, Oneida County. Eleven acres of potatoes, variety Carman No. 3, were sprayed five times—July 11, 20, August 4, 18 and September 2. The sprayer used was an Aspinwall one-horse, four-row power sprayer carrying one nozzle per row in the first spraying and two nozzles per row in the other four. (Plate IV, fig. 1.) The bordeaux was made by the 6-6-50 formula and the water

used in its preparation was obtained from a well at one corner of the field. One man pumped the water and made the bordeaux while another drove the sprayer. Paris green was used with the bordeaux only in the first two sprayings at the rate of one pound to 50 gallons. In 1904 a part of the field was in sod and the remainder grew corn. On each kind of ground four rows 525 feet long were left unsprayed. The unsprayed rows were treated twice with paris green in water at the same rate and on the same dates as the sprayed rows. Also, the application was made with the same sprayer. Bugs caused no material injury anywhere. Late blight was the principal enemy in this experiment. The unsprayed rows blighted much more than the sprayed rows although the latter were considerably injured. Toward the close of the season there was a marked contrast between the sprayed and unsprayed rows. Even at digging time (October 6) it was noticeable that the stalks of the unsprayed plants had been dead longer and were much drier than those on the sprayed rows.

The items of expense for spraying eleven acres five times were as follows:

317 lbs. copper sulphate @ 7c.	$22.19
5 bu. lime @ 15c.	.75
32 lbs. paris green @ 20c.	6.40
78 hrs. labor for man @ 15c.	11.70
34 hrs. labor for horse @ 10c.	3.40
Wear on sprayer	3.00
Total	$47.44

The total cost of spraying was $4.31 per acre or 86 cents per acre for each application.

Both sets of test rows were dug with a potato digger on October 6. The yields were as follows:

Test No. 1. Corn ground.

Second sprayed row on the north, 193¼ lbs. marketable tubers.
Second sprayed row on the south, 198 lbs. marketable tubers.
Average of two sprayed rows, 195⅝ lbs. marketable tubers.
One of middle two unsprayed rows, 128¾ lbs. marketable tubers.
Yield, sprayed, 90 bu. 9 lbs. marketable tubers per acre.

Yield, unsprayed, 59 bu. 20 lbs. marketable tubers per acre.
Gain, 30 bu. 49 lbs. marketable tubers per acre.

The yield of small and rotten tubers was 39½ bushels per acre for the sprayed and 34½ bushels per acre for the unsprayed.

Test No. 2. Sod ground.

Second sprayed row on the north, 176¼ lbs marketable tubers.
Second sprayed row on the south, 131 lbs. marketable tubers.
Average of two sprayed rows, 153⅝ lbs. marketable tubers.
One of the middle two unsprayed rows, 75 lbs. marketable tubers.

Yield, sprayed, 70 bu. 47 lbs. marketable tubers per acre.
Yield, unsprayed, 34 bu. 34 lbs. marketable tubers per acre.
Gain, 36 bu. 13 lbs. marketable tubers per acre.

The yield of small and rotten tubers was 50 bu. 10 lbs. per acre for the sprayed and 26 bu. 44 lbs per acre for the unsprayed.

Combining the results obtained in the two fields we have an average gain of 33 bu. 31 lbs. marketable tubers per acre. This is a comparatively small gain, but when the size of the yields is taken into consideration the showing made is a good one. Spraying increased the yield 71.4 per ct. At the time of digging the test rows the market price of potatoes in Utica was 75 cents per bushel. This makes the value of the increase $25.14 per acre. Subtracting $4.31, the cost of spraying, there is left *a net profit of $20.83 per acre.*

The loss from rot in this experiment was considerable and it was certainly greater on the sprayed than on the unsprayed rows. An explanation of this is given on page—. Had there been no unsprayed rows for comparison many would have pronounced the spraying a failure, while as a matter of fact it was a decided success.

THE VERONA MILLS EXPERIMENT.

This experiment was made by F. G. Rathbun, Verona Mills, Oneida County. Eleven acres of potatoes, in two fields, were sprayed five times. One field contained seven acres and the other four. In both, the variety was Green Mountain. The dates of spraying were as follows: June 24-29, July 12-15, July 24-31, August 9-14 and August 19-22. Poison was used with the bordeaux in the first three sprayings. Some unsprayed rows were

left in each field and these were treated with poison four times; yet in the seven-acre field bugs injured the unsprayed rows somewhat more than the sprayed rows. The sprayer used was a Spramotor one-horse, five-row power sprayer carrying thirteen nozzles. (Plate III, fig. 2.) The bordeaux was made with six pounds of copper sulphate and seven pounds of prepared lime to fifty gallons. The expense of spraying the eleven acres five times included the following items:

258	lbs. copper sulphate @ 6c.	$15.48
301	" lime @ 1c.	3.01
40	" paris green @ 16c.	6.40
6½	" white arsenic @ 8c.	.52
98	hrs. labor for man @ 15c.	14.70
83	" labor for horse @ 5c.	4.15
Interest and wear on sprayer		11.00
Total		$55.26

The total cost of spraying was $5.02 per acre or $1 per acre for each application.

In both fields the unsprayed rows died somewhat earlier than the sprayed owing chiefly to the ravages of late blight. Neither flea beetles nor early blight entered into the problem to any extent.

The test rows in both fields were dug by hand October 4. The results were as follows:

Seven-acre field.—Five rows 477 feet long were left unsprayed. The yields in this field were as follows:

Third sprayed row on the west, 372 lbs. marketable tubers.
Third sprayed row on the east, 327 lbs. marketable tubers.
Average of two sprayed rows, 349½ lbs. marketable tubers.
Middle unsprayed row, 286½ lbs. marketable tubers.
Yield, sprayed, 177 bu. 19 lbs. marketable tubers per acre.
Yield, unsprayed, 145 bu. 21 lbs. marketable tubers per acre.
Gain, 31 bu. 58 lbs. marketable tubers per acre.

There was a little rot on all of the rows and apparently no difference between the sprayed and unsprayed. The yield of small and rotten tubers was 26 bu. 53 lbs. per acre for the sprayed and 33 bu. 29 lbs per acre for the unsprayed.

Four-acre field.—There were four unsprayed rows 705 feet long. The yields in this field were as follows:

Second sprayed row on the east, 532 lbs. marketable tubers.
One of the middle unsprayed rows, 338 lbs. marketable tubers.
Yield, sprayed, 182 bu. 39 lbs. marketable tubers per acre.
Yield, unsprayed, 116 bu. 2 lbs. marketable tubers per acre.
Gain, 66 bu. 37 lbs. marketable tubers per acre.

The loss from rot was practically the same as in the seven-acre field. There was no noticeable difference between the amount of rot on the unsprayed rows and that on the sprayed rows. The yield of small and rotten tubers was 11 bu. 40 lbs. per acre for the sprayed and 13 bu. 44 lbs. per acre for the unsprayed.

The average gain per acre in the two fields was 49 bu. 17 lbs. worth $32.03 (at 65 cents per bushel which was the market price at digging time). After deducting the cost of spraying $5.02, there remains *an average net profit of $27.01 per acre.*

THE CHATEAUGAY EXPERIMENT.

This experiment was made by Oliver Smith & Son, Chateaugay, Franklin County. It included three fields of potatoes having a total area of 17 acres. Some unsprayed rows were left in each field. The sprayer used was an Iron Age one-horse, four-row power sprayer carrying one nozzle per row. The bordeaux was prepared by the 6-6-50 formula. Most of the water required was conveniently obtained from a small stream which ran between the larger two fields. The items of expense for spraying the entire seventeen acres (fifteen acres five times and two acres seven times) were as follows:

200	lbs. copper sulphate[17] @ 5½c.	$11.00
150	" copper sulphate @ 6c.	9.00
175	" copper sulphate @ 8c.	14.00
2	bbl. lime @ $1.10	2.20
36	lbs. paris green @ 18c.	6.48
57¾	hrs. labor for man and horse @ 25c.	14.44
10½	" labor for extra man @ 15c.	1.58
Wear of sprayer		10.00
Total		$68.70

[17]The expense account calls for more copper sulphate than was actually used in the spraying. A barrel of stock solution containing 150 pounds of copper sulphate broke and a considerable quantity was lost.

The cost of spraying in this experiment was 77 cents per acre for each application.

The two-acre field.—The potatoes in this field were of the variety Sulphic Beauty and planted May 15. They were sprayed seven times—July 3, 8, 22, August 1, 17, 28 and September 2. The total quantity of bordeaux used was 650 gallons. Paris green was used with the bordeaux twice; viz., on July 8 (two pounds per acre) and July 22 (one pound per acre). Three rows 323 feet long were left unsprayed. Paris green in water was applied to these rows twice (July 7 and 20) by means of a knapsack sprayer. The chief enemy was late blight which caused the death of the unsprayed rows about September 1 while the sprayed rows were still quite green on September 13 when they were killed by frost. No damage was done by bugs. The test rows were dug by hand September 22 with the following results:

Second sprayed row on the east, 382 lbs. marketable tubers.
Second sprayed row on the west, 357 lbs. marketable tubers.
Average of two sprayed rows, 369½ lbs. marketable tubers.
Middle unsprayed row, 282 lbs. marketable tubers.
Yield, sprayed, 276 bu. 49 lbs. marketable tubers per acre.
Yield, unsprayed, 211 bu. 16 lbs. marketable tubers per acre.
Gain, 65 bu. 33 lbs. marketable tubers per acre.

It was plain that spraying had checked the rot. There was practically no rot on either sprayed row while on the unsprayed row rotten tubers were frequent. The yield of small and rotten tubers was 24 bu. 32 lbs. per acre for the sprayed and 69 bu. 28 lbs. per acre for the unsprayed.

The nine-acre field.—The variety in this field was Enormous No. 9, planted May 18. They were given five sprayings, the total quantity of bordeaux used being 1,755 gallons. The dates of spraying were—July 10, 26, August 14-17, 28 and September 2. Paris green was used in the first two sprayings—seven pounds on July 10 and fifteen pounds on July 26. The three unsprayed rows, 1,419 feet long, were treated with paris green in water on the same dates. Toward the close of the season the unsprayed rows were plainly inferior to the adjacent sprayed rows. They died about two weeks earlier. In fact, the sprayed rows were

still partly green when frost came. The test rows were dug by hand September 23 and the following yields obtained:

Second sprayed row on the east, 1,382 lbs. marketable tubers.
Second sprayed row on the west, 1,540½ lbs. marketable tubers.
Average of two sprayed rows, 1,461 lbs. marketable tubers.
Middle unsprayed row, 966 lbs. marketable tubers.
Yield, sprayed, 235 bu. 59 lbs. marketable tubers per acre.
Yield, unsprayed, 156 bu. marketable tubers per acre.
Gain, 79 bu. 59 lbs. marketable tubers per acre.

Rotten tubers were much more frequent on the unsprayed row than on the sprayed rows, but the loss was not great in either case. The yield of small and rotten tubers was 21 bu. 26 lbs. per acre for the sprayed and 46 bu. 31 lbs. per acre for the unsprayed. Most of the difference was in rotten tubers.

The six-acre field.—This field, also, was of the variety Enormous No. 9. The plants were sprayed five times—July 27, August 17-18, 26, September 2 and 9. In all, 1,650 gallons of bordeaux were used on this field. Paris green was applied only once; viz., in the first spraying when eight pounds were used. There were three unsprayed rows 688 feet long and these received an application of paris green in water on the same date. Being so late planted (June 8) the potatoes in this field had not nearly finished their growth when frost came September 13. The unsprayed rows were already commencing to die, but the sprayed rows were in full foliage. Had not frost come so early the yields in this field would have been larger and also the gain due to spraying larger. The test rows were dug with a potato digger on October 10, the yields being as follows:

Second sprayed row on the east, 332 lbs. marketable tubers.
Second sprayed row on the west, 381 lbs. marketable tubers.
Average of two sprayed rows, 356½ lbs. marketable tubers.
Middle unsprayed row, 251 lbs. marketable tubers.
Yield, sprayed, 118 bu. 50 lbs. marketable tubers per acre.
Yield, unsprayed, 83 bu. 40 lbs. marketable tubers per acre.
Gain, 35 bu. 10 lbs. marketable tubers per acre.

