BULLETIN No. 323. MAY, 1910.

New York Agricultural Experiment Station.

GENEVA, N. Y.

POTATO SPRAYING EXPERIMENTS IN 1909.

F. C. STEWART G. T. FRENCH, S. M. McMURRAN AND F. A. SIRRINE.

PUBLISHED BY THE STATION

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* Riverhead, N. Y. † Absent on leave. ‡ Connected with the Chautauqua Grape Work.

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F. C. STEWART, G. T. FRENCH, S. M. McMURRAN AND F. A. SIRRINE.

SUMMARY.

This bulletin gives the results of the eighth year's work in the ten-year series of potato spraying experiments begun in 1902. During 1909 the experiments were conducted along the same lines as in previous years. Twenty-six separate experiments are reported.

TEN-YEAR EXPERIMENTS.

At Geneva, six sprayings increased the yield 49.75 bu. per acre and three sprayings increased it 38.67 bu. notwithstanding 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 six sprayings was 52.5 bu. per acre and to three sprayings 28.67 bu. The chief enemies were tip burn and flea beetles. There was no late blight and no rot.

FARMERS' BUSINESS EXPERIMENTS.

In twelve farmers' business experiments, including 203 acres, the average gain due to spraying was 24.4 bu. per acre; the average total expense of spraying, $4.15 per acre; and the average net profit, $9.55 per acre. In four of the experiments spraying was unprofitable.

VOLUNTEER EXPERIMENTS.

Twelve volunteer experimenters reported gains averaging 44.4 bu. per acre.

Aside from Colorado potato beetles, which are almost always troublesome, the chief troubles of potato foliage in 1909 were tip burn (caused primarily by dry weather) and flea beetles. Early blight was rare and late blight and rot wholly absent. The experiences of 1909 confirm us in the opinion 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 the 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;
No. 311. Potato Spraying Experiments in 1908.

SUMMARY OF RESULTS OBTAINED IN TEN-YEAR EXPERIMENTS PRIOR TO 1909.

RESULTS IN 1902.

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

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

* Rows 10, 11 and 12 omitted because of probable error.
† The yields given in Tables I to XIV relate to marketable tubers only.

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 2 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. On both 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, 96⅓ *bu. per acre.*

The larger yield on sprayed rows was due chiefly to partial protection against flea beetles which are unusually abundant. Both early and late blight also present. The loss from rot was 3 per ct. on Series I, 1 per ct. on Series II, and 6 per ct. on Series III.

RESULTS IN 1905.

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

Series.	Rows.*	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

* 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, 119⅓ *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, 31⅓ *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, $31\frac{3}{4}$ 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 August 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, $21\frac{1}{2}$ bu. per acre.
Increase in yield due to spraying five times, $53\frac{1}{4}$ 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, 73⅗ 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, 31¼ bu. per acre.

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

RESULTS IN 1908.

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

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

Increase in yield due to spraying three times, 29½ bu. per acre.
Increase in yield due to spraying six times, 39 bu. per acre.

There was no early blight, no late blight and no rot. Flea beetles caused slight damage to the unsprayed rows, most of which occurred after September 1. The chief trouble was tip burn, which was quite severe. 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.

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

Series.	Rows.	Dates of spraying.	Yield per acre.	
			Bu.	*lbs.*
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

Increase in yield due to spraying three times, 10¾ bu. per acre.
Increase in yield due to spraying five times, 15⅓ bu. per acre.

In this experiment there was some early blight and a moderate attack of flea beetles, but no late blight and no rot. During July considerable damage was done by aphids which were not checked by the spraying.

DETAILS OF THE TEN-YEAR EXPERIMENTS IN 1909.

AT GENEVA.

In 1909, the experiment was carried out in practically the same manner as in previous years. As usual, there were 15 rows, 290.4 feet long by 3 feet wide.[1] Planting was done by hand May 26. The variety was Rural New Yorker No. 2. Each row received ten pounds of chemical fertilizer applied by hand as uniformly as possible in the open furrow at planting time. The plat of land used was the same as that used for the experiment in 1908. The soil was heavy clay loam. The potatoes came up well so that there were but few missing hills.

The five rows constituting Series I were sprayed three times with bordeaux — July 9, 23 and August 11.

The five rows constituting Series II were sprayed six times with bordeaux — July 9, 23, August 11, 27, September 10 and 24.

The five rows constituting Series III (check) were not sprayed at all with bordeaux.

