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GENEVA, N. Y.

POTATO SPRAYING EXPERIMENTS IN 1908.

F. C. STEWART, G. T. FRENCH AND F. A. SIRRINE.



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 NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.

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 for them.

* Riverhead, N. Y.

† Absent on leave.

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POTATO SPRAYING EXPERIMENTS IN 1908.

F. C. STEWART, G. T. FRENCH AND F. A. SIRRINE.

SUMMARY.

This bulletin gives the results of the seventh year's work in the ten-year series of potato spraying experiments begun in 1902. During 1908 the experiments were conducted along the same lines as in previous years. Twenty-seven separate experiments are reported.

TEN-YEAR EXPERIMENTS.

At Geneva, six sprayings increased the yield 39 bu. per acre and three sprayings increased it $29\frac{1}{2}$ bu. although both early and late blight were wholly absent and there were but few flea beetles. The chief trouble was tip burn. There was no rot. At Riverhead the gain due to five sprayings was 15.3 bu. per acre and to three sprayings 10.75 bu. Here, the chief enemies were the flea beetle and early blight. There was no late blight and no rot.

FARMERS' BUSINESS EXPERIMENTS.

In fourteen farmers' business experiments, including 200 acres, the average gain due to spraying was 18.5 bu. per acre; the average total expense of spraying, \$4.30 per acre; and the average net profit, \$8.53 per acre. In five of the experiments spraying was unprofitable.

VOLUNTEER EXPERIMENTS.

Eleven volunteer experimenters reported gains averaging 66.3 bu. per acre. These experiments do not fairly represent the results obtained from spraying in 1908.

The chief trouble with potatoes in New York in 1908 was tip burn, caused primarily by dry weather, but aggravated by flea beetles, leaf hoppers and other insects. Early blight was rare and late blight and rot almost wholly absent. The experiences of 1908 indicate that it is unwise to neglect spraying in dry seasons.

INTRODUCTION.

Does it pay to spray potatoes in New York? Potato growers have been asking this question for fifteen years or more. It is well known that in seasons when blight is destructive spraying will check the blight and considerably increase the yield; but the majority of potato growers have doubted that spraying is profitable on the average. They argue that blight does not appear every year. In some seasons it causes but little if any damage, yet the spraying must be done regularly because it is impossible to foretell the appearance of blight. The result is that in some seasons spraying is profitable while in others it is unprofitable and they doubt that the aggregate gain will pay the expense of spraying for a series of years.

This Station has set out to find an answer to the above question. The investigation was begun in 1902 and is to be continued until 1912. During ten consecutive years numerous potato spraying experiments will be made each year and at the end of the period the results will be averaged. The experiments are of three kinds: (1) Station ten-year experiments; (2) farmers' business experiments; (3) farmers' volunteer experiments. The ten-year experiments (two each year) are carried out entirely by the Station. The business experiments (13 to 15 each year) are conducted by farmers in coöperation with the Station. The volunteer experiments are carried out entirely by farmers.

Bulletins previously published are:

- No. 221. Potato Spraying Experiments in 1902;
- No. 241. Potato Spraying Experiments in 1903;
- No. 264. Potato Spraying Experiments in 1904;
- No. 279. Potato Spraying Experiments in 1905;
- No. 290. Potato Spraying Experiments in 1906;
- No. 307. Potato Spraying Experiments in 1907.

SUMMARY OF RESULTS OBTAINED IN TEN-YEAR EXPERIMENTS PRIOR TO 1908.

RESULTS IN 1902.

TABLE I.—YIELD BY SERIES AT GENEVA IN 1902.

Series.	Rows. ¹	Dates of spraying.	Yield per acre. ²	
			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

¹ Rows 10, 11 and 12 omitted because of probable error.

² The yields given in Tables I to XII relate to marketable tubers only.

Increase in yield due to spraying three times, 98½ bu. per acre.

Increase in yield due to spraying seven times, 123½ bu. per acre.

The unsprayed rows died two weeks earlier than the sprayed rows, owing chiefly to a severe attack of late blight. They were also somewhat injured by flea beetles, but there was no early blight. On unsprayed rows the loss from rot was 7½ per ct.; on sprayed rows only an occasional tuber.

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

Increase in yield due to spraying three times, 27⅔ bu. per acre.

Increase in yield due to spraying seven times, 45 bu. per acre.

In this experiment there were only traces of early blight and no late blight. The larger yield on sprayed rows was due to partial protection against flea beetles which were rather plentiful at times. There was no rot.

RESULTS IN 1903.

TABLE III.—YIELD BY SERIES AT GENEVA IN 1903.

Series.	Rows.	Dates of spraying.	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

Increase in yield due to spraying three times, 88 bu. per acre.

Increase in yield due to spraying five times, 118 bu. per acre.

Three sprayings prolonged the life of the plants 11 days; five sprayings, 18 days. There was no early blight and the injury from flea beetles was only slight. Late blight was again the chief enemy. The loss from rot was even less than in 1902.

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

Increase in yield due to spraying three times, 39½ bu. per acre.

Increase in yield due to spraying five times, 56 bu. per acre.

The sprayed rows outlived those unsprayed by several days. Late blight and flea beetles were the chief enemies. Early blight, also, caused slight damage. On the unsprayed rows the loss from rot was two per ct.; on those sprayed, practically nothing.

RESULTS IN 1904.

TABLE V.—YIELD BY SERIES AT GENEVA IN 1904.

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

Increase in yield due to spraying three times, 191 bu. per acre.

Increase in yield due to spraying five times, 233 bu. per acre.

Spraying prolonged the life of the plants 25 days. Late blight was the only trouble. Both on sprayed and unsprayed rows there was a little rot at digging time. In storage, the sprayed potatoes rotted most. Spraying materially improved the cooking qualities.

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

Increase in yield due to spraying three times, 56½ bu. per acre.

Increase in yield due to spraying six times, 96½ bu. per acre.

The larger yield on sprayed rows was due chiefly to partial protection against flea beetles which were unusually abundant. Both early and late blight also present. The loss from rot was three per ct. on Series I., one per ct. on Series II., and six per ct. on Series III.

RESULTS IN 1905.

TABLE VII.—YIELD BY SERIES AT GENEVA IN 1905.

Series.	Rows. ³	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, Aug. 12 and 24.....	241	15
III.....	6, 9, 12 and 15...	Not sprayed.....	121	52

³ Rows 1, 2 and 3 omitted because of error.

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

Increase in yield due to spraying five times, 119½ bu. per acre.

From the combined attack of flea beetles, tip-burn and late blight the unsprayed rows died fully two weeks earlier than the sprayed ones. Spraying reduced the loss from rot at the rate of 41 bushels per acre. There was no subsequent rot in storage.

TABLE VIII.—YIELD BY SERIES AT RIVERHEAD IN 1905.

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, 31½ bu. per acre.

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

Late blight caused no injury in this experiment and there was not even a trace of rot. Flea beetles and early blight were the enemies fought.

RESULTS IN 1906.

TABLE IX.—YIELD BY SERIES AT GENEVA IN 1906.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	lbs.
I.....	1, 4, 7, 10 and 13.	July 9, August 10 and 30...	227	25
II.....	2, 5, 8, 11 and 14.	July 6, 20, Aug. 6, 20 and 21.	258	40
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	195	40

Increase in yield due to spraying three times, 31½ bu. per acre.

Increase in yield due to spraying five times, 63 bu. per acre.

Late blight, early blight, flea beetles and tip burn were all factors in this experiment, but none of them caused much damage. Spraying controlled blight and flea beetles completely and tip burn partially. The loss from rot was negligible, only four rotten tubers being found in the entire experiment.