There was no rot of any account except at the north end where hog manure had been spread. Here, there was some rot but decidedly more on the unsprayed row than on the sprayed. The

yield of small and rotten tubers was 9 bu. 10 lbs. per acre for the sprayed and 23 bu. per acre for the unsprayed.

Combining the results obtained in the three fields we have an average gain of 60 bu. 14 lbs. of marketable tubers per acre. On the average, spraying increased the yield 40 per ct. The gain is all the result of spraying, there having been no interference by bugs. On September 22 and 23 when the test rows in the first two fields were dug, the market price of potatoes in Chateaugay was 25 cents per bushel; on October 10 when the test rows in the third field were dug the price had risen to 40 cents per bushel. Even at these low prices *the average net profit in the Chateaugay experiment was $13.50 per acre.* The actual profit was considerably greater than this. The entire crop was stored. Under date of December 21 Mr. Smith wrote that 2,200 bushels had been sold on November 1 at 70 cents per bushel while the remainder of the crop was still in storage and keeping well.

THE PERU EXPERIMENT.

This experiment was made by Datus Clark, Peru, Clinton County, who made a similar experiment for the Station in 1904. A field of ten acres was sprayed four times—July 24, August 8, 19 and September 8. In the second and third sprayngs only 8 acres were sprayed each time, so that in reality the total area sprayed was only 36½ acres. The spraying was done with the same sprayer used in 1904; namely, an Aroostook two-horse, six-row power sprayer with one nozzle per row. Water for making the bordeaux was obtained from a river at the north end of the field.

As there were no bugs to fight no poison was used. There were two varieties of potato—Ironclad and World's Fair, and three unsprayed rows were left in each variety.

The expense of the spraying included the following items.

132	lbs. copper sulphate @ 8c.	$10.56
88	" lime @ 1c.	.88
23½	hrs. labor for man @ 15c.	3.53
19½	" labor for team @ 25c.	4.88
Wear on sprayer		4.00
Total		$23.85

The cost of spraying was 65½ cents per acre for each application.

A large part of the field needs underdrainage badly and as the season was an extremely wet one the conditions were very unfavorable for a crop of potatoes. On the wetter portion of the field, planted with World's Fair, the plants made a weak growth, blighted badly and died early in spite of spraying. On the drier portion of the field the variety Ironclad did considerably better. There was a rank growth of vines which did not blight until late in the season. The test rows were dug by hand October 11.

Test No. 1. Ironclad.—The unsprayed rows were 773 feet long. Up to the time of digging there had been no frost and the sprayed plants although much blighted still retained about one-fifth their foliage. The unsprayed rows were now dead but there had been no marked difference in appearance between the sprayed and unsprayed rows until within a few days. The yields were as follows:

Second sprayed row on the west, 457½ lbs. marketable tubers.
Middle unsprayed row, 303 lbs. marketable tubers.
Yield, sprayed, 143 bu. 21 lbs. marketable tubers per acre.
Yield, unsprayed, 94 bu. 56 lbs. marketable tubers per acre.
Gain, 48 bu. 35 lbs. marketable tubers per acre.

On both rows there was a large amount of rot, somewhat more on the unsprayed row than on the sprayed one. The yield of small and rotten tubers was 60 bu. 57 lbs. per acre for the sprayed and 71 bu. 36 lbs. per acre for the unsprayed.

Test No. 2. World's Fair.—The unsprayed rows were 633 feet long. Both the sprayed and the unsprayed plants had been dead for some time. The yields were as follows:

Second sprayed row on the west, 109½ lbs. marketable tubers.
Middle unsprayed row, 47 lbs. marketable tubers.
Yield, sprayed, 41 bu. 53 lbs. marketable tubers per acre.
Yield, unsprayed, 18 bu. marketable tubers per acre.
Gain, 23 bu. 53 lbs. marketable tubers per acre.

Here, also, there was much rot, the sprayed row showing a little more than the unsprayed. The yield of small and rotten tubers

was 26 bu. 11 lbs. per acre for the sprayed and 24 bu. 17 lbs. per acre for the unsprayed.

Combining the results obtained in the two tests there is an average gain of 36 bu. 14 lbs. per acre. In one test spraying increased the yield 51.2 per ct. and in the other 132.6 per ct. making an average of 91.9 per ct.

At the time of digging the test rows there was no market for potatoes in Peru, but a few days later the market opened at 55 cents per bushel. At this price 36 bu. 14 lbs. of potatoes would be worth $19.93. After deducting the cost of spraying, $2.62, there remains *a net profit of $17.31 per acre.*

Notwithstanding the fact that there was much rot on the sprayed rows in both tests and an extremely low yield in one test the spraying was successful and profitable. However, had there been no unsprayed rows for comparison it would have been pronounced a flat failure. This experiment shows the unreliability of conclusions drawn from results obtained in fields where there are no check rows. They who wish to learn definitely the benefit from spraying must leave unsprayed rows for comparison.

THE HEBRON EXPERIMENT.

This experiment was conducted by Walter B. Shaw, Hebron, Washington County. The conditions were not entirely suitable for such an experiment and Mr. Shaw was reluctant about undertaking it, but finally consented as no better location could be found. Very little potato spraying has been done in Washington County.

Six acres of potatoes, variety unknown, were sprayed twice very thoroughly by what we call the two-hose-and-three-men method. A Myers barrel spray pump was mounted in a fifty-gallon barrel drawn through the field on a one-horse cart. One man on the cart drove and worked the pump while two other men walking behind the cart directed the nozzles attached at the ends of two long leads of hose from the spray pump. Four rows were sprayed at each passage through the field. The dates of spraying were August 2 and August 25-26. The bordeaux was prepared by the 6-6-54 formula and water for making it was obtained from

a brook at one side of the field. Paris green was used with the bordeaux in the first spraying but not in the second. On the unsprayed rows, of which there were two sets of three rows each, paris green was applied August 3 by means of a powder gun. Owing to the delay in receiving the copper sulphate it was necessary to make one application of paris green over the entire field, check rows included, before any spraying was done. This application was made with a powder gun.

Both on the sprayed and unsprayed rows bugs were kept under control. It was plain that the paris green had been more effective where applied with bordeaux than where applied dry by means of a powder gun. Still there were not enough bugs on the unsprayed rows to warrant a second application of poison. Flea beetles were quite plentiful and, as usual, injured the unsprayed rows more than the sprayed. Late blight appeared about August 25. It spread slowly. From the time of the first spraying on, the foliage of the sprayed rows was better than that of the unsprayed rows. Toward the close of the season the difference became quite marked. At the time of digging the test rows, September 27, there had been no frost and many of the sprayed plants still retained much of their foliage while the unsprayed plants in both tests were dead.

The items of expense for spraying six acres of potatoes twice were as follows:

94 lbs. copper sulphate @ 6¾c.	$ 6.35
92 " lime @ 1c.	.92
7 " paris green[18] @ 16c.	1.12
74 hrs. labor for man[19] @ 15c.	11.10
26 " labor for horse[20] @ 10c.	2.60
Use of sprayer (hired)	2.05
Total	$24.14

The total cost of spraying was $4.02 per acre or $2.01 per acre for each application which is a little more than twice the average

[18]This does not include paris green used before spraying was commenced.
[19]Includes four hours consumed in damming brook and getting things ready; also four hours going after sprayer and returning it.
[20]Includes four hours consumed in going after sprayer and returning it.

cost in the other twelve experiments. The method of spraying employed in this experiment is expensive because it requires so much man labor. Of course the spraying can be done very thoroughly but it is doubtful if the gain is proportional to the extra expense. We are confident that, in most cases, horse sprayers with stationary nozzles will give larger net profit. On steep hillsides, such as were encountered in this experiment, it may be possible to spray by this method where a sprayer with stationary nozzles could not be used.

Both sets of test rows were dug by hand September 27 with the following results:

Test No. 1.—The unsprayed rows were 286 feet long. The following yields were obtained:

Second sprayed row on the west, 163 lbs. marketable tubers.
Second sprayed row on the east, 126½ lbs. marketable tubers.
Average of two sprayed rows, 144¾ lbs. marketable tubers.
Middle unsprayed row, 99¼ lbs. marketable tubers.
Yield, sprayed, 133 bu. 39 lbs. marketable tubers per acre.
Yield, unsprayed, 91 bu. 38 lbs. marketable tubers per acre.
Gain, 24 bu. 1 lb. marketable tubers per acre.

There were a few rotten tubers on the unsprayed row but none on the sprayed rows. The yield of small and rotten tubers was 15 bu. per acre for the sprayed and 20 bu. 19 lbs. per acre for the unsprayed.

Test No. 2.—The unsprayed rows were 704 feet long. The yields were as follows:

Second sprayed row on the west, 303¼ lbs. marketable tubers.
Second sprayed row on the east, 280 lbs. marketable tubers.
Average of two sprayed rows, 291⅝ lbs. marketable tubers.
Middle unsprayed row, 193½ lbs. marketable tubers.
Yield, sprayed, 109 bu. 21 lbs. marketable tubers per acre.
Yield, unsprayed, 72 bu. 34 lbs. marketable tubers per acre.
Gain, 36 bu. 47 lbs. marketable tubers per acre.

As regards rot, the conditions were about the same here as in Test No. 1; viz., but little on the unsprayed and none on the sprayed. The yield of small and rotten tubers was 16 bu. 58 lbs. for the sprayed and 24 bu. per acre for the unsprayed.

Combining the results obtained in the two tests there is an average gain of 39 bu. 24 lbs. marketable tubers per acre. The average percentage of gain was 48.2 per ct.

On the date of digging the test rows the market price of potatoes at Rupert, Vt., the nearest shipping point, was 40 cents per bushel. At this price the gain of 39 bu. 24 lbs. would be worth $15.66. After deducting the cost of spraying, $4.02, there remains *a net profit of $11.64 per acre.* Probably the actual profit will be greater than this. Up to the present writing (December 23) only one load has been sold at 65 cents per bushel of 65 pounds. The remainder of the crop is in storage and seems to be keeping well.

THE SYOSSET EXPERIMENT.

This experiment was conducted by John S. Burke, Syosset, Long Island. Two fields of potatoes were sprayed—one of ten acres planted with three different varieties and one of eleven acres planted throughout with the variety Green Mountain. In the latter field two four-row strips were left unsprayed. A part of the 21 acres was sprayed four times, a part three times and a part twice, the total amount of spraying being equal to 66½ acres sprayed once. The spraying was done with a Spramotor hand-power pump mounted on the truck of a discarded Aspinwall sprayer and rigged to spray four rows at a time with three nozzles for each of the two outside rows and two nozzles for each of the two inside rows. The items of the expense of the spraying were as follows:

622	lbs. copper sulphate @ 6c.	$37.32
2	bbl. lime @ $1.35	2.70
58	lbs. paris green @ 15c.	8.70
48¾	hrs. labor for man @ 15c.	7.32
48¾	" labor for horse @ 20c.	9.75
	Man and team hauling water	19.00
	Wear on sprayer	5.00
	Total	$89.79

The cost per acre for each spraying was $1.36½. This high cost is largely due to the expense of hauling water to the field. Although the work was light, the team while thus employed was

not available for any other purpose so it is necessary to charge for full time.