Bugs were controlled by spraying the entire field twice (July 3 and 20) with paris green in lime water (1 lb. to 50 gals.) Thus all three series received the same treatment as regards poison for bugs. However, it should be stated that at the time of making the second application of paris green (July 20) bugs were numerous and had slightly injured some of the plants. This injury was somewhat greater on Series III (check) than on Series I and II sprayed with bordeaux. Bugs dislike bordeaux mixture. It has been our custom, in these experiments, to apply poison for bugs simultaneously with the first two applications of bordeaux, but this year it was not convenient to do so.

In each application the work was done very thoroughly with a knapsack sprayer, using 125 to 250 gallons of bordeaux per acre. The bordeaux mixture used contained six pounds of copper sulphate to each fifty gallons, and lime somewhat in excess of the amount required to satisfy the potassium ferro-cyanide test.

[1] Besides the fifteen rows in the experiment proper there were, as in all previous experiments, two other rows which served the purpose of outside rows.

Both early blight and late blight were wholly absent. Some injury from flea beetles was noticeable throughout the season. After about September 1 there was, also, considerable tip burn owing to the drought prevailing at that time. But as late as September 24 the difference between sprayed and unsprayed rows was not marked. The difference between Series I and II was very slight indeed. The sprayed rows held most of their foliage until killed by frost on October 14. Even at this date the difference in the foliage indicated that there would be only slight difference in the yield of the three series.

The potatoes were dug by hand and sorted and weighed in the usual manner. No rotten tubers were found. The yield by rows is shown in the following table:

TABLE XV.— YIELDS IN THE EXPERIMENT AT GENEVA IN 1909.

Row.	TREATMENT.	Yield per Row.*		Yield per Acre.			
		Marketable.	Culls.	Marketable.		Culls.	
		Lbs.	Lbs.	Bu.	lbs.	Bu.	lbs.
1	Sprayed three times	191	3	159	10	2	30
2	Sprayed six times	190	3½	158	20	2	55
3	Unsprayed	136	6	113	20	5	—
4	Sprayed three times	170	6	141	40	5	—
5	Sprayed six times	203	5	169	10	4	10
6	Unsprayed	143	6	119	10	5	—
7	Sprayed three times	204	6	170	—	5	—
8	Sprayed six times	204½	4	170	25	3	20
9	Unsprayed	150	7	125	—	5	50
10	Sprayed three times	205	5½	170	50	4	35
11	Sprayed six times	213	5	177	30	4	10
12	Unsprayed	153½	5	127	55	4	10
13	Sprayed three times	204	5½	170	—	4	35
14	Sprayed six times	230	5	191	40	4	10
15	Unsprayed	159½	4	132	55	3	20

*Rows 290.4 feet long by 3 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 XVI.— YIELD BY SERIES AT GENEVA IN 1909.

Series.	Rows.	Dates of spraying.	Yield per acre.*	
			Bu.	*lbs.*
I	1, 4, 7, 10 and 13	July 9, 23 and Aug. 11	162	20
II	2, 5, 8, 11 and 14	July 9, 23, Aug. 11, 27, Sept. 10 and 24	173	25
III	3, 6, 9, 12 and 15	Not sprayed	123	40

* Marketable tubers only.

Increase in yield due to spraying three times, 38⅗ bu. per acre.
Increase in yield due to spraying six times 49¾ 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, variety Carman No. 1, were planted April 21 with a Robbins potato planter which, at the same time applied chemical fertilizer at the rate of 1,000 pounds per acre. The soil was sandy loam and the previous crop timothy hay. When the plants came up there were few missing hills.

The five rows of Series I were sprayed three times (June 11, July 16 and 31), with bordeaux and paris green. They were also treated twice (June 25 and July 7) with paris green and lime water.

The five rows of Series II were sprayed six times with bordeaux and paris green, the dates being June 11, 25, July 9, 24, August 6 and 21.

The five rows of Series III (check) were not sprayed at all with bordeaux, but were treated three times (June 18, 25 and July 7) with paris green in lime water to control bugs.

All of the applications were made with a knapsack sprayer, and the work was done very thoroughly. The bordeaux was prepared in the same manner as in the Geneva experiment. In the use of paris green there were some variations, but it was so managed that there was not at any time any material injury done by bugs.