TABLE X.—YIELD BY SERIES AT RIVERHEAD IN 1906.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	lbs.
I.....	1, 4, 7, 10 and 13.	June 12, July 18 and Aug. 6.	172	—
II.....	2, 5, 8, 11 and 14.	June 12, 25, July 10, 25 and Aug. 6.....	203	45
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	150	30

Increase in yield due to spraying three times, 21½ bu. per acre.

Increase in yield due to spraying five times, 53¼ bu. per acre.

In the experiment at Riverhead the principal enemies were late blight and flea beetles, there being a moderate attack of both. Early blight was not sufficiently abundant to cause material injury. There was no loss from rot.

RESULTS IN 1907.

TABLE XI.—YIELD BY SERIES AT GENEVA IN 1907.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	lbs.
I.....	1, 4, 7, 10 and 13.	July 15, Aug. 9 and 24.....	220	15
II.....	2, 5, 8, 11 and 14.	July 15, 24, Aug. 9, 24 and Sept. 17.....	249	50
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	176	10

Increase in yield due to spraying three times, 44 bu. per acre.

Increase in yield due to spraying five times, 73 $\frac{3}{4}$ bu. per acre.

Late blight and rot were wholly absent and early blight appeared only in traces. There was some tip burn and a light attack of flea beetles. Considering the seemingly small amount of damage done by blight and insects it is remarkable that spraying should have increased the yield so much.

TABLE XII.—YIELD BY SERIES AT RIVERHEAD IN 1907.

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	lbs.
I.....	1, 4, 7, 10 and 13.	June 19, July 25 and Aug. 15	186	45
II.....	2, 5, 8, 11 and 14.	June 19, July 2, 17, 31, Aug. 15 and 29.....	200	5
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	168	50

Increase in yield due to spraying three times, 18 bu. per acre.

Increase in yield due to spraying six times, 31 $\frac{1}{4}$ bu per acre.

There was some early blight, but no late blight. Flea beetles were plentiful and caused much damage. The large yield of the sprayed rows is to be attributed to their partial protection against flea beetles and early blight.

DETAILS OF THE TEN-YEAR EXPERIMENTS IN 1908.

AT GENEVA.

In 1908, the experiment was carried out in very nearly the same manner as in previous years. As usual, there were 15 rows 290.4 feet long by three feet wide. Planting was done by hand May 25. The variety was Rural New Yorker No. 2. The plat of land used was the same as that used for the experiment in 1903 and 1905. The soil was heavy clay loam and the previous crop alfalfa.

The five rows constituting Series I were sprayed three times—twice with bordeaux mixture and paris green and once with bordeaux alone—the dates being July 3, 17 and Aug. 3.

The five rows constituting Series II were sprayed six times—twice with bordeaux mixture and paris green and four times with bordeaux alone—the dates being July 3, 17, Aug. 3, 18, Sept. 1 and 16.

The five rows constituting Series III (Check) were not sprayed at all with bordeaux, but were treated twice (July 3 and 20) with paris green in lime water to control bugs.

The spraying was done very thoroughly with a knapsack sprayer. The bordeaux mixture used contained six pounds of copper sulphate to each 50 gallons and lime considerably in excess of the amount required to satisfy the potassium ferrocyanide test. Whenever paris green was used it was applied at the rate of one pound to 50 gallons.

It was the intention to apply poison to the unsprayed rows on the same date that Series I and II were sprayed the second time (July 17); but rain interfered, making it impossible to treat the unsprayed rows until July 20. During this period bugs were active and the unsprayed rows were slightly injured by them. After July 20 there was no further trouble with bugs. There was no early blight and no late blight. Flea beetles caused a little damage to the unsprayed rows, most of which occurred after September 1. The chief trouble was tip burn, which was quite severe. As late as September 1 the

difference between sprayed and unsprayed rows was slight. However, the sprayed rows of Series II outlived the unsprayed rows of Series III by about five days, owing, apparently, to the smaller amount of tip burn and flea beetle injury on the sprayed rows.

The potatoes were dug by hand and sorted and weighed in the usual manner. The yields are shown in the following table:

TABLE XIII.—YIELDS IN THE EXPERIMENT AT GENEVA IN 1908.

Rows.	Treatment.	Yield per row.*		Yield per acre.			
		Marketable.	Culls.	Marketable.		Culls.	
		Lbs.	Lbs.	Bu.	lbs.	Bu.	lbs.
1	Sprayed 3 times.....	202	6	168	20	5	—
2	Sprayed 6 times.....	189½	2	157	55	1	40
3	Unsprayed.....	143	6	119	10	5	—
4	Sprayed 3 times.....	197	6	164	10	5	—
5	Sprayed 6 times.....	203½	7	169	35	5	50
6	Unsprayed.....	148	8	123	20	6	40
7	Sprayed 3 times.....	196	5	163	20	4	10
8	Sprayed 6 times.....	187	7	155	50	5	50
9	Unsprayed.....	167	5	139	10	4	10
10	Sprayed 3 times.....	173	7	144	10	5	50
11	Sprayed 6 times.....	199	6	165	50	5	—
12	Unsprayed.....	143	6	119	10	5	—
13	Sprayed 3 times.....	166	4	138	20	3	20
14	Sprayed 6 times.....	212	5	176	40	4	10
15	Unsprayed.....	156	8	130	—	6	40

* Rows 290.4 feet long by three feet wide making the area of each row exactly one-fiftieth acre.

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

TABLE XIV.—YIELD BY SERIES AT GENEVA IN 1908.

Series.	Rows.	Dates of spraying.	Yield per acre. ⁵	
			Bu.	lbs.
I.....	1, 4, 7, 10 and 13.	July 3, 17 and Aug. 3.....	155	40
II.....	2, 5, 8, 11 and 14.	July 3, 17, Aug. 3, 18, Sept. 1 and 16.....	165	10
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	126	10

⁵ Marketable tubers only.

Increase in yield due to spraying three times, 29½ bu. per acre.

Increase in yield due to spraying six times, 39 bu. per acre.

AT RIVERHEAD.

The experiment at Riverhead was carried out in practically the same manner as the one at Geneva. There were fifteen rows 290.4 feet long by three feet wide. The seed tubers, which were of the variety Carman No. 1, were planted April 20 with a Robbins potato planter. The previous crop had been potatoes. The soil was sandy loam and well drained.

The five rows of Series I were sprayed three times—twice (June 11 and July 9) with bordeaux and paris green and once (Aug. 4) with bordeaux alone. They were also treated once (June 25) with paris green in lime water.

The five rows of Series II were sprayed five times—three times (June 11, 25 and July 9) with bordeaux and paris green and twice (July 24 and Aug. 4) with bordeaux alone.

The five rows of Series III (Check) were not sprayed at all with bordeaux, but were treated three times (June 11, 25 and July 9) with paris green in lime water to control bugs.

The bordeaux mixture used was prepared in the same manner as in the Geneva experiment (see page 9). Whenever paris green was used it was applied at the rate of one pound to 50 gallons. All of the applications were made with a knapsack sprayer and the work done very thoroughly.

In this experiment there was some early blight and a moderate attack of flea beetles, but no late blight. The season

was too dry for late blight. During July the plants were considerably injured by plant lice.

At digging time the potatoes were sorted and weighed in the usual manner. The yields were as follows:

TABLE XV.—YIELDS IN THE EXPERIMENT AT RIVERHEAD IN 1908.