In the eleven-acre field containing the two strips of unsprayed rows the plants made a luxuriant growth and seemed to be doing well until about the middle of July when they were seriously injured by drought. On July 20 Mr. Burke wrote that the crop had been so much injured by drought that he thought it might not pay to spray any more. Up to that time there seemed to be no benefit from the spraying. In fact Mr. Burke was of the opinion that the unsprayed rows were superior to the sprayed ones. On July 22 rain came and at the same time flea beetles appeared in swarms. After this rain the plants revived and another spraying was made early in August. From the time of the outbreak of flea beetles the sprayed rows made a better appearance than the unsprayed. Probably the increased yield on the sprayed rows was chiefly owing to the better protection against flea beetles. Early blight did not enter into the problem to any extent and late blight appeared only at the close of the season. Bugs were kept well under control both on the sprayed and the unsprayed rows. The dates of spraying the test rows were June 26, July 6 and August 7. Paris green was applied only in the first spraying and the unsprayed rows were treated with poison on the same date.

Test No. 1.—The rows in this test were 874 feet long. They were dug September 27 and the following yields obtained:

Second and third sprayed rows on the north, 1,287 lbs. marketable tubers.
Second and third sprayed rows on the south, 1,329 lbs. marketable tubers.
Average yield for two sprayed rows, 1,308 lbs. marketable tubers.
Middle two unsprayed rows, 1,104 lbs. marketable tubers.
Yield, sprayed, 197 bu. 30 lbs. marketable tubers per acre.
Yield, unsprayed, 166 bu. 42 lbs. marketable tubers per acre.
Gain, 30 bu. 48 lbs. marketable tubers per acre.

The yield of culls was at the rate of 10 bu. 12 lbs. per acre for the sprayed and 16 bu. 18 lbs. per acre for the unsprayed. There was a little rot on the sprayed rows, but somewhat more on the unsprayed.

Test No. 2.—Here, the test rows were 674 feet long. The sprayed rows on the north were given three sprayings as in Test

No. 1, but those on the south received only two sprayings—June 26 and July 6. The test rows were dug September 27 with the following results:

Second and third sprayed rows on the north, 604 lbs. marketable tubers.
Second and third sprayed rows on the south, 637 lbs. marketable tubers.
Average yield for two sprayed rows, 620½ lbs. marketable tubers.
Middle two unsprayed rows, 420 lbs. marketable tubers.
Yield, sprayed, 126 bu. 35 lbs. marketable tubers per acre.
Yield, unsprayed, 85 bu. 41 lbs. marketable tubers per acre.
Gain, 40 bu. 54 lbs. marketable tubers per acre.

The yield of culls was 14 bu. 47 lbs. per acre for the sprayed rows and 5 bu. 12 lbs. per acre for the unsprayed. On the sprayed as well as the unsprayed rows there was considerable loss from rot.

Why the rows on the south, sprayed only twice, yielded more than those on the north which were sprayed three times is not known. Mr. Burke states that on the whole the portion of the field sprayed twice (about four acres) did not yield as well as the portion sprayed three times.

Combining the results obtained in the two tests the average gain due to spraying in this experiment is 35 bu. 51 lbs. per acre. At 60 cents per bushel[21] this gain would be worth $21.51. Deducting $4.10, the cost of three sprayings, there remains *a net profit of $17.41 per acre.*

THE MATTITUCK EXPERIMENT.

This experiment was conducted by W. H. Satterly, Mattituck, Long Island, who made a similar experiment for the Station in 1904. Sixteen and two-thirds acres of potatoes, variety Green Mountain, were sprayed with a one-horse "Schanck" sprayer the same one used in the 1904 experiment. Two strips of seven rows each were left unsprayed. The entire sixteen and two-thirds acres were sprayed seven times—June 24-26, July 4-5, July 10-12, July 17, July 25-26, August 2 and August 10-11. About one-

[21]At the time of digging the test rows Mr. Burke was selling potatoes in the 103d St. (New York) market at $2 to $2.25 per barrel of 170 pounds. Allowing thirty cents per barrel for marketing, the net returns would be $1.70 to $1.95 per barrel which is somewhat more than sixty cents per bushel.

half the field was given an additional spraying July 22. This makes the total amount of spraying done equivalent to spraying 114 2-3 acres once. The expense account included the following items:

540	lbs. copper sulphate @ 6c.	$32.40
360	" lime @ 1c.	3.60
112	" paris green @ 15c.	16.80
74½	hrs. labor for man @ 20c.	14.90
74½	" labor for boy @ 10c.	7.45
74½	" labor for horse @ 10c.	7.45
Wear and repairs on sprayer		10.00
Total		$92.60

The total cost of spraying was $5.55 per acre or 74 cents per acre for each application.

The bordeaux mixture was of the 6-4-50 formula, the total quantity used being 4,500 gallons which is at the rate of a little more than 39 gallons per acre at each application. By comparing these figures with those given for the experiment in 1904 (Bul. 264, p. 143) it will be seen that the quantity per acre per application was one-half greater than in 1904. This difference is chiefly the result of spraying fewer rows at a time. In 1904 eight rows were covered at each passage in most of the spraying, while in 1905 the sprayer was driven over every fifth row. This also accounts for the increased expense of spraying in 1905.

Paris green was used with the bordeaux not uniformly over the whole field, but whenever and wherever needed in the first, third, fifth and sixth sprayings and in the extra spraying of July 22. In all, 112 pounds of paris green were used. Perhaps the quantity was unnecessarily large. On the unsprayed rows, one application of paris green made June 26 was sufficient to prevent injury by bugs.

An examination of the experiment was made July 11. At that time there was no appreciable difference between the sprayed and unsprayed rows. On the unsprayed rows in the north test it was easy to find leaves affected with late blight and occasionally specimens of the disease were found also on the sprayed rows. Mr. Satterly states that he first found late blight July 5. For-

tunately, the weather conditions during the greater part of July were unfavorable to blight so that an epidemic of the disease was avoided, but it made steady progress and in August did considerable damage. About July 22 swarms of flea beetles appeared and became an important factor in the experiment. There was also some early blight.

The test rows were dug on October 10 with a potato digger.

North test.—In the portion of the field in which this test was located the previous crop was hay. The test rows were 360 feet long. The yields were as follows:

Second sprayed row on the north, 469½ lbs. marketable tubers.
Second sprayed row on the south, 412 lbs. marketable tubers.
Average of two sprayed rows, 440¾ lbs. marketable tubers.
Middle unsprayed row, 329 lbs. marketable tubers.
Yield, sprayed, 296 bu. 15 lbs. marketable tubers per acre.
Yield, unsprayed, 221 bu. 9 lbs. marketable tubers per acre.
Gain, 75 bu. 6 lbs. marketable tubers per acre.

The yield of culls (small sound tubers) was at the rate of 16 bu. 48 lbs. per acre for the sprayed and 22 bu. 11 lbs. for the unsprayed. On the unsprayed row there was some rot, but on the sprayed rows none.

South test.—This test was located in a portion of the field which grew potatoes in 1904. The rows were 348 feet long. The yields were as follows:

Second sprayed row on the north, 281 lbs. marketable tubers.
Third sprayed row on the south,[22] 296½ lbs. marketable tubers.
Average of two sprayed rows, 288¾ lbs. marketable tubers.
Middle unsprayed row, 241 lbs. marketable tubers.
Yield, sprayed, 200 bu. 47 lbs. marketable tubers per acre.
Yield, unsprayed, 167 bu. 35 lbs. marketable tubers per acre.
Gain, 33 bu. 12 lbs. marketable tubers per acre.

The yield of culls was at the rate of 18 bu. 57 lbs. per acre for the sprayed and 18 bu. 5 lbs. for the unsprayed. In this test the unsprayed as well as the sprayed rows were free from rot. Most of the gain on the sprayed rows was due to protection against flea beetles and early blight.

Combining the results obtained in the two tests we have an average gain of 54 bu. 9 lbs. marketable tubers per acre, worth

[22]The second sprayed row on the south fell in a dead furrow.

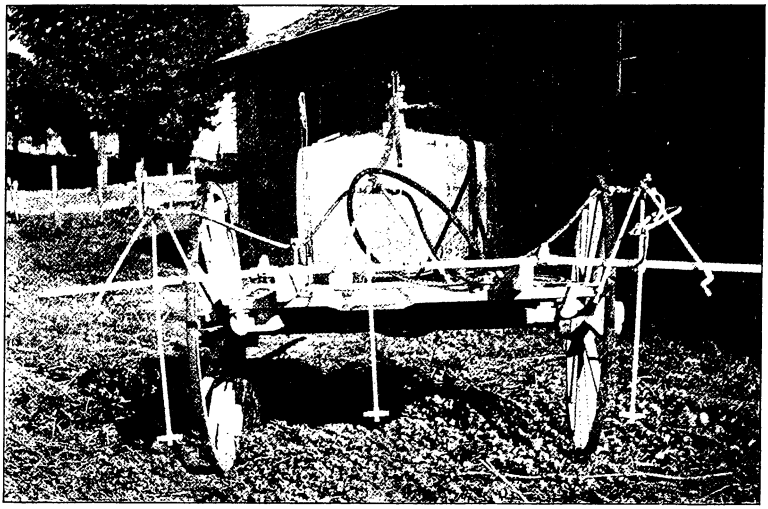


FIGURE 1.—USED IN GOWANDA EXPERIMENT.

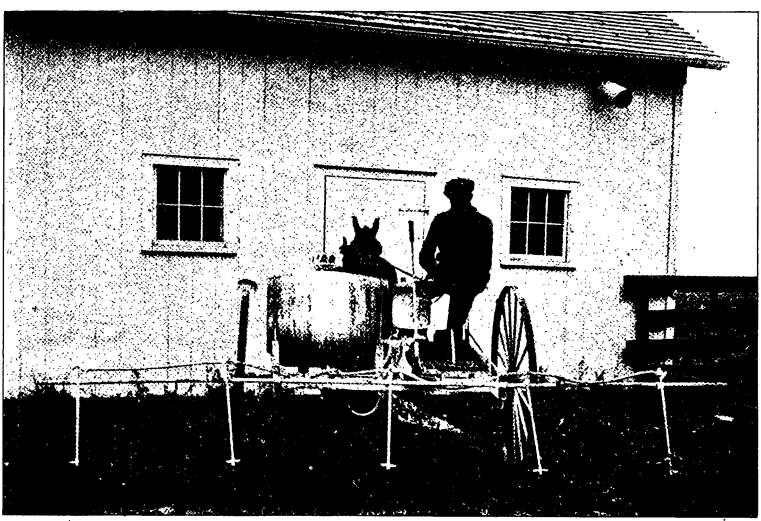


FIGURE. 2—USED IN VERONA MILLS EXPERIMENT.

PLATE III.—SOME SPRAYERS USED IN EXPERIMENTS.