After July 7 there was a little early blight, but no late blight at any time. Some flea beetles were present, as usual, during May and June, but caused practically no damage. The new brood appeared about July 15 and thereafter beetles were a factor in the experiment though less numerous and less destructive than usual. After about the middle of July the plants suffered severely from drought, but they did not present the usual symptoms. Instead of showing tip burn the leaves became overgrown with a dark-colored mold consisting chiefly of *Cladosporium herbarum* (?).

From July 15th until the plants were all dead the sprayed rows were noticeably superior to the unsprayed ones. Strange to say, this difference was more marked during the latter part of July than on August 21. On the latter date some plants in Series III were still alive, apparently having made a second growth.

The potatoes were dug, sorted and weighed on October 19. No rotten tubers were found. The yields were as follows:

TABLE XVII.— YIELDS IN THE EXPERIMENT AT RIVERHEAD IN 1909.

Row.	TREATMENT.	Yield per Row.*		Yield per Acre.			
		Marketable.	Culls.	Marketable.		Culls.	
		Lbs.	Lbs.	Bu.	lbs.	Bu.	lbs.
1	Sprayed three times	179	8	149	10	6	40
2	Sprayed six times	177	6	147	30	5	—
3	Unsprayed	127	8½	105	50	7	5
4	Sprayed three times	135	8	112	30	6	40
5	Sprayed six times	178	9	148	20	7	30
6	Unsprayed	141	8	117	30	6	40
7	Sprayed three times	157	7	130	50	5	50
8	Sprayed six times	189	4	157	30	3	20
9	Unsprayed	122	7	101	40	5	50
10	Sprayed three times	174	5	145	—	4	10
11	Sprayed six times	214	5	178	20	4	10
12	Unsprayed	121	8	100	50	6	40
13	Sprayed three times	174	4	145	—	3	20
14	Sprayed six times	204	7	170	—	5	50
15	Unsprayed	136	9	113	20	7	30

*Rows 290.4 feet long by 3 feet wide, making the area of each row exactly one-fiftieth acre.

TABLE XVIII.— YIELD BY SERIES AT RIVERHEAD IN 1909.

SERIES.	Rows.	Dates of spraying.	Yield per acre.*	
			Bu.	*lbs.*
I..........	1, 4, 7, 10 and 13..	June 11, July 16 and 31............	136	30
II..........	2, 5, 8, 11 and 14..	June 11, 25, July 9, 24, Aug. 6 and 21	160	20
III..........	3, 6, 9, 12 and 15..	Not sprayed.....................	107	50

* Marketable tubers only. Owing to their small average size it was deemed advisable to make two grades of the marketable tubers; " firsts " which sold for 80 cents per bushel and " seconds " which sold for 40 cents. The increase in yield due to spraying was chiefly in the grade of " firsts," the yields being as follows:

Rows sprayed three times, $75\frac{1}{3}$ bu. " firsts " and $61\frac{1}{6}$ bu. " seconds;" rows sprayed six times, 100 bu. " firsts " and $60\frac{1}{6}$ bu. " seconds;" unsprayed rows, 50 bu. " firsts " and $57\frac{5}{6}$ bu. "seconds."

Increase in yield due to spraying three times, $28\frac{2}{3}$ bu. per acre.

Increase in yield due to spraying six times, $52\frac{1}{2}$ bu. per acre.

For the first time in the eight years during which these experiments have been running the gain from six sprayings was slightly greater at Riverhead than at Geneva, the amount of the difference being $2\frac{3}{4}$ bu. per acre. However, the gain from three sprayings was ten bushels *less* at Riverhead than at Geneva. Usually, the gains at Geneva have been much larger than those at Riverhead. This is shown in the next table.

SUMMARY OF RESULTS OBTAINED IN THE TEN-YEAR EXPERIMENTS, 1902–1909.

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

TABLE XIX.— SUMMARY OF THE TEN-YEAR EXPERIMENTS FOR EIGHT YEARS.

YEAR.	AT GENEVA.		AT RIVERHEAD.	
	Gain per acre due to spraying every two weeks.	Gain per acre due to spraying three times.	Gain per acre due to spraying every two weeks.	Gain per acre due to spraying three times.
	Bu.	*Bu.*	*Bu.*	*Bu.*
1902..................	$123\frac{1}{2}$	$98\frac{1}{2}$	45	$27\frac{2}{3}$
1903..................	118	88	56	$39\frac{1}{2}$
1904..................	233	191	96	$56\frac{1}{2}$
1905..................	119	107	82	$31\frac{1}{2}$
1906..................	63	32	53	$21\frac{1}{2}$
1907..................	$73\frac{2}{3}$	44	31	18
1908..................	39	$29\frac{1}{2}$	$15\frac{1}{3}$	$10\frac{3}{4}$
1909..................	$49\frac{3}{4}$	$38\frac{2}{3}$	$52\frac{1}{2}$	$28\frac{2}{3}$
Average..........	102 +	78 +	54—	29 +

FARMERS' BUSINESS EXPERIMENTS.