Rows.	Treatment.	Yield per row. ⁶		Yield per acre.			
		Marketable.	Culls.	Marketable.		Culls.	
		<i>Lbs.</i>	<i>Lbs.</i>	<i>Bu.</i>	<i>lbs.</i>	<i>Bu.</i>	<i>lbs.</i>
1	Sprayed 3 times.....	189½	4	157	55	3	20
2	Sprayed 5 times.....	202	3½	168	20	2	55
3	Unsprayed.....	163½	3½	136	15	2	55
4	Sprayed 3 times.....	159½	2	132	55	1	40
5	Sprayed 5 times.....	173	3½	144	10	2	55
6	Unsprayed.....	172	3	143	20	2	30
7	Sprayed 3 times.....	177	4	147	30	3	20
8	Sprayed 5 times.....	178	5	148	20	4	10
9	Unsprayed.....	147½	4½	122	55	3	45
10	Sprayed 3 times.....	179	3	149	10	2	30
11	Sprayed 5 times.....	179½	4	149	35	3	20
12	Unsprayed.....	184	4	153	20	3	20
13	Sprayed 3 times.....	180½	4	150	25	3	20
14	Sprayed 5 times.....	180½	5	150	25	4	10
15	Unsprayed.....	154	3	128	20	2	30

⁶ Rows 290.4 feet long by three feet wide making the area of each row exactly one-fiftieth acre.

TABLE XVI.—YIELD BY SERIES AT RIVERHEAD IN 1908.

Series.	Rows.	Dates of spraying.	Yield per acre. ⁷	
			<i>Bu.</i>	<i>lbs.</i>
I.....	1, 4, 7, 10 and 13.	June 11, July 9 and Aug. 4..	147	35
II.....	2, 5, 8, 11 and 14.	June 11, 25, July 9, 24 and Aug. 4.....	152	10
III.....	3, 6, 9, 12 and 15.	Not sprayed.....	136	50

⁷ Marketable tubers only.

Increase in yield due to spraying three times, 10¾ bu. per acre.

Increase in yield due to spraying five times, 15½ bu. per acre.

In 1908, as in each of the other years during which these experiments have been running, the gain from spraying has been considerably less at Riverhead than at Geneva. The amount of this difference is shown in the following table:

SUMMARY OF RESULTS OBTAINED IN THE TEN-YEAR EXPERIMENTS, 1902-1908.

The following table shows the results obtained in the ten-year experiments during the first seven years:

TABLE XVII.—SUMMARY OF THE TEN-YEAR EXPERIMENTS FOR SEVEN YEARS

Year.	AT GENEVA.		AT RIVERHEAD.	
	Gain per A. due to spraying every two weeks	Gain per A. due to spraying three times.	Gain per A. due to spraying every two weeks	Gain per A. due to spraying three times.
	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>
1902.....	123½	98½	45	27⅔
1903.....	118	88	56	39½
1904.....	233	191	96	56½
1905.....	119	107	82	31½
1906.....	63	32	53	21½
1907.....	73⅔	44	31	18
1908.....	39	29½	15½	10¾
Average.....	110	84	54	29½

FARMERS' BUSINESS EXPERIMENTS.

During the season of 1908 fourteen farmers in different parts of the State conducted business experiments for the Station. The object of these experiments is to determine the actual profit in spraying potatoes under farm conditions. The methods employed were essentially the same as in previous years. An accurate record was kept of all of the expense of spraying, including labor, chemicals and wear of machinery. In each experiment a strip of three to six rows was left unsprayed for comparison.

In order to bring the account of the experiments within the required space limit it has been necessary to omit many interesting details.

"Spraying," as used in this bulletin, means the application of bordeaux mixture exclusively. The application of paris green or arsenite of soda in lime water is not called spraying.

Whenever "arsenite of soda" is mentioned it should be understood to mean the stock solution prepared by the Kedzie formula—one pound white arsenic, four pounds sal soda and one gallon of water boiled together twenty minutes.

By "test rows" is meant the rows used in determining the amount of the increase in yield due to spraying. These are, usually, the middle unsprayed row and the second sprayed row on either side.

The yields given are for marketable tubers only.

The price used in computing the value of the increased yield is, in every case, the market price for potatoes in the locality where the experiment was made on the date on which the test rows were dug.

THE WILLINK EXPERIMENT.

Conducted by M. J. Buntin, Willink, N. Y. Twenty acres of potatoes, variety Snowflake Jr., were sprayed three times with a two-horse E. C. Brown Co. "Auto" sprayer carrying one nozzle per row and covering four rows at each passage. The water used in the preparation of the bordeaux was pumped by hand from a stream about 80 rods distant from the potato field. Three rows 80 rods long were left unsprayed for a check. So few bugs appeared that poisoning of the check rows was not required. As a precautionary measure arsenite of soda was used with the bordeaux in the first spraying, but this seems to have been quite unnecessary.

The expense account contained the following items:

360 lbs. copper sulphate @ 6c.....	\$21.60
300 lbs. lime @ 62½c. per 100.....	1.88
40 lbs. sal soda @ 1c.....	.40
10 lbs. white arsenic @ 4½c.....	.45
7½ days labor for man @ \$1.50.....	11.25
7½ days labor for team @ \$2.00.....	15.00
Wear of sprayer.....	5.00
Total.....	<u>\$55.58</u>

The check rows were 80 rods long by 32 in. wide. Owing to the weather being disagreeable at digging time the test was confined to a representative section 300 feet long. The yields were as follows:

Average of two sprayed rows, 121 lbs.=109.8 bu. per acre.

Middle unsprayed row, 113 lbs.=102.6 bu. per acre.

Gain, 7.2 bu. per acre.

What caused the greater yield on the sprayed rows is not clear. There was no blight of any kind and only a few flea beetles.

The market price of potatoes being 70 cents per bushel 7.2 bu. have a value of \$5.04. After deducting the expense of spraying there remains *a net profit of \$2.26 per acre.*

THE BATAVIA EXPERIMENT.

Conducted by G. A. Prole, Batavia, N. Y. Thirteen acres of potatoes were sprayed five times with a two-horse, four-row "Iron Age" sprayer carrying one nozzle per row. Water was obtained from a well about eight rods from the field. The pumping was done by a windmill. Poison (arsenite of soda) was used with the bordeaux in the first spraying at the rate of 3 qts. of the stock solution to 50 gallons. The check consisted of a strip of three rows 1,424 ft. long by 34 in. apart. These were treated with paris green twice—July 11 and Aug. 18. During the last three weeks of growth the check rows were plainly somewhat inferior to the adjacent sprayed rows. There was no blight, but the check rows had suffered more from the attack of flea beetles and bugs. Inasmuch as the check rows received two applications of poison while the sprayed rows received but one Mr. Prole considers that the sprayed rows did not have an unfair advantage.

The expense account contained the following items:

392 lbs. copper sulphate @ 6½c.....	\$24.50
4 bu. lime @ 25c.....	1.00
32 lbs. sal soda @ 2c.....	.64
8 lbs. white arsenic @ 12c.....	.96
67½ hrs. labor for man @ 20c.....	13.50
135 hrs. labor for horse @ 5c.....	6.75
Wear on sprayer.....	5.00
Total.....	<u>\$52.35</u>

The test rows (Sir Walter Raleigh) yielded as follows:

Two sprayed rows, 1,818 lbs.=163.6 bu. per acre.

Middle unsprayed row, 752 lbs.=135.3 bu. per acre.

Gain, 28.3 bu. per acre.

At 55 cents per bushel 28.3 bu. have a market value of \$15.56. Subtracting the expense of spraying, \$4.03 per acre, we have left a net profit of \$11.53 per acre.