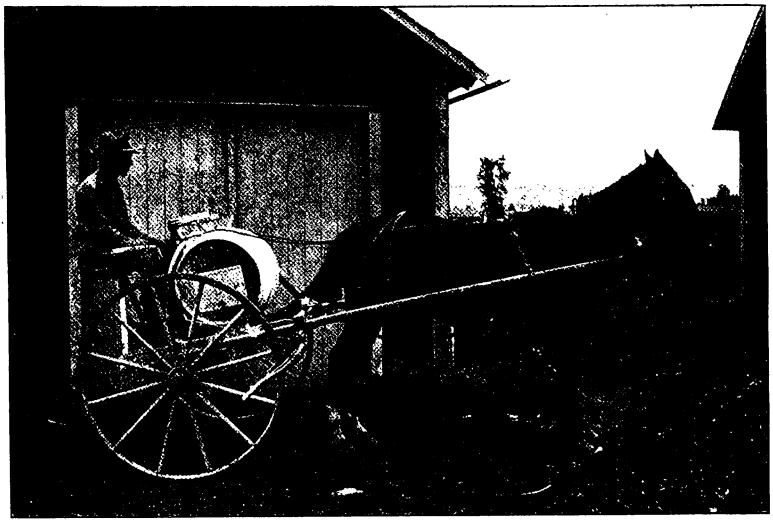
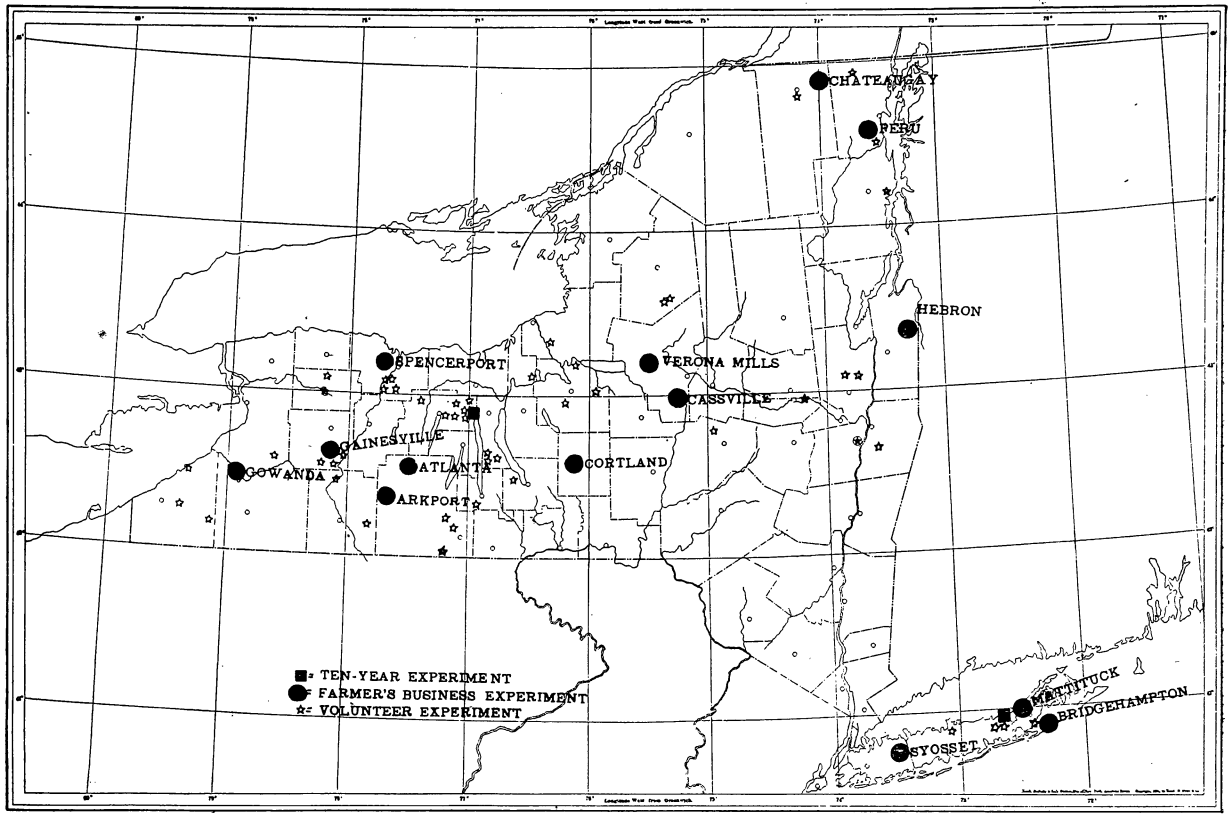


FIGURE 1.—SPRAYER USED IN THE CASSVILLE EXPERIMENT.

FIGURE 2.—RESULTS IN VOLUNTEER EXPERIMENT NO. 42.

PLATE IV.

PLATE V.—THE SPENCERPORT EXPERIMENT.
Three rows through the center unsprayed. Photographed Sept. 23.



MAP I.—LOCATION OF POTATO SPRAYING EXPERIMENTS IN 1905.

at the time of digging, $32.49. After subtracting the cost of spraying, $5.55 there remains *a net profit of $26.94 per acre.*

THE BRIDGEHAMPTON EXPERIMENT.

E. E. Halsey, Bridgehampton, Long Island, conducted this experiment. Eighteen acres of potatoes, mostly of the variety Carman No. 1, were sprayed eight times between June 13 and August 8. Two strips of four unsprayed rows each were left for checks. The spraying was done with an E. C. Brown, two-horse, five-row, power sprayer carrying one nozzle per row.

The bordeaux was of the usual 6-4-50 formula applied at the average rate of about 55 gallons per acre for each application. Arsenite of soda (prepared by boiling together one pound of white arsenic and four pounds of sal soda in one gallon of water) was used with the bordeaux in every spraying. On the unsprayed rows paris green was applied twice (June 24 and July 8) by means of a powder gun.

The items of expense for spraying 18 acres 8 times were as follows:

900 lbs. copper sulphate @ 6½c.	$ 58.50
5 bbl. lime @ $1.45	7.25
34 lbs. white arsenic @ 15c.	5.10
150 " sal soda @ 1½c.	2.25
8 days labor for man @ $1.50	12.00
8 " labor for team @ $3.50	28.00
Wear on sprayer	10.00
Total	$123,10

In this experiment the total expense of spraying was $6.84 per acre or 85½ cents per acre for each application.

On July 11 when one of the writers visited the experiment field the unsprayed rows were apparently in as good condition as the sprayed rows. However, close examination revealed traces of late blight on the unsprayed rows. A month later (August 12) the unsprayed rows were nearly dead with late blight and the sprayed rows also were much affected and going down rapidly. Flea beetles which appeared in large numbers about July 22 added their injury to that done by blight. In the north

test the sprayed rows outlived the unsprayed ones about two weeks, but in the south test the difference was less. Bugs were kept well under control on the unsprayed rows as well as on the sprayed ones. The test rows were dug on August 26 with a potato digger and the following results obtained:

North test.—Eighteen rows required to make an acre. The yields were as follows:

Two sprayed rows,[23] 2,044 lbs. marketable tubers.
Middle two unsprayed rows, 1,548 lbs. marketable tubers.
Yield, sprayed, 306 bu. 36 lbs. marketable tubers per acre.
Yield, unsprayed, 232 bu. 12 lbs. marketable tubers per acre.
Gain, 74 bu. 24 lbs. marketable tubers per acre.

The yield of culls (small sound tubers) was 16½ bu. per acre for the sprayed and 25½ bu. for the unsprayed. There was somewhat more rot on the unsprayed rows than on the sprayed, but not much in either case.

South test.—Here, also, eighteen rows were required to make an acre. The yields were as follows:

Two sprayed rows,[24] 2,167 lbs. marketable tubers.
Middle two unsprayed rows, 2,007 lbs. marketable tubers.
Yield, sprayed, 325 bu. 3 lbs. marketable tubers per acre.
Yield, unsprayed, 301 bu. 3 lbs. marketable tubers per acre.
Gain, 24 bu. marketable tubers per acre.

The yield of culls was 28 bu. 39 lbs. per acre for the sprayed and 23 bu. 51 lbs. per acre for the unsprayed. The conditions as regards rot were the same as in the north test.

Why the gain was so much greater in the north test is not known. The conditions in the two tests were practically the same except that in the north test the check rows were accidentally sprayed on July 3; but this would tend to lower the gain in the north test. Fortunately, the spraying was a light one owing to the spray pump being out of order and the pressure low.

Combining the results obtained in the two tests we find that the average increase in yield due to spraying in this experiment was 49 bu. 12 lbs. per acre. At 50 cents per bushel, which was the market price at the time of digging the test rows, this increase

[23]The second sprayed row on either side of the check.
[24]The second and third sprayed rows on the south side of the check.

would be worth $24.60. Deducting $6.84, the expense of spraying, there remains *a net profit of $17.76 per acre.* The actual selling price was 50 and 55 cents per bushel for about one-half the crop and 60 cents per bushel for the remainder.

SUMMARY OF BUSINESS EXPERIMENTS IN 1905.

The principal features of the fourteen business experiments are shown in the following table.

TABLE XI.—SHOWING RESULTS OF BUSINESS EXPERIMENTS.

Experiment.	Area sprayed.	No. of times sprayed.	Increase in yield per acre.	Total cost of spraying per acre	Cost per acre for each spraying.	Net profit per acre.[25]
	A.		*Bu.*			
Gowanda	10	4	46 1/5	$ 3 76	$ 0 94	$ 23 93
Gainesville	16	7	67 1/3	5 41	77 1/3	22 63
Arkport	6	4	34 2/3	3 95	98 1/2	13 39
Atlanta	8	3 to 4	44 1/2	3 50	99 1/2	18 59
Spencerport	10	3	53 1/5	2 44	81 1/3	29 47
Verona Mills	11	5	49 1/7	5 02	1 00	27 01
Cassville	11	5	33 1/2	4 31	86	20 83
Cortland[26]	6	5	173	6 50	1 30	
Chateaugay	17	5 to 7	60 1/4	4 04	77	13 50
Peru	10	4	36 1/2	2 41	65 1/2	17 31
Hebron	6	2	39 2/5	4 02	2 01	11 64
Syosset	21	3	35 5/6	4 09	1 36 1/2	17 41
Mattituck	16 2/3	7 1/2	54 1/6	5 55	74	26 94
Bridgehampton	18	8	49 1/5	6 84	85 1/2	17 76

Total area sprayed in thirteen experiments, 160 2-3 acres.
Average increase in yield per acre, 46 1-2 bushels.
Average total cost of spraying per acre, $4.25.
Average cost per acre for each spraying, 98 cents.
Average net profit per acre, **$20.04**

SUMMARY OF BUSINESS EXPERIMENTS IN 1904.

Total area sprayed in fourteen experiments, 180 acres.
Average increase in yield per acre, 62 1-4 bushels.
Average total cost of spraying per acre, $4.98.
Average cost per acre for each spraying, 93 cents.
Average net profit per acre, **$24.86.**

[25] Based on local market prices for potatoes at time of digging the test rows.

[26] In computing the averages following Table XI, the Cortland experiment has not been included. The gain in this experiment may not have been entirely due to spraying. See page 181.

SUMMARY OF BUSINESS EXPERIMENTS IN 1903.

Total area sprayed in six experiments, 61 1-6 acres.
Average increase in yield per acre, 57 bushels.
Average total cost of spraying per acre, $4.98.
Average cost per acre for each spraying, $1.07.
Average net profit per acre, **$23.47.**

Average net profit for three years, $22.79 per acre.

VOLUNTEER EXPERIMENTS.

In 1904 the Station began collecting and recording the results of experiments made by farmers in all parts of the State. As these experiments were carried out entirely by the farmers themselves we call them volunteer experiments. Forty-one such experiments made in 1904 were reported in Bulletin 264.

It was hoped that in 1905 a much larger number of volunteer experiments might be secured for publication in the present bulletin. In the spring many farmers were urged to make volunteer experiments and in the fall they were requested to report results. Although considerable effort was expended in this line only 50 reports were obtained. Evidently, our farmers are not experimenting as much as they should. We have had occasion to mention this before.

The highly favorable results obtained in the numerous experiments made by the Station and by New York farmers during the past four years should stimulate potato growers to give spraying a trial. If it really is as profitable as these experiments indicate they can not afford to neglect spraying. As a matter of fact many are beginning to practice spraying, but only a few are making any attempt to determine how much the yield is increased thereby or whether the spraying is profitable. Let us have more experiments in 1906. It is a very easy matter to make potato spraying experiments like the farmers' business experiments reported in this bulletin. The two important points to be determined are: (1) The increase in yield due to spraying; and (2) the expense of spraying.