During the season of 1909 twelve 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 BATAVIA EXPERIMENT.

Conducted by G. A. Prole, Batavia, N. Y. Fifteen acres of potatoes were sprayed six times with a two-horse, four-row "Iron Age" sprayer carrying one nozzle per row. The dates of spraying were July 10, 17, 30, August 10, 20 and 27. Water was obtained from a well about forty 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 three quarts of the stock solution to fifty gallons. The check consisted of a strip of three unsprayed rows 1,256 feet long, thirty-two inches apart. These were treated once (July 10) with paris green to control bugs. Sprayed and unsprayed rows were practically indistinguishable until within a few days of the close of growth, when the unsprayed rows appeared slightly inferior. There was no early blight, no late blight and no rot. The chief troubles were flea beetles and tip burn, neither of which caused much damage.

The expense account contained the following items:

402	lbs. copper sulphate @ 5c	$20 10
3½	bus. lime @ 25c	88
28	lbs. sal soda @ 2½c	70
7	lbs. white arsenic @ 12c	84
94	hrs. labor for man @ 20c	18 80
94	hrs. labor for horse @ 10c	9 40
	Use of sprayer (hired)	5 00
	Total	$55 72

The test rows (Sir Walter Raleigh) yielded as follows: Two sprayed rows.[2] 1,441 lbs.= 156.1 bu. per acre.

Middle unsprayed row, 728 lbs.= 157.7 bu. per acre.

Loss, 1.6 bu. per acre.

To the expense of spraying, which was $3.71 per acre, must be added the loss of 1.6 bu. of potatoes, worth eighty cents, which makes *the total loss* $4.51 *per acre.*

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[2] One row on east side of check, 696 lbs.; the other on west side, 745 lbs.

THE VICTOR EXPERIMENT.

Conducted by William C. Green, Victor, N. Y. Twelve acres of potatoes (variety Carman No. 3), were sprayed twice (July 17 and August 6) with bordeaux mixture, formula 5-5-50. The sprayer used was a one-horse, home-made, four-row sprayer, carrying one nozzle per row. The potato field was only about ten rods from the water supply. A windmill did the pumping. Four rows 948 feet long by 34 inches wide were left unsprayed for a check. Owing to the absence of bugs it was unnecessary to use any poison, either on the sprayed or the unsprayed rows. While the field as a whole was sprayed only twice, the four rows next the check, on the east side, were double-sprayed four times. One of these rows was used to represent the sprayed rows at digging time. In spite of their thorough spraying the sprayed rows appeared no better than the unsprayed ones. This is not strange, because there was no blight, only a few flea beetles and a little tip burn.

The items of expense were as follows:

120 lbs. copper sulphate @ 6c	$7 20
120 lbs. lime @ ½c	60
20 hrs. labor for man @ 20c	4 00
20 hrs. labor for horse @ 10c	2 00
Allowance for wear of sprayer	5 00
Total	$18 80

Expense of spraying one acre once, 78⅓ cents.

Expense of spraying one acre eight times, $6.27.

The yields were as follows:[3]

One row sprayed eight times, 776 lbs.= 209.6 bu. per acre.

One unsprayed row, 782 lbs.= 211.2 bu. per acre.

Loss, 1.6 bu. per acre.

There being a *decrease* instead of an increase in yield the expense of spraying, $1.57 per acre, was all lost. To this must be added 64 cents, the value of 1.6 bu. potatoes, which makes the actual total loss $2.21 per acre. Had the whole field been double-sprayed four times like the test rows the total loss would have been $6.91 per acre.

[3] There were so few small tubers that sorting was unnecessary.

THE ELMIRA EXPERIMENT.