THE ELMIRA EXPERIMENT.

Conducted by John Strouse, Elmira, N. Y. Nineteen acres of potatoes (in three lots) were sprayed all over four times and 13 acres a fifth time. The sprayer was a two-horse, 6-row "Perfection" sprayer carrying one nozzle per row. Part of the water for the bordeaux came from a creek near the field and the remainder from a well about 80 rods distant. In two of the lots 3-row checks were left. Both checks were treated with paris green once—about July 12. In the first spraying paris green was used with the bordeaux at the rate of two pounds to 50 gallons. In one of the later sprayings arsenite of soda was used with the bordeaux at the rate of 4 qts. of the stock solution to 50 gals. The checks were not injured by bugs. There was no blight and very few flea beetles. Lot No. 1 suffered severely from tip burn, but Lots II and III were very little injured by anything.

The expense account contained the following items:

380 lbs. copper sulphate @ 6c.....	\$22.80
9 sacks lime @ 30c.....	2.70
Sal soda and white arsenic.....	3.67
52 hrs. labor for man @ 15c.....	7.80
26 hrs. labor for team @ 25c.....	6.50
Wear of sprayer.....	5.00
Total.....	<u>\$48.47</u>

The test rows yielded as follows:

Lot No. 1. Sprayed five times; rows 485 ft. by 3 ft.

Two sprayed rows, 230 lbs.=57.4 bu. per acre.

Middle unsprayed row, 113 lbs.=55.9 bu. per acre.

Gain, 1.5 bu. per acre.

Lot No. III. Sprayed 4 times; rows 517 ft. by 39 in.

Two sprayed rows, 424 lbs.=91.6 bu per acre.

Middle unsprayed row, 204 lbs.=88.1 bu per acre.

Gain, 3.5 bu. per acre.

The average gain in the two tests being 2.5 bu. per acre, worth (at 65 cts. per bu.) \$1.62, and the average expense of spraying being \$2.45 per acre, there was a *loss of 83 cents per acre.*

THE VICTOR EXPERIMENT.

Conducted by C. E. Green, Victor, N. Y. Ten acres of potatoes were sprayed twice with a one-horse, home-made, four-row sprayer carrying one nozzle per row. The dates of spraying were July 10 and 27. The bordeaux used was of the 4-5-50 formula and the water used in its preparation had to be hauled about 150 rods. In the second spraying arsenite of soda was used with the bordeaux. On the same date the four check rows were treated with arsenite of soda in lime water. During the whole season there was no marked difference between the sprayed and unsprayed rows. Some damage was done by flea beetles, but none whatever by blight. No rot was found at digging time.

The expense account contained the following items:

80 lbs. copper sulphate @ 6½c.....	\$5.20
100 lbs. lime @ ½c.....	.50
100 lbs. sal soda @ 3c.....	3.00
25 lbs. white arsenic @ 12½c.....	3.13
16 hrs. man labor.....	3.00
16 hrs. horse labor.....	1.50
Extra man to prepare bordeaux.....	2.00
Wear of sprayer.....	1.00
Total.....	<u>\$19.33</u>

The test rows were of the variety Sir Walter Raleigh. No representative of the Station was present at the digging. The rows were measured and the potatoes weighed by Mr. Green. The rows were 618 ft. long by 34 in. wide.

The yields were as follows:

One sprayed row, 234 lbs.=97 bu. per acre.

One check row, 189 lbs.=78.3 bu. per acre.

Gain, 18.7 bu. per acre.

The market price of potatoes at digging time being 60 cents per bushel the gain of 18.7 bu. had a value of \$11.22. After deducting the expense of spraying, which is \$1.93 per acre, there remains a *net profit of \$9.29 per acre.*

THE INTERLAKEN EXPERIMENT.

Conducted by F. C. and L. B. Bradley, Interlaken, N. Y. Ten acres of potatoes, variety Carman No. 3, were sprayed four times—June 27, July 10, 28, and Aug. 10. The sprayer used was a two-horse, four-row "Watson" sprayer carrying one nozzle per row in the first two sprayings and two nozzles per row in the last two. Part of the bordeaux used was of the regular 4-4-50 formula and the remainder soda bordeaux. Water was obtained from a stream about 30 rods from the potato field. Paris green, at the rate of one-half pound to fifty gallons, was applied with the bordeaux in two sprayings, but it appears that the second application was unnecessary. Three rows were left unsprayed for a check. These were treated with paris green once. There was no blight whatever and only a moderate amount of damage done by flea beetles. Tip burn was severe; also, many plants died prematurely from an unknown cause, although the crop was given excellent care and cultivation. There was no appreciable difference between sprayed and unsprayed rows:

The expense account contained the following items:

230 lbs. copper sulphate @ 6½c.....	\$14.95
170 lbs. lime @ 1½c.....	2.55
50 lbs. sal soda @ 1½c.....	.63
10 lbs. paris green @ 34½c.....	3.45
53 hrs. man labor @ 20c.....	10.60
37 hrs. team labor @ 10c.....	3.70
Wear of sprayer.....	2.00
Total.....	<u>\$37.88</u>

The test rows were 893 x 3 ft. They yielded as follows:

Two sprayed rows, 603 lbs.=81.7 bu. per acre.

Middle check row, 312.5 lbs.=84.7 bu. per acre.

Loss, 3 bushels per acre.

A carload of the potatoes was sold directly from the field at 57 cents per bushel. At this price, 3 bu. have a value of \$1.71. Adding to this the expense of spraying, \$3.79 per acre, the total loss is shown to be \$5.50 per acre.

THE GROTON EXPERIMENT.

Conducted by E. A. Landon, Groton, N. Y., who sprayed $8\frac{3}{4}$ acres of potatoes five times on the following dates: July 7, 16, 27, Aug. 18 and 25. The sprayer was a two-horse, six-row "Aroostook" sprayer carrying two nozzles per row. The bordeaux used was of the 4-4-50 formula. The water required for its preparation was pumped by hand from a stream at one side of the field. Bugs were kept under control by using paris green with the bordeaux in three sprayings at the rate of one-half pound to 50 gallons. The check rows, of which there were four, were also treated three times with paris green. Early and late blight were both absent, but flea beetles and tip burn caused much damage. The spraying checked the flea beetles somewhat, but the difference between sprayed and unsprayed rows was not marked at any time.

The items of expense were as follows:

300 lbs. copper sulphate @ 8c.....	\$24.00
300 lbs. lime @ 1c.....	3.00
25 lbs. paris green @ 28c.....	7.00
Sprayer, man and team, hired for 5 days @ \$5 per day.....	25.00
2 $\frac{1}{2}$ days labor for extra man @ \$2.....	5.00
Total.....	<u>\$64.00</u>

The test rows, which were of the variety State of Maine, were 650 ft. long by three feet wide. They yielded as follows:

Two sprayed rows, 715 lbs.=133.1 bu per acre.

Two unsprayed rows, 607 lbs.=113 bu. per acre.

Increase in yield due to spraying, 20.1 bu per acre.

The market price of potatoes being 65 cents per bushel the value of the increase is \$13.06. If we subtract the expense of spraying, \$7.31 per acre, there remains *a net profit of \$5.65 per acre.*

THE STERLING STATION EXPERIMENT.