To make a detailed report of each of the volunteer experiments as was done in Bulletin 264 necessitates frequent repetition of certain statements and requires an unnecessarily large amount of space in the bulletin. It is believed that these reports may be greatly condensed without materially reducing their value. The leading features of the experiments of the 50 volunteer experiments are shown in the following table:

TABLE XII.—SHOWING RESULTS OF VOLUNTEER EXPERIMENTS IN 1905.

Experiment.	Location.	Name.	Area sprayed.	Times sprayed.	Yield per acre.		Gain per acre due to spraying.		Cost per acre each spraying.	Price of potatoes.	Kind of sprayer.
					Sprayed.	Not sprayed.					
			A.		*Bu. lbs.*	*Bu. lbs.*	*Bu. lbs.*			*Cts.*	
1	Dewittville	G. A. Kirkland	6	6	215 37	140 37	75 —		$1 16	65	One-horse, home-made, 2-row.
2	Dunkirk	C. S. Aldrich	2	3	197 —	173 —	24 —			75	Knapsack.
3	Poland Center	Newel Cheney	3	11	188 41	152 29	36 12		70	60	One-horse, 4-row.
4	Springville	C. E. Safford		4	175 57	97 45	78 12		1 25	50	Knapsack.
5	Fillmore	O. C. Gibbs	8½	4	180 54	130 48	50 6			62	Two-horse, 5-row, home-made.
6	Pike	C. M. Dennis	12½	4	150 —	100 —	50 —			40-60	
7	Hardys	L. H. Taylor	10	5	184 41	128 29	56 12		70	50	One-horse, home-made, 4-row.
8	Castile	L. J. Wilson	10	5	204 35	155 56	48 39		62	40-60	Two-horse, home-made, 4-row.
9	Elba	C. W. Driggs	1½	3	153 49	135 29	18 20		77	60	4-row, horse sprayer.
10	Batavia	G. A. Prole	10½	6	181 48	118 43	63 5		67	52	Two horse, home-made, 5-row.
11	W. Henrietta	C. M. Lyday	6	7	198 —	136 7	61 53		43½	50	Peppler 1-horse, 6-row power sprayer.
12	W. Henrietta	Wm. Robert	15	7	229 41	148 49	80 52			50	Brown power sprayer.
13	West Rush	D. S. Norris	5	5	257 18	166 —	91 18		70	42-45	Home-made, 4-row.
14	West Rush	T. E. Martin	17½	20	352 20	215 40	136 40		40	38	One-horse, home-made, 6-row, geared.
15	Andover	E. R. Crandall	5	4	100 —	55 —	45 —			50	One-horse, 4-row, power sprayer.
16	Nichols	Daniel Dean	14½	3	146 40	93 30	53 10			68-75	Watson, 4-row, 1-horse power sprayer.
17	Coopers Plains	W. L. McConnell	1	3	242 —	221 50	20 10			60	Knapsack.
18	Campbell	E. S. Cole	1	2	100 48	72 36	28 12			50	Hand sprayer.

Experiment.	Location.	Name.	Area sprayed.	Times sprayed.	Yield per acre.		Gain per acre due to spraying.		Cost per acre each spraying.	Price of potatoes.	Kind of sprayer.
					Sprayed.	Not sprayed.					
			A.		*Bu. lbs.*	*Bu. lbs.*	*Bu. lbs.*			*Cts.*	
19	Beaver Dams	A. J. Moore	5	3	165 —	144 —	21 —		$1 16	60	Watson, one-horse, 4-row, power sprayer.
20	Victor	C. E. Green	10	8	230 —	166 34	63	26		60	Home-made, 4-row.
21	Canandaigua	H. Van Voorhis	14	4	191 9	119 28	71	41	1 00	50	Two-horse, 6-row, home-made, geared.
22	Clifton Springs	J. F. Curran	$6\frac{3}{10}$	5	199 10	127 50	71	20	1 13	60	Aroostook, 6-row, 2-horse power sprayer.
23	Clifton Springs	P. H. Pettit	18	4	147 58	117 45	30	13	68	55	Brown, 4-row, 2-horse power sprayer.
24	Phelps	J. V. Salisbury & Sons	25	5	140 12	58 25	81	47	80	60	Aroostook, 2-horse, 6-row power sprayer.
25	Phelps	M. B. Newman	15	5	300 —	200 —	100 —		90	55	Aroostook, 2-horse, 6-row, power sprayer.
26	Geneva	H. W. Hadlow	$\frac{1}{3}$	3	194 41	176 31	18	10	2 03	50	Knapsack.
27	Ovid	J. M. Bennett	2	3	97 30	53 11	44	19		50-60	
28	Interlaken	M. C. Brokaw	10	5	230 —	145 —	85 —			40	One-horse, home-made, 2-row outfit.
29	Interlaken	F. C. & L. B. Bradley	5	6	187 46	105 46	82 —		1 02	50	Two-horse, home-made, 4-row outfit.
30	Trumansburg	F. N. Smith	20	10	252 —	144 —	108 —		50	60	Watson, 2-horse, 4-row power sprayer.
31	Jordan	F. O. Chamberlin	10	6	70 —	58 21	11	39	53	70	Home-made cart with barrel spray pump.
32	Fulton	V. W. Shattuck	$6\frac{1}{2}$	4	230 46	176 19	54	27		60	One-horse, home-made 4-row.
33	Clay	C. N. Breman	$1\frac{1}{4}$	5	260 48	196 56	63	52	98	45-55	Home-made cart.
34	S. Onondaga	G. G. Hitchings	32	6	117 22	62 7	55	15	50	55	Niagara gas sprayer 2-horse, 2-row.

Experiment.	Location.	Name.	Area sprayed.	Times sprayed.	Yield per acre.		Gain per acre due to spraying.		Cost per acre each spraying.	Price of potatoes.	Kind of sprayer.
					Sprayed.	Not sprayed.					
			A.		*Bu. lbs.*	*Bu. lbs.*	*Bu. lbs.*			*Cts.*	
35	Fayetteville	F. E. Dawley	5	5	220 30	156 30	64 —		$ 98	60	Iron Age, one-horse, 4-row, power sprayer.
36	Schuyler Lake	D. C. Williams	2	4	286 46	145 12	141	34	1 32	60	Knapsack.
37	Constableville	C. H. Zimmer	1	3	326 —	256 —	70	—		50	Comp. air sprayer.
38	Constableville	G. P. Bernholz	1	3	237 58	159 19	78	39	1 58	50	Five-gallon, comp. air sprayer.
39	Malone	T. J. Shields	10	3	132 —	110 —	22	—		50	Aspinwall, 1-horse, 4-row power sprayer.
40	Ellenburgh Depot	Wm. Brennan	10	3	247 30	38 30	209	—		40	Home-made cart, 4-rows.
41	Peru	John Mannix	6	4	158 12	112 —	46	12	75	51	5-gallon, compressed-air sprayer.
42	Westport	J. M. Graeff	5	2	224 —	192 —	32	—		75	Gould, 1-horse, 2-row automatic sprayer.
43	Greenfield C't'r	E. D. Harris	¼	1	121 —	111 —	10	—		45	Hand sprayer.
44	Saratoga Springs	John Gick	2	3	242 —	242 —	0	—		60	Common garden sprinkler.
45	Akin	J. T. Buchanan	7½	5	240 39	179 32	61	7		65	Aspinwall 1-horse, 4-row, power sprayer.
46	W. Sand Lake	J. Jeannin Jr.	½	2	157 56	114 38	43	18	2 21	65	Auto compressed air sprayer.
47	Setauket	W. S. Rowland	11	4	220 —	165 —	55	—		50 60	Aspinwall 1-horse, 4-row power sprayer.
48	Riverhead	D. H. Hudson	4	5	216 20	155 28	60	52	73	50	Hudson, 4-row power sprayer.
49	Riverhead	E. Salmon	20	6	200 —	150 —	50	—		60	Peppler, 2-horse, 6-row power sprayer.
50	Water Mill	C. B. Foster	12	10	251 —	196 50	54	10	81	50	One-horse, Shangle 6 to 7 rows.

SUMMARY OF THE VOLUNTEER EXPERIMENTS IN 1905.

Total area sprayed in 50 experiments, 407 acres.

Average increase in yield per acre, 59 bu. 32 lbs.

Average total cost of spraying per acre (29 experiments), $4.57.

Average cost per acre for each spraying (29 experiments), 92 cts.

Average market price of potatoes at digging time, 57 cts.

Average net profit per acre (29 experiments), $29.85.

SUMMARY OF THE VOLUNTEER EXPERIMENTS IN 1904.[27]

Total area sprayed in 41 experiments, 363¾ acres.

Average increase in yield per acre, 58 bu. 28½ lbs.

Average total cost of spraying per acre (23 experiments) $3.91.

Average cost per acre for each spraying (23 experiments), 90 2-3 cents.

Average market price of potatoes at digging time, 43½ cents per bushel.

Average net profit per acre (23 experiments), $22.01.

REMARKS ON THE VOLUNTEER EXPERIMENTS IN 1905.

It is probable that the yields, expense of spraying and other data given for the volunteer experiments are not as accurate as are those given for the farmers' business experiments. The former have been furnished entirely by farmers, some of whom made the experiments merely for their own information and consequently were not as careful in measuring the yields as they would have been had they known that the figures were to be published. However, the increase in yield due to spraying has in all cases been determined by actual measurement or weight and not estimated. The yields given in Table XII refer to marketable tubers only, except in Experiments No. 8 and 21 as noted below. The expense of spraying includes both labor and chemicals and, in some cases, also an allowance for wear of sprayer.

[27]Copied from Bulletin 264, page 187.

Several of the experiments have interesting features which could not be shown in the table; hence they are brought together here.

Experiment No. 1.—The dates of spraying were July 3, 11, 22, August 4, 16 and 29. There was practically no loss from rot either on the sprayed or unsprayed rows. The difference in yield (75 bu. per acre) was due to the longer growth on the sprayed rows. "Spraying appeared to prolong the life of the vines about three weeks." The items of expense for spraying six acres six times were as follows:

310 lbs. copper sulphate @ 5¾c.	$17.82
32 " paris green @ 15½c.	4.96
Freight on copper sulphate and paris green	.52
Lime	1.40
78 hrs. labor for man @ 12½c.	9.75
58 " labor for horse @ 10c.	5.80
Wear on sprayer (10 per cent. of cost)	1.60
Total	$41.85

Experiment No. 2.—Report obtained through the courtesy of Prof. J. L. Stone of the Cornell University Experiment Station. The potatoes in this experiment were planted very late—July 3 and 5—following a crop of peas grown for the canning factory.

Experiment No. 3.—The test rows were dug and measured in the presence of Prof. J. L. Stone through whose courtesy we are able to publish the results. The potatoes were sprayed six times, but in five of these times the plants were gone over twice so that in reality the number of sprayings was eleven. At digging time the sprayed rows showed rot to the amount of 24 bu. 10 lbs. per acre while on the unsprayed rows it was only 6 bu. 56 lbs. per acre. Concerning this, Prof. Stone writes as follows: "As Mr. Cheney states, it seemed that there were fewer diseased potatoes in the unsprayed area because the decay had gone on so rapidly that most of the diseased potatoes had disappeared or at least remained only as shriveled skins." Mr. Cheney has made a practice of spraying his potatoes during the past twelve years.

Experiment No. 4.—Spraying reduced the loss from rot.

Experiment No. 5.—The dates of spraying were July 10, 17, August 5 and 19. Bordeaux of the 6-6-50 formula was applied at the rate of 50 gallons per acre in the first three sprayings and 75 gallons per acre in the last one. Paris green at the rate of one pound per acre was applied with the bordeaux in the first two sprayings. On the same dates the unsprayed rows were treated with paris green in water. The unsprayed rows were free from rotten tubers while on the sprayed rows the loss from rot was at the rate of 25 bushels per acre.