Conducted by John Strouse, Elmira, N. Y. About twenty-two acres of potatoes (in two lots) were sprayed twice with bordeaux by means of a two-horse, six-row "Perfection" sprayer, carrying one nozzle per row. Part of the water required was obtained from a creek and the remainder from a well nearby. In both lots three-row checks were left. In both sprayings arsenate of lead was used with the bordeaux at the rate of four pounds to fifty gallons. This seems to have been unnecessary. It was the intention to use arsenate of lead on the check rows, also, as soon as bugs attacked them, but no bugs appeared and so no poison was applied. There was some tip burn and a few flea beetles, but no blight. Sprayed and unsprayed rows appeared equally good throughout the season.

The expense account contained the following items:

176 lbs. copper sulphate @ 6c	$10 56
4 sacks hydrated lime @ 30c	1 20
84 lbs. arsenate of lead @ 14c	11 76
24 hrs. labor for man @ 12½c	3 00
21 hrs. labor for team @ 30c	6 30
Wear on sprayer	3 50
Total	$36 32

Average expense of two sprayings, $1.65 per acre.

The test rows (Carman No. 3) yielded as follows:[4]

Lot No. 1.—Rows 516 feet long by 3 feet wide.

One sprayed row, 347 lbs.= 162.7 bu. per acre.

One unsprayed row, 328 lbs.= 153.8 bu. per acre.

Gain, 8.9 bu. per acre.

Lot No. 2.— Rows 488 feet long by 3 feet wide.

Two sprayed rows,[5] 586 lbs.= 145.3 bu. per acre.

One unsprayed row, 297 lbs.= 147.3 bu. per acre.

Loss, 2 bu. per acre.

The average gain in the two tests being 6.9 bu. per acre, worth (at 50 cents per bu.) $3.45, and the average expense of spraying being $1.65 per acre, there was *a net profit of* $1.80 *per acre.*

[4] Potatoes not sorted.

[5] One south of check, 273 lbs ; the other north of check, 313 lbs.

THE STERLING STATION EXPERIMENT.

Conducted by A. E. Curtis, Sterling Station, N. Y. One field of 6.33 acres was sprayed six times; another of 8.14 acres, seven times. The sprayer was a one-horse, four-row, home-made affair carrying four nozzles per row, A four-row check was left in each field. The bordeaux used was of the 6-10-45 formula. Paris green for bugs was applied once on the sprayed rows, also once on the check rows. Both kinds of blight were absent. There was some tip burn, but the chief trouble was flea beetles which were quite plentiful. Toward the close of the season the difference in appearance between sprayed and unsprayed rows became quite noticeable in both fields.

The expense of spraying 6.33 acres six times and 8.14 acres seven times was as follows:

555	lbs. copper sulphate @ 6½c	$36 08
3½	bbls. lime @ $1.25	4 38
30	lbs. paris green @ 25c	7 50
13	days labor for man @ $1.50	19 50
13	days labor for horse @ $1	13 00
	Wear of sprayer	5 00
	Total	$85 46

The test rows (Carman No. 3) showed the following yields:

Field No. 1.— Sprayed six times. Rows 442 x 3 feet.

One sprayed row, 246 lbs.= 134.7 bu. per acre.

One unsprayed row, 214 lbs.= 117.2 bu. per acre.

Gain, 17.5 bu. per acre.

Field No. 2.— Sprayed seven times. Rows 546 x 3 feet.

One sprayed row, 340 lbs.= 150.7 bu. per acre.

One unsprayed row, 245 lbs.= 108.6 bu. per acre.

Gain, 42.1 bu. per acre.

In the two tests the average gain per acre was 29.8 bu. worth, at 45 cents per bu., $13.41. In one field the expense of spraying was $5.40 per acre and in the other $6.30, the average being $5.85 per acre. Subtracting this sum from $13.41 leaves *a net profit of $7.56 per acre.*

THE EAST SYRACUSE EXPERIMENT.

Conducted by M. W. Garrett, East Syracuse, N. Y. Four and one-half acres of potatoes, variety Norcross, were sprayed three times — July 9, 16 and 26. The sprayer used was a one-horse, four-row "Iron Age" sprayer carrying one nozzle per row. The bordeaux was of the 6-6-50 formula made with water pumped by hand from a well about twenty rods from the field. Paris green, at the rate of one pound to fifty gallons, was used with the bordeaux in all three sprayings. The four check rows, also, were treated with paris green three times — July 9, 18 and 30. Both kinds of blight and flea beetles were absent. Throughout the season the foliage on the sprayed rows was slightly inferior to that on the unsprayed rows. Apparently the plants were slightly injured by spraying. This strange condition was observed also in Mr. Garrett's 1908 experiment.[6] Mr. Garrett now suspects that the trouble, in both seasons, was due to the use of a poor grade of hydrated lime. In the future he will use lump lime.