Conducted by A. E. Curtis, Sterling Station, N. Y. One field of 5 acres was sprayed 6 times; another of 4 acres, 5 times; and a portion of a third field containing 15 acres, 5 times. The sprayer was a 1-horse, 4-row, home-made affair. A four-row check was left in each field. There were so few bugs that it was unnecessary to use any poison for them. No late blight appeared. In all three fields there were a few flea beetles. Field No. 3 suffered severely from tip burn, but in the other fields it was not serious. In Field No. 1 the unsprayed rows were slightly injured by early blight. Here, there was some contrast between sprayed and unsprayed rows. In the other two fields there was little or no contrast. The following expense account covers only Fields 1 and 2 (9 acres) :

269 lbs. copper sulphate @ 6c.....	\$16.14
433 lbs. lime @ $\frac{3}{4}$ c.....	3.25
75 hrs. labor for man @ 15c.....	11.25
75 hrs. labor for horse @ 10c.....	7.50
Wear of sprayer.....	10.00
Total.....	<u>\$48.14</u>

The test rows showed the following yields:

Field No. 1. Sprayed six times. Rows 957 x 3 ft.

Two sprayed rows, 784 lbs.=99.1 bu. per acre.

Two unsprayed rows, 640 lbs.=80.9 bu. per acre.

Gain, 18.2 bu. per acre.

Field No. 2. Sprayed five times. Rows 818 x 3 ft.

Two sprayed rows, 754 lbs.=111.5 bu. per acre.

Two unsprayed rows, 600 lbs.=88.7 bu. per acre.

Gain, 22.8 bu. per acre.

Field No. 3. Sprayed five times. Rows 1,243 x 3 ft.

Two sprayed rows, 726 lbs.=70.7 bu. per acre.

Two unsprayed rows, 518 lbs.=50.4 bu. per acre.

Gain, 20.3 bu. per acre.

In the three tests the average gain was 20.4 bu. per acre, worth, at 60c. per bu., \$12.24. Assuming that the expense of 5 sprayings in Field No. 3 was the same as for 5 sprayings in Field No. 2, the average expense of spraying was \$5.18 per acre. Hence there was a *net profit of \$7.06 per acre.*

THE EAST SYRACUSE EXPERIMENT.

Conducted by M. W. Garrett, East Syracuse, N. Y. Four acres of potatoes, variety Norcross, were sprayed five times. The dates of spraying were July 4, 11, 24 and 29 and Aug. 8. The sprayer was a one-horse, four-row "Iron Age" sprayer which carried one nozzle per row in the first two sprayings and two nozzles per row in the last three sprayings. The bordeaux used was of the 6-6-50 formula. Water had to be pumped by hand and hauled about 50 rods. In all five sprayings arsenite of soda was used with the bordeaux at the rate of two quarts of the stock solution to 50 gallons. The check consisted of four rows. These were treated three times with paris green. Both kinds of blight and flea beetles were absent. The only trouble was a very severe attack of tip burn. For some unknown reason the unsprayed rows made a slightly larger growth and remained green a little longer than the sprayed rows. Such a condition of affairs has not been observed in any of our previous experiments.

The expense account contained the following items:

125 lbs. copper sulphate @ 5½c.....	\$6.88
100 lbs. lime @ ½c.....	.50
32 lbs. sal soda @ 1½c.....	.48
8 lbs. white arsenic @ 20c.....	1.60
30 hrs. man labor @ 15c.....	4.50
15 hrs. horse labor @ 10c.....	1.50
Wear of sprayer.....	5.00
Total.....	<u>\$20.46</u>

The test rows (524.5 x 3 ft.) yielded as follows:

Two sprayed rows, 488 lbs.=133.4 bu. per acre.

Two unsprayed rows, 578.5 lbs.=112.6 bu. per acre.

Loss, 20.8 bu. per acre.

At 90 cents per bushel 20.8 bushels of potatoes have a market value of \$18.72. To this must be added the expense of spraying, \$5.12 per acre, which makes *the total loss \$23.84 per acre.*

THE OGDENSBURG EXPERIMENT.

Conducted at Ogdensburg, N. Y., by Andrew Tuck, who sprayed five and one-half acres of potatoes seven times on the following dates: July 17, 24, 31, Aug. 10, 19, 29 and Sept. 7. The sprayer used was a one-horse, four-row "Aspinwall" sprayer carrying one nozzle per row. The bordeaux was of the 5-5-50 formula made with water pumped by hand from a well within a few rods of the field. Paris green (two pounds to 50 gallons) was used with the bordeaux in the first four sprayings. The three check rows also were treated with paris green four times on the same dates. The writers did not see this experiment until digging time. Mr. Tuck reports that by Aug. 10 the unsprayed rows were markedly inferior to the sprayed ones owing to the ravages of some kind of blight. He thinks it was not due to dry weather. The unsprayed rows were not injured by bugs or flea beetles. No rotten tubers were found at digging time.

The expense account contained the following items:

120 lbs. copper sulphate @ 7½c.....	\$9.00
120 lbs. lime.....	1.00
30 lbs. paris green @ 31c.....	9.30
42 hrs. man labor @ 15c.....	6.30
42 hrs. horse labor @ 5c.....	2.10
Wear of sprayer.....	1.00
Total.....	<u>\$28.70</u>

The test rows were of the variety Rural New Yorker No. 2. They were 586 ft. long by 33 in. wide. The yields were as follows:

Two sprayed rows, 436 lbs.=98.2 bu. per acre.

Middle unsprayed row, 66 lbs.=29.7 bu. per acre.

Gain, 68.5 bu. per acre.

Potatoes being worth 80 cents per bushel at time of digging the test rows (Oct. 15) the market value of the gain was \$54.80. After subtracting the expense of spraying, \$5.22 per acre, there remains *a net profit of \$48.58 per acre.*

THE CHATEAUGAY EXPERIMENT.

Conducted by O. Smith & Son, Chateaugay, N. Y. Ten acres were sprayed four times using a one-horse, four-row "Iron Age" sprayer carrying one nozzle per row. Bordeaux of the 6-6-50 formula was used, the necessary water for its preparation being pumped by horse power from a stream at one side of the field. In the first and third sprayings arsenite of soda was applied with the bordeaux mixture to keep bugs under control. It was used at the rate of three quarts of the stock solution to 50 gallons of bordeaux. There were four check rows. These were treated with paris green twice, July 13 and 31. The writers did not see this experiment until digging time, but Mr. Smith reports that the sprayed rows outlived the unsprayed ones by about three weeks. He thinks the difference was due chiefly to early blight, which was prevented by the spraying.

The expense account contained the following items:

215 lbs. copper sulphate @ 8½c.....	\$18.28
2 bbls. lime @ \$1.10.....	2.20
80 lbs. sal soda @ 3c.....	2.40
20 lbs. white arsenic @ 8c.....	1.60
21½ hrs. man labor @ 15c.....	3.23
21½ hrs. horse labor @ 15c.....	3.22
Wear of sprayer.....	10.00
Total.....	<u>\$40.93</u>

The test rows were dug Oct. 2. They were 1,507 ft. long by 37 in. wide and the potatoes were of the variety Uncle Sam. The yields were as follows:

Four sprayed rows, 3,502 lbs.=136.7 bu. per acre.

Two unsprayed rows, 1,340 lbs.=104.6 bu. per acre.

Gain, 32.1 bu. per acre.

There was no loss from rot.

On Oct. 2 the market price of potatoes at Chateaugay was 60 cents per bushel. At this price the gain of 32.1 bu. would have a value of \$19.26. Deducting the expense of spraying, \$4.09 per acre, there remains a *net profit of \$15.17 per acre.*

THE GREENWICH EXPERIMENT.