Experiment No. 6.—Used one nozzle per row in the first two sprayings and two nozzles per row in the last two. The unsprayed rows died three weeks earlier than the sprayed ones.

Experiment No. 7.—The sprayed rows outlived the unsprayed ones from two to three weeks. There were quite a good many more rotten tubers on the sprayed rows. The expense of spraying ten acres five times was $21 for materials and $14 for labor (man and team four days) making a total of $35.

Experiment No. 8.—The sprayed rows lived ten days longer than the unsprayed ones. The expense of spraying ten acres five times was $13.40 for lime and blue vitriol and $17.50 for labor (man and team five days) making a total of $30.90. The yields given in the table are for unsorted potatoes.

Experiment No. 9.—The dates of spraying were August 25 and September 2 but as the spraying of August 25 was a double one it seems proper to consider that the plants were sprayed three times. The items of expense for spraying one and one-half acres three times were as follows:

25	lbs. copper sulphate @ 5½c.	$1.38
32	" "new process" lime @ 1c.	.32
6	hrs. labor for man @ 15c.	.90
3¼	" labor for team @ 15c.	.49
Use of sprayer		.40
Total		$3.49

Experiment No. 10.—The bordeaux was applied at the rate of 30 gallons per acre at each spraying, but Mr. Prole expresses the opinion that a larger quantity would have given better results.

Another season he will go over the rows in both direction at each spraying using about 60 gallons per acre.

Experiment No. 11.—The dates of spraying were July 8, 14, 21, August 1, 8, 17 and 28. In the first and last sprayings the bordeaux used was of the 5-5-50 formula; in the others it was 4-4-50. It was applied at the rate of 33 gallons per acre each time. Mr. Lyday thinks one additional spraying would have increased the yield still further.

Experiment No. 12.—Seven sprayings were made between July 10 and September 2. Three unsprayed rows 48 rods long yielded 23 bushels, while three sprayed rows on one side yielded 35 bushels and three on the other 36 bushels. Mr. Roberts believes that the early sprayings are the most important.

Experiment No. 13.—In addition to five applications of bordeaux the plants were treated twice with paris green. The sprayed rows outlived the unsprayed ones by three weeks.

Experiment No. 14.—Ten double sprayings (= 20 single sprayings) were made between June 30 and September 7. The total quantity of bordeaux used on 17½ acres was 12,980 gallons which is at the rate of 742 gallons per acre. Check rows were left in three different lots. In Lot No. 1 the gain due to spraying was 120 bushels per acre; in Lot No. 2 it was 192 bushels per acre; and in Lot No. 3, 98 bushels per acre. The average gain was 136 2-3 bushels per acre. The total yield on 18 acres (17½ a. sprayed and ½ a. unsprayed) was 4,825 bushels which is at the rate of 268 bushels per acre.

Experiment No. 15.—Most of the field on both sides of the four unsprayed rows was sprayed four times and gave an average yield of 100 bushels per acre; but some rows at one side of the field were sprayed seven times. These rows yielded at the rate of 123 bushels per acre.

Experiment No. 16.—The total yield on 14½ acres was 2,100 bushels which is at the rate of 145 bushels per acre. This shows that the test rows were located in a representative portion of the field.

Experiment No. 17.—The unsprayed rows died two weeks earlier than the sprayed ones. Spraying reduced the loss from rot.

Experiment No. 18.—On the unsprayed rows the loss from rot was at the rate of 38 1-3 bushels per acre, while on the sprayed rows it was 28¼ bushels per acre.

Experiment No. 19.—The loss from rot was the same on sprayed and unsprayed rows; viz., 21 bushels per acre. This field of five acres was the only one in the vicinity of Beaver Dams which was sprayed in 1905.

Experiment No. 20.—The test rows were dug and weighed in the presence of a Station representative.

Experiment No. 21.—The yields given are for unsorted potatoes.

Experiment No. 22.—In this experiment the net profit from spraying was at the rate of $37 per acre. Mr. E. Haggerty of Clifton Springs witnessed the digging and weighing of the test rows. The loss from rot was at the rate of 4 bu. 33 lbs. per acre on the sprayed rows and 4 bu. 16 lbs. on the unsprayed rows.

Experiment No. 23.—The test rows were much injured by excessive rain in late spring. No rot.

Experiment No. 24.—The unsprayed rows were "dead several weeks before the sprayed ones." No rot.

Experiment No. 25.—The unsprayed rows were dead within two weeks after the first appearance of blight.

Experiment No. 26.—The unsprayed row was only slightly injured by blight.

Experiment No. 27.—The loss from rot was 17¾ bu. per acre on the sprayed rows and 24 1-6 bushels on the unsprayed rows. Mr. Bennett thinks that more thorough spraying would have given better results.

Experiment No. 28.—A part of the ten acres was sprayed five times, a part three times and the remainder only twice. The yields given in the table are for test rows located in the portion of the field sprayed five times.

Experiment No. 29.—There were only four applications, but in the last two applications the plants were gone over twice each

time. Hence, the number of sprayings is given as six. The unsprayed rows were severely injured by flea beetles and slightly also by bugs. There was a marked difference in the amount of rot. On the unsprayed rows the loss from rot was 34 2-5 bu. per acre, while on two sprayed rows 50 rods long there were but nine rotten tubers.

Experiment No. 30.—Report obtained through the courtesy of Prof. J. L. Stone. Five double sprayings (=10 single sprayings) were made. The total yield of 20 acres was 5,383 bushels which is at the rate of 269 bu. per acre. At digging time the market price of potatoes in Ithaca was 60 cents per bushel, but the crop was sold later at 70 cents per bushel. The actual net profit from spraying in this experiment was $70 per acre.

Experiment No. 31.—At digging time the yield of sprayed and unsprayed rows was measured but not recorded. The yields given in the table are estimates. However, Mr. Chamberlin remembers distinctly that the difference between sprayed and unsprayed rows was just one bushel on two rows 34 rods long which is at the rate of 11 2-3 bushels per acre. Excessively wet weather is largely responsible for the small yields.

Experiment No. 32.—One row near the center of the field was left unsprayed. The gain due to spraying amounted to one bushel per hundred hills or 54 bu. 27 lbs. per acre. The total yield on 6½ acres was 1,500 bushels which is at the rate of 230 bu. 46 lbs. per acre.

Experiment No. 33.—The bordeaux was applied five times at the rate of 60 gallons per acre. The expense of spraying includes only labor and chemicals. No allowance is made for wear of sprayer.

Experiment No. 34.—Unsprayed rows were left in each of three varieties. On the variety Carman the gain due to spraying was 63 bushels per acre; on Mammoth Whiton, 34½ bushels; and on Rural New Yorker No. 2, 68 1-3 bushels, making an average gain of 55¼ bushels per acre.

Experiment No. 35.—The percentage of rot was very much lessened by spraying.

Experiment No. 36.—One half acre was sprayed four times ½ acre twice, one acre once and ½ acre left unsprayed. The half acre sprayed four times yielded 143 bu. 23 lbs. or at the rate of 286 bu. 46 lbs. per acre; while the unsprayed half acre yielded only 72 bu. 36 lbs. or at the rate of 145 bu. 12 lbs. per acre. On the unsprayed half-acre the loss from rot was heavy; on the sprayed half acre much less.

Experiment No. 37.—The loss from rot was at the rate of one bushel per acre on the sprayed rows and 29 bushels per acre on the unsprayed ones.

Experiment No. 38.—There was apparently but little blight, yet there was some rot both on sprayed and unsprayed rows.

Experiment No. 39.—The sprayed rows outlived the unsprayed ones about 12 days. On sprayed rows the loss from rot was about 11 bu. per acre and on the unsprayed ones 22 bu. per acre.

Experiment No. 40.—In this experiment the enormous gain was mostly due to the prevention of rot. About three-fourths of the unsprayed potatoes rotted while there was only a little rot among the sprayed ones.

Experiment No. 41.—The unsprayed rows died two weeks earlier than the sprayed ones.

Experiment No. 42.—The potatoes were sprayed twice with bordeaux and paris green and treated once besides with paris green in water. Mr Graeff states that three applications of paris green for bugs would have been required anyway so that the extra expense of spraying for blight was only the cost of materials. "There was no noticeable difference as to rot between the sprayed and unsprayed."

Experiment No. 43.—The sprayed rows were killed by frost about a week after the unsprayed rows died from blight.

Experiment No. 44.—The unsprayed rows were not affected by blight.

Experiment No. 45.—The gain due to spraying is based on the difference in yield between an unsprayed row and a sprayed one fifteen feet distant. Mr. Buchanan estimates that where he sprayed at least one-fifth of the crop rotted and on unsprayed rows the loss was still greater.

Experiment No. 46.—Very little blight and no rot in this experiment.

Experiment No. 47.—The sprayed rows lived two weeks longer than the unsprayed ones. The total yield of 11 acres was 2,247 bushels which is at the rate of 204 bushels per acre.

Experiment No. 48.—In this experiment the expense of spraying includes the cost of water which was purchased at three cents per barrel. The spraying consisted of three single applications and one double one or five in all.

Experiment No. 49.—A portion of the field was sprayed only five times. Spraying lessened the amount of rot.

Experiment No. 50.—The items of expense for spraying 12 acres ten times were as follows:

625 lbs. copper sulphate @ 6c.	$37.50
3 bbl. lime @ $1.75	5.25
49 hrs. labor for two men @ 20c.	19.60
24 " labor for single horse @ 10c.	2.40
25 " labor for team @ 20c.	5.00
46 lbs. paris green @ 16½c.	7.59
27 " paris green @ 17½c.	4.73
Wear on sprayer	15.00
Total	$97.07

The test rows were in a two-acre field which was dug after the vines were dead, but before the time when potatoes rotted badly. In this field there was practically no rot on either the sprayed or unsprayed rows. The remaining ten acres were dug later, after the rot epidemic, and the loss from rot was estimated at 40 to 50 bushels per acre. As unsprayed fields in the same vicinity did not rot to any extent Mr. Foster believes that his actual gain from spraying was not as great as the yield of the test rows indicate. For further discussion of this experiment see page 228.

The writers take this opportunity to heartily thank the gentlemen who have furnished the reports of their volunteer experiments for publication. Potato growers throughout the State are under obligations to them.

SODA BORDEAUX VS. LIME BORDEAUX.

It has been stated that soda bordeaux is superior to lime bordeaux for spraying potatoes, but experiments of the past two years show that this is probably not true. In an experiment made by this Station in 1904 lime bordeaux gave better results by 16 2-3 bushels per acre.[28] Another experiment in 1905 resulted in a difference of nine bushels per acre in favor of lime bordeaux. The latter experiment included fifteen rows each 290½ feet long. Five were sprayed four times with soda bordeaux (made with six pounds of copper sulphate and seven and one-half pounds of sal soda to 50 gallons), five with lime bordeaux (6-4-50 formula) and the other five were not sprayed. The sprayed and unsprayed rows alternated as in the ten-year experiment. The spraying was done with a knapsack sprayer and very thoroughly by going over each row twice—out on one side and back on the other. The dates of spraying were June 30, July 10, August 1 and 2, and August 23. In the first three sprayings paris green was used with both kinds of bordeaux and on the same dates the unsprayed or check rows were treated with the same quantity of paris green in lime water.[29]

TABLE XIII.—YIELDS IN THE SODA BORDEAUX EXPERIMENT.