Conducted by P. C. Billings, Greenwich, N. Y., who sprayed 8 acres of potatoes on three different dates, July 1, 13 and 31. The last spraying was a double one, i. e., the field was gone over twice. On Aug. 13 six rows each side of the check (three rows 931 ft. long) were given an additional spraying. Accordingly, the test rows were sprayed 5 times while the total expense, \$35.58, covers the spraying of 8 acres 4 times and about 0.8 acre once. The sprayer used was a two-horse, 6-row "Aroostook" carrying one nozzle per row. In the first spraying, 4-4-50 bordeaux was used; in the others, 5-5-50 bordeaux. Paris green, one pound to 50 gallons, was used with the bordeaux in the first four sprayings. The check rows were treated with paris green three times—July 1, 13 and 31. There was no blight and scarcely any damage by flea beetles. The plants suffered only from tip burn and leaf hoppers. Mr. Billings states that there was no contrast between sprayed and unsprayed rows—it was apparent that the spraying was of no benefit.

The expense of spraying 8 acres 4 $\frac{1}{9}$ times was as follows:

154 lbs. copper sulphate @ 9c.....	\$13.86
154 lbs. lime @ 1c.....	1.54
24 lbs. Paris green @ 32c.....	7.68
15 hrs. man labor @ 20c.....	3.00
15 hrs. labor for team @ 30c.....	4.50
Wear of sprayer.....	5.00
Total.....	<u>\$35.58</u>

The test rows were of the variety Gold Coin. They were 931 ft. long by 3 ft. wide. The yields were as follows:

Two sprayed rows, 851 lbs.=110.6 bu. per acre.

Middle unsprayed row, 439 lbs.=114.1 bu. per acre.

Loss, 3.5 bu. per acre.

At 66 cts. per bu. 3.5 bu. have a value of \$2.31. Adding to this the expense of 5 sprayings, \$5.40 per acre, we have a *total loss of \$7.71 per acre.*

THE GLENHEAD EXPERIMENT.

Conducted by G. T. Powell, Glenhead, N. Y. Fifteen acres of potatoes (in two lots) were sprayed five times. The sprayer used was a one-horse, four-row "Sprimotor" sprayer carrying two nozzles per row. Arsenite of soda was used with the bordeaux in the first four sprayings. This was not necessary for bugs, but it was thought the poison might be of assistance in checking flea beetles which were very numerous. In one lot there was a strip of five check rows, in the other a strip of three. These were kept free from bugs by one application of paris green on June 23. During the drought in July there was a marked contrast between sprayed and unsprayed rows in both lots. There was no blight, but flea beetles were very numerous and injurious.

The expense account contained the following items:

400 lbs. copper sulphate @ 6½c.....	\$26.00
2 bbls. lime @ \$1.50.....	3.00
100 lbs. sal soda @ 1c.....	1.00
30 lbs. white arsenic @ 10c.....	3.00
60 hrs. man labor @ 20c.....	12.00
60 hrs. horse labor @ 10c.....	6.00
Wear of sprayer.....	5.00
Total.....	<u>\$56.00</u>

The test rows gave the following yields:

West Field. Variety, Green Mountain. Rows 552 ft. x 30 in.

One sprayed row, 336 lbs.=176.7 bu. per acre.

One check row, 259 lbs.=136.2 bu. per acre.

Gain, 40.5 bu. per acre.

South Field. Variety, Gold Coin. Rows 450 ft. x 30 in.

One sprayed row, 215 lbs.=138.7 bu. per acre.

One check row, 243 lbs.=156.8 bu. per acre.

Loss, 18.1 bu. per acre.

Probably some mistake was made in the south field. Mr. Powell thinks that the stakes marking the check rows became misplaced. However, as definite proof of this is lacking it seems best not to reject the experiment. Averaging the two tests we have a gain of 12.4 bu., worth \$9.92. Deducting the expense of spraying, \$3.73, leaves a net profit of \$6.19 per acre.

THE JAMESPORT EXPERIMENT.

Conducted by Henry A. Hallock, Jamesport, Long Island. Seventeen acres of potatoes were sprayed four times. The sprayer used was a one-horse, four-row Hudson sprayer carrying two nozzles per row. The dates of spraying were June 11, 17, 24 and July 10. The bordeaux was made by the 7-4-50 formula. The water required was pumped by a gasoline engine and hauled from 40 rods to one-half mile. In two sprayings arsenite of soda was used with the bordeaux at the rate of four quarts of the stock solution to 50 gallons of bordeaux mixture. There were four check rows. These received one application of paris green on June 11. The whole season there was no perceptible difference between sprayed and unsprayed rows. There was no blight, bugs did no damage and flea beetles were not troublesome. Apparently, there was nothing to spray for.

The expense account contained the following items:

500 lbs. copper sulphate @ 6½c.....	\$32.50
2 bbls. lime @ \$1.50.....	3.00
200 lbs. sal soda @ 2c.....	4.00
50 lbs. white arsenic @ 6½c.....	3.25
4 days man labor @ \$2.....	8.00
4 days horse labor @ \$1.....	4.00
Wear of sprayer.....	5.00
Total.....	<u><u>\$59.75</u></u>

The test rows (variety, Green Mountain) were 690 feet long by three feet wide. They yielded as follows:

Two sprayed rows, 648 lbs.=113.6 bu. per acre.

Two check rows, 640 lbs.=112.2 bu. per acre.

Gain, 1.4 bu. per acre.

At the time of digging the test rows the market price of potatoes was 85 cents per bushel. At this price 1.4 bushels have a value of \$1.19. Since the expense of spraying was \$3.51 per acre the gain was not sufficient to pay expenses. There was a loss of \$2.32 per acre.

THE SOUTHAMPTON EXPERIMENT.

Conducted by Lewis E. Downs, Southampton, Long Island. Fifty-six acres of potatoes were sprayed eight times with a two-horse, six-row "Aroostook" sprayer carrying one nozzle per row. The dates of spraying were June 17, 23, July 3, 10, 14, 20, 21 and 28. The bordeaux used was prepared by the formula, 6 lbs. copper sulphate in 50 gals. of water with sufficient lime added to satisfy the potassium ferrocyanide test. It was necessary to haul water about 40 rods. It was pumped by a windmill. In each spraying two quarts of the arsenite of soda stock solution were added to each 50 gallons of bordeaux. There were four unsprayed rows which were treated twice with paris green—on June 23 and July 5. There was no blight and not many flea beetles. Yet there was considerable contrast between sprayed and unsprayed rows during the last ten days of growth.

The expense of spraying 56 acres 8 times was as follows:

2,688 lbs. copper sulphate @ \$6.17 per 100 lbs.....	\$165.65
2,688 lbs. lime @ 1c.....	26.88
896 lbs. sal soda @ 1c.....	8.96
224 lbs. white arsenic @ 6c.....	13.44
182 hrs. man labor @ 20c.....	36.40
182 hrs. labor for team @ 30c.....	54.60
Wear of sprayer.....	12.00
Total.....	<u>\$317.93</u>

The test rows were of the variety Carman No. 1. They were 1,000 feet long by 33 inches wide. The yields were as follows:

Two sprayed rows, 1,938 lbs.=254.8 bu. per acre.

Two check rows, 1,366 lbs.=180.3 bu. per acre.

Gain, 74.5 bu. per acre.

The market price of potatoes at digging time was 80 cents per bushel. Accordingly, the gain of 74.5 bu. had a value of \$59.60. After deducting the expense of spraying \$5.68 per acre there remains a net profit of \$53.92 per acre.

SUMMARY OF BUSINESS EXPERIMENTS IN 1908.

TABLE XVIII.—SHOWING RESULTS OF BUSINESS EXPERIMENTS IN 1908.

Experiment.	Area sprayed.	Number of times sprayed.	Increase or decrease in yield per acre.	Total cost of spraying per acre	Cost per acre for each spraying.	Net profit or loss per acre.
	<i>A</i>		<i>Bu.</i>			
Southampton.....	56	8	74.5	\$5.68	\$0.71	\$53.92
Ogdensburg.....	5.5	7	68.5	5.22	.75	48.58
Chateaugay.....	10	4	32.1	4.09	1.02	15.17
Batavia.....	13	5	28.3	4.03	.81	11.53
Sterling Station...	9	5-6	20.4	5.18 ⁸	.96	7.06
Groton.....	8.75	5	20.1	7.31	1.46	5.65
Victor.....	10	2	18.7	1.93	.97	9.29
Glenhead.....	15	5	12.4	3.73	.75	6.19
Willink.....	20	3	7.2	2.78	.93	2.26
Elmira.....	19	4-5	2.5	2.45 ⁹	.54	— .83
Jamesport.....	17	4	1.4	3.51	.88	—2.32
Interlaken.....	10	4	— 3	3.79	.95	—5.50
Greenwich.....	8	4-5	— 3.5	5.40 ¹⁰	1.08	—7.71
E. Syracuse.....	4	5	—20.8	5.12	1.02	—23.84

⁸ Average of 5 and 6 sprayings.⁹ Average of 4 and 5 sprayings.¹⁰ For 5 sprayings.*Average increase in yield per acre, 18.5 bushels.**Average net profit per acre, \$8.53.*

SUMMARY OF BUSINESS EXPERIMENTS, 1903-1908.

TABLE XIX.—SHOWING RESULTS OF BUSINESS EXPERIMENTS, 1903—1908

Year.	Number of experiments.	Total area sprayed.	Average increase in yield per acre	Average total cost of spraying per acre.	Average cost per acre for each spraying.	Average net profit per acre.
		<i>A.</i>	<i>Bu.</i>			
1903.....	6	61.2	57	\$4.98	\$1.07	\$23.47
1904.....	14	180	62.2	4.98	.93	24.86
1905.....	13	160.7	46.5	4.25	.98	20.04
1906.....	15	225.6	42.6	5.18	.985	13.89
1907.....	14	152.75	36.8	5.90	1.18	17.07
1908.....	14	200.25	18.5	4.30	.92	8.53

*Average increase in yield, for six years, 43.8 bu. per acre.**Average net profit, for six years, \$17.94 per acre.*

VOLUNTEER EXPERIMENTS.

In 1904 the Station began collecting and recording the results of potato spraying experiments made by farmers in all parts of the State. As these experiments are carried out entirely by the farmers themselves we call them volunteer experiments. It is probable that, in some cases, 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. Nevertheless, they are valuable. They supplement the regular business experiments. By bringing together the results of a large number of business experiments and volunteer experiments extending over several consecutive seasons the Station hopes to be able to answer definitely the question, Does it pay to spray potatoes in New York? We are under obligations to the many farmers who have assisted in this work and take this opportunity to express our appreciation of their services. The experiments are to be continued at least three years longer and it is hoped that we may continue to have the hearty coöperation of potato growers throughout the State. All who spray potatoes with bordeaux mixture are requested to leave a few rows unsprayed in order that it may be determined how much the yield is increased by spraying. The product of unsprayed and sprayed rows adjacent should be *weighed or measured* and the length of the rows measured so that the yields may be accurately determined. We cannot use experiments in which the yields have been only estimated. Neither can we use experiments in which the application of poison to the unsprayed rows has been neglected.

The following table shows the principal results of the eleven volunteer experiments reported in 1908. The marked decline in the number of volunteer experiments is probably due, in part, to the present lack of interest in spraying owing to the scarcity of blight during the past two seasons. There are also other reasons.

TABLE XX.—SHOWING RESULTS OF VOLUNTEER EXPERIMENTS IN 1908.

Experiment.	Location.	Name.	Area sprayed.	Times sprayed.	Yield per acre.		Gain per acre due to spraying.	Cost per acre each spraying.	Price of pota- toes.	Kind of sprayer.
					Sprayed.	Not sprayed.				
					Bu. lbs.	Bu. lbs.	Bu. lbs.	Cts.	Cts.	
1	Gainesville....	C. M. Dennis....	12	4	187 15	63 55	123 20	...	60	6-row, 2-horse, Arcostook.
2	Lisbon.....	S. Miller.....	2	5	226 7	103 9	122 58	60 ¹¹	90	2-row, 1-horse, home-made.
3	West Rush....	T. E. Martin....	18	27	240 7	137 21	102 46	47	60	6-row, 1-horse, home-made.
4	West Rush....	D. S. Norris....	4.5	4	59 51	4 43	55 8	...	70	6-row, 2-horse, Brown.
5	Bacon Hill....	E. W. Williams..	10	3	217 21	170 47	46 34	60	72	4-row, 1-horse, Aspinwall.
6	Canandaigua..	S. L. Van Voorhis	10	3	100 22	72 40	27 42	...	55-60	4-row, 1-horse, home-made.
7	Peru.....	John Mannix....	2	2	82 48	58 4	24 44	77	50	5-gal. compressed-air.
8	Memphis.....	M. Bowes.....	7	4	143 31	122 1	21 30	123	60	4-row, 1-horse, home-made.
9	Memphis.....	C. Parry.....	3.25	3	193 25	174 25	19 78	53	55	4-row, 1-horse, home-made.
10	Hornell.....	W. Faulkner....	14	4	168 35	151 41	16 54	...	85	4-row, 2-horse, Watson.
11	Deer River....	DeV. Vrooman....	1.5	4	34 22	30 56	3	4-row, 1-horse, Hurst.

¹¹ For chemicals only,—does not include labor.

ADDITIONAL NOTES ON THE VOLUNTEER EXPERIMENTS IN 1908.

Experiment No. 1. Mr. Dennis states that the sprayed and unsprayed rows had an equal chance except as regards spraying. The unsprayed rows were not injured by bugs, yet they died four weeks earlier than the sprayed rows. The fact that a considerable number of rotten tubers were found at digging time indicates that late blight was a factor in this experiment. Flea beetles were not troublesome.

Experiment No. 2. It is not clear how spraying benefited the plants in this experiment. Although there was a marked contrast between sprayed and unsprayed rows Mr. Miller thinks there was no blight and the unsprayed rows were only slightly injured by bugs. Plant lice were plentiful.

Experiment No. 3. The total quantity of bordeaux used on 18 acres was 25,685 gallons, which is at the rate of 1,427 gallons per acre. A few rows which were double-sprayed each time, receiving bordeaux at the rate of 2,854 gallons per acre, outyielded the single-sprayed rows by 38 bu. per acre. Mr. Martin's experience shows that there is little danger of injuring potatoes by the most thorough spraying. Early and late blight were both absent and there was no rotting of the tubers. The unsprayed rows were well protected against bugs by several applications of paris green, but tip burn was prevalent and flea beetles and several other kinds of insects were numerous. The items of expense of spraying 18 acres were as follows:

20 cwt. copper sulphate @ \$5.875.....	\$117.50
23 bbls. Ohio Marblehead lime @ \$1.05.....	24.15
28 days labor, man and team, @ \$3.....	84.00
Incidentals.....	8.35
Total.....	<u>\$234.00</u>

Experiment No. 4. There is some doubt about this experiment being a fair one. In the rush of haying the potatoes were neglected and the whole field was considerably injured

by bugs. Although the unsprayed rows were thoroughly poisoned the plants did not recover as promptly as on the sprayed rows. The sprayed rows outlived the unsprayed ones by about four weeks.