Rows.	Treatment.	Yield per row.		Yield per acre.			
		Marketable.	Small.	Marketable.		Small.	
		Lbs.	*Lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
1	Unsprayed	106	43	88	20	35	50
2	Lime bordeaux	233	43	194	10	35	50
3	Soda bordeaux	244	37	203	20	30	50
4	Unsprayed	111	49	92	30	40	50
5	Lime bordeaux	224	24	186	40	20	—
6	Soda bordeaux	235	38	195	50	31	40
7	Unsprayed	86	29	71	40	24	10
8	Lime bordeaux	214	26	178	20	21	40
9	Soda bordeaux	217	28	180	50	23	20
10	Unsprayed	79	38	65	50	31	40
11	Lime bordeaux	265	33	220	50	27	30
12	Soda bordeaux	226	42	188	20	35	—
13	Unsprayed	109	37	90	50	22	30
14	Lime bordeaux	277	26	230	50	21	40
15	Soda bordeaux	235	23	195	50	19	10

[28]For details of this experiment see Bulletin 264, pages 187-194.

[29]Ten ounces of paris green to 50 gallons in the first spraying and one pound to 50 gallons in the second and third sprayings.

The potatoes were dug October 23 and sorted into two grades—sound tubers of marketable size and sound tubers below marketable size. No account was taken of rotten tubers. The yields are shown in Table XIII.

In each of the first three sections of the experiment the soda bordeaux gave slightly better results, while in the last two sections lime bordeaux was considerably in the lead so that on the average there was a difference of 9 bu. 20 lbs. of marketable tubers per acre in favor of the lime bordeaux. The average yields for the three kinds of treatment were as follows:

Sprayed with lime bordeaux, 202 bu. 10 lbs. marketable tubers per acre.
Sprayed with soda bordeaux, 192 bu. 50 lbs. marketable tubers per acre.
Unsprayed, 81 bu. 50 lbs. marketable tubers per acre.

The rows sprayed with lime bordeaux outyielded the unsprayed rows by 120 1-3 bushels per acre. The unsprayed rows died early from blight and bugs. Although the unsprayed rows received the same amount of paris green as did the sprayed rows and it was applied on the same dates and with equal thoroughness, they were, nevertheless, much more severely injured by bugs than were the sprayed rows. This is only another example of the well known fact that bordeaux assists in the control of bugs.

No attempt was made to determine accurately the loss from rot in this experiment. It seemed to be about the same as in the ten-year experiment. (See page 165). In this respect there was apparently no difference between the rows sprayed with lime bordeaux and those sprayed with soda bordeaux.

Further experimental evidence on the relative value of these two kinds of bordeaux for potatoes is furnished by an experiment made by F. A. Sirrine at Riverhead, Long Island, in 1905. A plat of potatoes containing eight rows 235 feet long and sprayed four times with lime bordeaux yielded at the rate of 211 bushels per acre, while another plat of eight rows similarly sprayed with soda bordeaux yielded only 176 bushels per acre, making a difference of 35 bushels per acre in favor of the lime bordeaux. The two plats were only two rows apart.

Certainly, the results of these experiments are not favorable to soda bordeaux. The most that can be said for soda bordeaux is

that it is probably about equal to lime bordeaux in efficiency and that its mechanical condition is slightly better. Poisons can not be used as safely with it as with lime bordeaux. We advise the use of lime bordeaux.

BORDEAUX WITH PARIS GREEN VS. BORDEAUX ALONE.

The Station made an experiment on this in 1904. There was no injury to the foliage and the yield was in favor of bordeaux with paris green by 7½ bushels per acre.[30] Another experiment was made in 1905. Again there was no injury to the foliage and the yield was in favor of bordeaux with paris green by five bushels per acre. In the latter experiment there were 15 rows 86 feet long. Five rows were sprayed five times with bordeaux and paris green (one pound to fifty gallons), five with bordeaux only and the other five (checks) with paris green in lime water (one pound to fifty gallons). The rows of the different treatments alternated with each other as in the ten-year experiment. The spraying was done with a knapsack sprayer very thoroughly and as uniformly as possible. The quantity of bordeaux used varied from 100 to 300 gallons per acre in different sprayings according to the size of the plants. In order to make sure that the bordeaux used was the same in both cases the following method was employed in each spraying: A quantity of bordeaux was prepared. A part of this was used for spraying the rows which were to receive bordeaux only; then paris green was added to the remainder and the rows which were to receive bordeaux with paris green were sprayed. The dates of spraying were June 29, July 6, July 20, August 7 and August 21.

At the beginning of the experiment it was the intention to keep the bordeaux-only rows free from bugs by hand picking as in the experiment in 1904; but after one picking it was found that this could be much more easily accomplished by very thorough spraying with bordeaux just after the bugs were hatched. In this

[30]Details of this experiment given in Bulletin 267, pp. 269-278.

manner the bugs were kept entirely under control so that they were eliminated from the experiment.[31]

Throughout the season there was no apparent difference in the appearance of the foliage on the rows sprayed with bordeaux only and that on the rows sprayed with bordeaux and paris green. There was no indication that the paris green in the bordeaux was injurious to the foliage. The check rows receiving paris green in lime water blighted considerably and died somewhat prematurely, but there was no evidence that the foliage was injured by paris green.

[31]In this experiment and also in the experiment with arsenite of soda, page 220 it was shown that bugs may be controlled with bordeaux mixture alone provided the spraying is done just after the bugs have hatched and very thoroughly. But for this fact this experiment could not have been carried through properly. After the first spraying of June 29 a few bugs remained alive and these were removed by hand picking July 3. On July 5, we were dismayed to find all of the plants swarming with young bugs. Of course it was to be expected that on the rows treated with paris green they would be poisoned before they could do harm; but on the rows sprayed with bordeaux alone they would surely injure the plants and thereby ruin the experiment. For the most part, the bugs were located among the small young leaves in the tops of new shoots. To have removed them by hand picking would have been a tedious operation, besides it could not well have been accomplished without considerable mutilation of the plants. In this emergency we decided to try bordeaux mixture. Accordingly, the second spraying was made July 6, or about a week earlier than it would have been made had not this trouble with bugs arisen. The operator was instructed to give special attention to the new growth and to spray very thoroughly. Twenty-four hours after the spraying most of the bugs had disappeared on the "bordeaux—only" rows as well as on those on which poison had been used. The bugs still in evidence appeared uneasy. Some were traveling on the ground under the plants. Practically all of them disappeared so that no harm was done to the plants and no further hand picking or other treatment for bugs was necessary. Whether the bugs were actually killed by the bordeaux could not be determined, but they certainly disappeared.

Although this experiment was entirely successful we do not believe that farmers should attempt to control bugs by the use of bordeaux alone. The method is too expensive and requires too much care. To be successful the spraying must be done with extreme thoroughness and while the bugs are very small. Nevertheless the results have a direct bearing on practical potato spraying. They show that the bordeaux is not only a preventive of blight, but also an aid in the control of bugs and should be used with the poison whenever it is necessary to combat bugs.

The potatoes in this experiment were dug by hand October 26. The yields are shown in the following table:

TABLE XIV.—SHOWING YIELDS IN PARIS GREEN EXPERIMENT.

Treatment.	Rows.	Yield of five rows.		Yield per acre.			
		Marketable.	Small.	Marketable.		Small.	
		Lbs.	*Lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
Bordeaux with paris green	1, 4, 7, 10, 13	579	34	325	53	19	8
Bordeaux only	2, 5, 8, 11, 14	570	37	320	49	20	49
Paris green in lime water	3, 6, 9, 12, 15	378	44	212	45	24	45

Difference in favor of bordeaux with paris green, 5 bu. 4 lbs. per acre.

The results of these experiments agree with the experience of potato growers who practice spraying. During the past four years the writers have been close observers of potato spraying and have seen no evidence that potatoes are in any way injured by paris green properly applied; viz., in moderate amount (one to two pounds per acre) with bordeaux mixture.

In a former experiment it was shown that paris green has some value as a preventive of potato blight.[32] With this fact in mind some potato growers have raised the question as to the advisability of using paris green with the bordeaux regularly. Our opinion is that it would not be profitable. Paris green should be added only when there are bugs or flea beetles to poison.

[32]See Bulletin 267 of this Station, page 272.

BORDEAUX WITH ARSENITE OF SODA VS. BORDEAUX ALONE.

In an experiment made at this Station in 1904 potato rows sprayed with bordeaux mixture containing arsenite of soda as poison yielded 34 bushels per acre less than rows sprayed with bordeaux mixture alone.[33] As there was no apparent injury to the foliage this reduction in yield was attributed to unequal conditions in the experiment rather than to the arsenite. However, it was deemed advisable to make the following experiment in 1905:

In a plat of 58 rows 108 feet long every other row was sprayed five times with bordeaux and arsenite of soda (one quart of stock solution[34] to 50 gallons), while the alternating 29 rows were sprayed with bordeaux only. As in the paris green experiment, care was taken to have the bordeaux of uniform character and uniformly applied. (At the rate of 100 to 300 gallons per acre in the different sprayings.) The bordeaux was made by the 1-to-8 1-3 formula with lime in moderate excess of the quantity required to satisfy the potassium ferro-cyanide test. The frequent and thorough spraying kept the bugs so well under control that but one hand picking was required even on the bordeaux-only rows.[35] About July 20 all of the rows were slightly injured by bugs, but so far as could be determined there was no more damage to the bordeaux-only rows than to those receiving the arsenite. The dates of spraying were July 1, 6-7, 20, August 4-5 and 21-22.

At no time during the season did the difference in treatment seem to have any effect on the foliage. The yields were as follows:

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[33]Reported in Bulletin 267, pages 278-284.

[34]Prepared by the Kedzie formula as follows:—

White arsenic ..... pounds 2
Sal soda ..... pounds 8
Water ..... gallons 2

Boil until the arsenic is all dissolved which will take about 15 minutes.

[35]The second spraying made July 6 and 7 was entirely successful in destroying swarms of young bugs as in the paris green experiment (See footnote No. 31 on page 128). Even on the bordeaux-only rows, so few

TABLE XV.—SHOWING YIELDS IN THE ARSENITE OF SODA EXPERIMENT.

Treatment.	Yield of 29 rows.		Yield per acre.			
	Marketable.	Small.	Marketable.		Small.	
	Lbs.	*Lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs*
Bordeaux with arsenite of soda	2,928	297	226	14	22	57
Bordeaux only	2,808	254	216	58	19	37

Difference in favor of bordeaux with arsenite of soda, 9 bu. 16 lbs. marketable tubers per acre.

We believe the results of this experiment to be trustworthy. They indicate that the arsenite of soda may be used safely with bordeaux at the rate of one quart of the stock solution (Kedzie formula) to fifty gallons. Probably considerably larger proportions of the arsenite would not be harmful. Arsenite of soda is a cheaper poison than paris green and remains in suspension better. Based on the arsenic it contains one quart of arsenite-of-soda stock solution is equivalent, in poisoning properties, to eight ounces of paris green.

bugs survived that it was thought unnecessary to remove them by hand picking. However, by July 18 quite a good many bugs were in evidence, many of them being half-grown slugs. Having in mind our previous success we had little doubt that the bugs could be managed by spraying. By accident, the first rows which should have been sprayed with bordeaux and arsenite were sprayed with bordeaux only. This error made it necessary to spray the entire experiment with bordeaux alone. Only the younger bugs disappeared. The half-grown slugs continued their depredations. Accordingly, on July 20 the spraying was repeated and this time done properly. At the same time the bugs on the bordeaux-only rows were hand picked and there was no further trouble. This experience leads to the conclusion that while newly-hatched bugs may be successfully fought by thorough spraying with bordeaux alone, half-grown slugs can not be controlled in that way. Even when poisons are used bugs are much more easily killed while they are small.

DOES BORDEAUX MADE WITH COLD WATER INJURE POTATO FOLIAGE?

In making bordeaux for potatoes is it safe to use very cold water such as comes from deep wells? Will the foliage be injured? Such questions as these are asked occasionally. Some potato growers hold that spraying potatoes with very cold bordeaux on a hot, sunny day causes injury to the foliage. They advise that water from deep wells be allowed to stand in the air and warm before it is used for spraying potatoes.

In order to secure definite information on this point the following experiment was made on the Station grounds in 1905: Six rows of potatoes, 290½ feet long and of the variety Rural New Yorker No. 2 were planted especially for the experiment. Rows 1, 3 and 5 were sprayed three times with cold bordeaux, while Rows 2, 4 and 6 were sprayed on the same dates with warm bordeaux about the temperature of the air. The spraying was done with a knapsack sprayer and very thoroughly. The temperature was obtained immediately before spraying commenced by thrusting a thermometer into the knapsack after it was in position on the back of the operator. Two knapsackfuls were required to spray three rows and in the case of the cold bordeaux it was difficult to get the same temperature in both. This explains why two temperatures are given in the "cold bordeaux" column of the table below. The low temperatures were obtained by the use of cracked ice. The following table shows in condensed form the conditions under which the experiment was made:

TABLE XVI.—CONDITIONS IN THE EXPERIMENT ON COLD VS. WARM BORDEAUX.

Date of spraying.	Temperature of cold bordeaux.	Temperature of warm bordeaux	Temperature of the air.	Cloudiness.
	Deg. Fahr.	*Deg. Fahr.*	*Deg. Fahr.*	
June 30	50 to 54	74	70	Clear
July 12	50 to 54	81	88	Clear
August 8.	40 to 42	70	82	Clear

At no time during the experiment was there any evidence that the cold bordeaux had injured the foliage and when the potatoes were dug it was found that the rows sprayed with cold bordeaux outyielded those sprayed with warm bordeaux at the rate of 4½ bushels per acre. This difference in yield may have been due to other causes than the difference in temperature of the bordeaux used, but being in favor of the cold bordeaux it removes all doubt as to the injurious effect of cold bordeaux. The results of this experiment seem to justify the opinion that no attention need be paid to the temperature of the water used in making bordeaux for spraying potatoes.[36]

POTATO TROUBLES IN NEW YORK IN 1905.

Over the greater part of the State the season of 1905 was characterized by heavy losses from blight and rot. Throughout the growing season there was an abundance of rain in most localities. Floods in June caused much damage to potatoes on low ground and heavy rains in the latter part of September and fore part of October brought about an epidemic of potato rot. Many potato fields were killed by frost on September 14 and the remainder on September 26. Had it not been for the early frost several of the experiments reported in this bulletin would have shown considerably larger gains due to spraying.

Late blight, *Phytophthora infestans,* was destructive in nearly all parts of the State. The earliest outbreak of this disease of which we have definite knowledge occurred in the vicinity of Sagaponack and Wainscott in the eastern part of Long Island. Here, one of the writers found it already well established on July 1 and Mr. J. S. Strong, a farmer of Wainscott, states that he observed it as early as June 25. On July 2 it was found near Riverhead and on July 5 at Mattituck. It is reported to have

[36]This statement applies only to the effect on the foliage. In this experiment no special attempt was made to determine the effect of the temperature of the water on the mechanical condition of the bordeaux. However, it was observed that forty-degree bordeaux prepared by mixing copper sulphate solution having a temperature somewhat below 40 degrees Fahr. with milk of lime also below 40 degrees had apparently as good mechanical condition as had bordeaux made with the component solutions at about 70 degrees Fahr.

appeared in a garden at Phelps about July 20, but the first specimens seen by us (excepting those from Long Island) came from Hornell where they were collected July 28. On August 1 we found it on early potatoes at Atlanta, Steuben County. Although carefully sought, no trace of late blight was found at Geneva until August 12.

Early potatoes were not affected with rot, but the late varieties suffered severely. In the Hudson Valley there was less loss from rot and blight than in any other part of the State. This region suffered from drought in July as did also Long Island.

The record for early blight, *Alternaria solani,* and flea beetles is about the same as in 1904. Early blight was rarely destructive except on Long Island where it was an important factor in many fields. Flea beetles appeared in injurious numbers at several different points in the State, but were especially numerous and destructive on Long Island during the last ten days in July.

Colorado potato beetles or "bugs" were unusually troublesome. In many fields the plants were stripped of their foliage in spite of efforts made to control them. In some localities the demand for paris green exceeded the available supply with the result that local prices were materially advanced.

Judging from the results of numerous experiments the loss from blights, rot and flea beetles in unsprayed fields could not have been less than fifty bushels per acre on the average. In the 13 farmers' business experiments the average gain due to spraying was 46½ bushels per acre, while 50 volunteer experimenters reported gains averaging 59½ bushels per acre; and it should be borne in mind that these figures represent only a part of the damage done by blight and rot, because in only a few of the experiments was either the blight or the rot completely controlled.

DOES SPRAYING PREVENT ROT?

It is generally stated that spraying will prevent that rot of the tubers which often follows an attack of late blight, *Phytophthora infestans.* The theory advanced is, that spraying prevents the growth of the blight fungus on the leaves so that there are no spores, or at least *fewer* spores, to fall upon the ground and cause rot; hence there should be less rot where the plants have been sprayed.

As a matter of fact there are on record numerous experiments in which it was shown conclusively that the loss from rot was greatly reduced by spraying. Probably the most notable example is an experiment made by Jones and Morse[37] at the Vermont Station in 1904 in which unsprayed potatoes rotted at the rate of 245 bushels per acre while among sprayed potatoes under conditions otherwise parallel the loss from rot was only 27 bushels per acre.

However, there are also on record instances in which spraying had no appreciable effect in reducing the amount of rot; and it has been the custom to explain such cases by assuming that the rot in question was not the late blight rot, but the dry rot (*Fusarium oxysporum*) or the bacterial wet rot (*Bacillus solanacearum*), two diseases which work only below ground and hence are not preventable by spraying.

At various times during the past four years this matter has been brought to our attention by farmers who complained that they had failed to prevent rot by spraying and some of them even claimed that spraying encourages rot. Accordingly, we took advantage of the excellent opportunity afforded by the rot epidemic of 1905 to make some observations along this line. The result is that our views on the subject have changed somewhat. Briefly stated our conclusion is as follows: The general tendency of spraying is to reduce the amount of rot. In most cases the reduction is very marked; in some cases there is no difference and occasionally spraying increases the amount of rot. It

[37] Jones, L. R. & Morse, W. J. Vt. Agr. Exp. Sta. Rep. 17: 389, 390.

depends on weather conditions and the thoroughness of spraying. But whatever the effect on rot, *sprayed plants invariably give a larger yield of marketable tubers.*

It must be admitted that under certain conditions spraying increases rather than diminishes the amount of rot. For specific instances see the Cortland experiment, p. 179, the Cassville experiment, p. 182, and Volunteer Experiments Nos. 5 and 7, page 209. The explanation seems to be as follows : Rot is brought about chiefly by spores which fall from the blighted leaves to the ground and are carried by rain down through the soil to the tubers. These spores are delicate and readily killed by drying. Unsprayed plants may die prematurely from blight with scarcely any rot of the tubers provided the soil remains fairly dry until after the plants are dead and dry; because under such conditions the spores dry up and die before they can reach the tubers. No matter how much rain comes later there can be no rot because there are no live blight spores to cause rot. Now, suppose these plants had been sprayed in the manner in which spraying is usually done by farmers. Their life would have been prolonged two or three weeks. Nevertheless, they would have been somewhat affected by blight because farmers rarely spray thoroughly enough to prevent blight completely when the disease is epidemic; and so long as the plants remain green live blight spores continue to be formed on the leaves and fall upon the ground. Then, if heavy rains came there would be rot. In short, spraying prolongs the period during which the tubers are subject to rot.

Sometimes there may appear to be more rot on sprayed rows than on unsprayed ones when in reality such is not the case. This happens when rot sets in early on unsprayed rows so that by digging time many of the tubers have completely decayed and disappeared; while on the sprayed rows where blight was unable to gain a foothold until late in the season and the rot correspondingly retarded, all affected tubers are still in evidence at digging time. For an example see Volunteer Experiment No. 3, p. 208; also Bulletin 264, pages 111-112.

When sprayed potatoes rot badly it should not be assumed, without investigation, that the spraying has been a failure. If any unsprayed rows have been left for comparison it will be found generally that they have rotted much worse so that in spite of the rot there may be enough more marketable potatoes on the sprayed rows to make the spraying a profitable operation. The Peru experiment on page— furnishes a good illustration. In Volunteer Experiment No. 50 made by C. B. Foster, Water Mill (page—), there were, unfortunately, no check rows in the ten-acre field where the rot was so severe. Hence, it can not be determined whether the spraying was beneficial or otherwise; but judging from similar cases in which the facts are known we feel confident that the spraying was profitable notwithstanding the rot.

During the past season many cases were reported in which there was considerable loss from rot although there had been apparently little or no blighting of the vines. The explanation of this is that shortly before digging time the weather conditions were exceptionally favorable to rot so that a little blight, which may have passed unnoticed, was sufficient to cause much trouble. There may he much blight and yet little rot if the weather is dry for two or three weeks preceding digging, but if there is much rain during this period heavy loss from rot may follow a light attack of blight.

Concerning the identity of the rot which was so destructive in this State in 1905, we have no reason for believing that it was any other than the rot which follows late blight; namely, that caused by *Phytophthora infestans.* Other kinds of rot undoubtedly occurred, in small amount, but by far the greater part of the rot in New York during the past season was certainly due to *Phytophthora infestans* and might have been largely prevented by thorough spraying. In this connection we wish to emphasize the importance of more thorough spraying in the latter part of the season as a safeguard against rot.

MAKING EXPERIMENTS IN 1906.

During the season of 1906 the work on potato spraying will be carried forward along practically the same lines as in 1904 and 1905. The regular ten-year experiments at Geneva and Riverhead will be conducted again as usual; also, about fifteen farmers' business experiments in different parts of the State. In addition the Station hopes to secure again, as in the past, reports of numerous volunteer experiments—the more the better. Potato growers throughout the State are earnestly requested to make spraying experiments in 1906 and report the results to the Station. Whatever the outcome of the experiments, whether for or against spraying, the reports are desired provided, of course, the experiments have been properly conducted. Upon request, the Station will supply blanks for making such reports.

DIRECTIONS FOR SPRAYING.[38]

In general, commence spraying when the plants are six to eight inches high and repeat the treatment at intervals of 10 to 14 days in order to keep the plants well covered with bordeaux throughout the season. During epidemics of blight it may be necessary to spray as often as once a week. Usually six applications will be required. The bordeaux should contain six pounds of copper sulphate to each 50 gallons.[39] Whenever bugs or flea beetles are plentiful add one to two pounds of paris green or two quarts of arsenite of soda stock solution (See footnote, p. 220) to the quantity of bordeaux required to spray an acre.

Thoroughness of application is to be desired at all times, but is espcially important when flea beetles are numerous or the weather favorable to blight. Using the same quantity of bor-

[38]Substantially the same as given in Bulletin 264, p. 204. The experiences of the past season do not warrant any material alteration in the recommendations there made.

[39]For the preparation of bordeaux mixture see Bulletin 243 of this Station.

deaux, frequent light applications are likely to be more effective than heavier applications made at long intervals; e. g., when a horse sprayer carrying but one nozzle per row is used, it is better to go over the plants once a week than to make a double spraying once in two weeks. A good plan is to use one nozzle per row in the early sprayings and two nozzles per row in the later ones.

Those who wish to get along with three sprayings should postpone the first one until there is danger of injury from bugs or flea beetles and then spray thorougly with bordeaux and poison. The other two sprayings should likewise be thorough and applied at such times as to keep the foliage protected as much as possible during the remainder of the season. Very satisfactory results may be obtained from three thorough sprayings.

A single spraying is better than none and will usually be profitable, but more are better. Spraying may prove highly profitable even though the blight is only partially prevented. It is unsafe to postpone spraying until blight appears. Except, perhaps, on small areas, it does not pay to apply poison alone for bugs. When it is necessary to fight insects use bordeaux mixture and poison together.