Experiment No. 5. Mr. Williams reports that there seemed to be no blight in this experiment. There was no rot, flea beetles were not troublesome and the unsprayed rows were not injured by bugs. The contrast between sprayed and unsprayed rows was not marked. The weather was very dry.

Experiment No. 6. The yields given are for unsorted potatoes.

Experiment No. 7. Mr. Mannix states that the unsprayed rows were considerably injured by some kind of blight; also, that some damage was done by "small green flies" [probably leaf hoppers] which were unaffected by paris green.

Experiment No. 8. The unsprayed rows died about a week earlier than the sprayed ones. The chief enemy fought was the flea beetle. It is doubtful if there was any blight in this experiment.

Experiment No. 9. Although the potatoes used for this experiment were the property of Mr. Charles Parry the experiment was, in reality, conducted by Mr. M. Bowes, who did the spraying and superintended the digging of the test rows.

Experiment No. 10. Mr. Faulkner states that there was no noticeable difference between sprayed and unsprayed rows. There was no blight on either.

Experiment No. 11. In this experiment the test rows were of the variety Early Harvest.

SUMMARY OF VOLUNTEER EXPERIMENTS, 1904-1908.

The following table shows the results obtained in the volunteer experiments during the past five years,—1904 to 1908 inclusive:

TABLE XXI.—SHOWING RESULTS OF VOLUNTEER EXPERIMENTS, 1904-1908

Year.	Number of experiments.	Total area sprayed.	Average gain per acre due to spraying.		Average market price per bushel of potatoes at digging time.
			Bu.	lbs.	Cts.
1904.....	41	364	58	28	43.5
1905.....	50	407	59	32	57.0
1906.....	62	598	53	6	44.5
1907.....	24	264	30	28	58
1908.....	11	74	66	18	66

Average gain for 5 years (188 experiments) 50½ bu. per acre.

According to the above table the average gain per acre due to spraying, as reported by the volunteer experimenters, was larger in 1908 than in any preceding year. This is misleading. It indicates that spraying gave unusually good results in 1908, whereas exactly the opposite is true. In 1908 spraying was much *less* profitable than usual. It appears that the few experiments reported were the most successful ones. The truth of the matter is that many experimenters were ashamed to report the low yields which they obtained in 1908. It appears, also, that some consider their experiments of no value unless an increase in yield is obtained. This is a mistake. Whatever the results may be they are valuable and should be reported to the Station.

POTATO TROUBLES IN NEW YORK IN 1908.

In 1908 the potato crop in New York behaved strangely. In many cases even experienced potato growers were puzzled to account for the premature browning and drying of the potato foliage. The trouble known as tip burn, in which the tips and margins of the leaves become brown and dry, was almost universal and, in many fields, very severe. Many persons mistook this for blight. Both of the real blights, early blight and late blight, were scarce. The season was a dry one. Undoubtedly, the dry, hot weather was the chief cause of the tip burn. In many cases it was aggravated by flea beetles; in others, by leaf hoppers and other insects feeding on the foliage. Leaf hoppers were unusually abundant and flea beetles, as usual, were destructive in many fields. Bugs were not particularly troublesome.

Early blight (*Alternaria solani*) occurred in only a few localities and in a mild form.

Late blight and the rot which follows it appear to have been almost entirely absent. Although constantly on the lookout for it, the writers did not see a single specimen of *Phytophthora infestans* on potatoes during the past season. However, there is evidence that it occurred in at least three places in the State—Batavia, Gainesville and Clyde. Prof. H. H. Whetzel informs us that he has positive knowledge of its occurrence at Batavia. Mr. C. M. Dennis, of Gainesville, reports some loss from rot. While this rot may have been due to other causes the chances are decidedly in favor of it being due to *Phytophthora*. That the fungus appeared on potatoes at Clyde is proven by its occurrence there in a greenhouse on tomatoes which could have contracted the disease in but one way, viz., from potato plants beside which the young tomato plants stood previous to being transplanted into the greenhouse.¹²

¹² December 10, 1908, F. F. Miller, Clyde, N. Y., sent to the Station some greenhouse tomatoes affected with an unusual form of rot. After lying in a moist chamber for 24 hours some of the fruits developed conidiophores

DIRECTIONS FOR SPRAYING.¹³

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 four pounds of copper sulphate to each 50 gallons in the first two sprayings and six pounds to 50 gallons in subsequent sprayings. Whenever bugs or flea beetles are plentiful add one to two pounds of paris green or two quarts of arsenite of soda stock solution to the quantity of bordeaux required to spray an acre.

Thoroughness of application is to be desired at all times, but is especially important when flea beetles are numerous or the weather favorable to blight. Using the same quantity of bordeaux, frequent light applications are likely to be more effective

and conidia of *Phytophthora, infestans*, the potato blight fungus. It is not uncommon for this fungus to attack the foliage and fruit of tomatoes in the open, but its occurrence on tomatoes under glass seems to be rare. The fact that potatoes were so generally free from *Phytophthora* during the summer of 1908 lends additional interest to the case. Accordingly, one of the writers visited Clyde for the purpose of looking into it.

Mr. Miller stated that the tomato seed had been sown in June in a garden close beside a patch of potatoes. Here, the young tomato plants grew until some time in August when they were transplanted into the greenhouse. Mr. Miller did not notice whether the potatoes were affected with blight. Neither did he observe anything wrong with the tomato plants at the time of removing them to the greenhouse. In November some of the fruits began to rot. The trouble started in one corner of the greenhouse where the temperature was often lower than it should have been. The loss was small, yet there were always to be found a few rotting fruits. At the time of our visit (Dec. 15) only traces of the disease were to be found on the leaves, but affected fruits were common. Green fruits of all ages were attacked and, occasionally, fruits nearly ripe were affected. The fruits were variously marked with a conspicuous brown discoloration in the flesh. Many of the affected fruits showed no fungus on the surface; some, particularly those in an advanced stage of decay, bore molds of various kinds; while a few showed the fructification of *Phytophthora* which appeared as a delicate white mold.

If we assume that *P. infestans* produces no resting spores, the conclusion is inevitable that the tomatoes contracted the disease from the potatoes while growing beside them in the garden.

¹³ Copied from Bulletin 290, p. 320. The experiences of the past season do not warrant any material alteration in the recommendations there made.

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 thoroughly 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.

SPRAYING IN DRY SEASONS.

The past season being a very dry one over the entire State we have had exceptional opportunities for observing the effect of spraying potatoes in dry weather. An examination of Table XVIII shows that in nine of the fourteen business experiments spraying proved profitable while in the remaining five it was unprofitable. Notwithstanding dry weather and the absence of late blight the business experiments show an average increase in yield of 18.5 bu. per acre due to spraying and an average net profit of \$8.53 per acre. Our observations convince us that it is unwise to neglect spraying in dry seasons. Even when there is no blight five or six sprayings should be made during the season. In dry weather the wounding of the leaves by bugs, flea beetles and other insects is more in-

jurious than in wet weather. Unless regular spraying is practiced the application of poison for bugs is likely to be neglected. Flea beetles flourish best in dry weather. It is an established fact that thorough spraying at the proper time will materially lessen the damage done by flea beetles. If flea beetles are not, at least partially, checked by spraying it is positive proof that the work has not been done properly. With us, the opinion is steadily growing that very few farmers spray thoroughly enough to secure the maximum profit from the operation. There seems to be little danger of overdoing the matter. The experience of T. E. Martin, West Rush, N. Y., is strong evidence on this point. Mr. Martin sprays with extreme thoroughness and invariably secures large increase in yield and large net profit.