The expense account contained the following items:

100 lbs. copper sulphate @ 6c	$6 00
100 lbs. hydrated lime	45
10 lbs. paris green @ 25c	2 50
10 hrs. labor for man @ 25c	2 50
10 hrs. labor for horse @ 15c	1 50
Wear of sprayer	5 00
Total	$17 95

Average expense of three sprayings, $3.99 per acre.

The test rows (425 x 3 ft.) yielded as follows:

Two sprayed rows,[7] 449.5 lbs.= 130.9 bu. per acre.

One unsprayed row, 235.25 lbs.= 136.9 bu. per acre.

Loss, 6 bu. per acre.

At sixty cents per bu. six bu. of potatoes have a value of $3.60. To this must be added the expense of spraying, $3.99 per acre, which makes the *total loss* $7.59 *per acre.*

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[6] See Bul. 311 of this Station, page 22.

[7] One row north of check, 202.5 lbs.; the other south of check, 247 lbs.

THE OGDENSBURG EXPERIMENT.

Conducted at Ogdensburg, N. Y., by Andrew Tuck who sprayed 5.7 acres of potatoes seven times on the following dates: July 19, 26, August 2, 10, 21, 30 and September 9. 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 about 96 rods from the field. Paris green (2½ lbs. to 50 gallons) was used with the bordeaux in four sprayings. The three check rows, also, were treated four times with paris green. When this experiment was examined by one of the writers on August 31 there appeared to be but little if any difference between sprayed and unsprayed rows. There was some tip burn and some injury by flea beetles. Later, Mr. Tuck reports that blight was absent and that there was no contrast between sprayed and unsprayed rows. No rotten tubers were found at digging time.

The expense account contained the following items:

140 lbs. copper sulphate @ 7c	$9 80
140 lbs. lime	1 75
40 lbs. paris green @ 25c	10 00
45 hrs. labor for man @ 15c	6 75
45 hrs. labor for horse @ 5c	2 25
Wear of sprayer	1 00
Total	$31 55

The test rows were of the variety Rural New Yorker No. 2. They were 936 ft. long by 3 ft. wide. The yields were as follows:

One sprayed row, 626 lbs.=161.8 bu. per acre.

Middle unsprayed row, 556 lbs.=143.7 bu. per acre.

Gain, 18.1 bu. per acre.

Potatoes being worth 50 cents per bushel at time of digging the test rows (October 5), the market value of the gain was $9.05. After subtracting the expense of spraying, $5.53 per acre, there remains *a net profit of* $3.52 *per acre.*

THE CHATEAUGAY EXPERIMENT.

Conducted by O. Smith & Son, Chateaugay, N. Y. Twelve acres were sprayed three times with 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 being pumped by hand from a stream at one side of the field. Arsenite of soda (2½ to 3 qts. in 50 gals.) was used with the bordeaux in two sprayings. A few rows on each side of the checks received a fourth spraying on September 11. The checks consisted of two unsprayed strips of three rows each. On these rows three applications of paris green kept bugs completely under control. On September 1 there was very little difference between sprayed and unsprayed rows. In fact there was no marked contrast at any time during the season. There were traces of early blight, some flea beetle injury and a severe attack of tip burn, but no late blight. The variety was Sir Walter Raleigh.

The expense account contained the following items:

222	lbs. copper sulphate @ 7¾c	$17 20
1½	bbls. lime @ $1.10	1 65
120	lbs. sal soda @ 1c	1 20
30	lbs. white arsenic @ 10c	3 00
14¾	hrs. labor for man @ 15c	2 21
12¾	hrs. labor for horse @ 15c	1 91
	Wear on sprayer	10 00
	Total	$37 17

The test rows gave the following yields:

East test.— Rows 609 ft. long by 3 ft. wide.

Two sprayed rows,[8] 1,295 lbs.=257.3 bu. per acre.

Middle unsprayed row, 467 lbs.=185.6 bu. per acre.

Gain, 71.7 bu. per acre.

West test.— Rows 542 ft. long by 3 ft. wide.

Two sprayed rows,[9] 1,469 lbs.= 327.8 bu. per acre.

Middle unsprayed row, 577 lbs.= 257.3 bu. per acre.

Gain, 70.5 bu. per acre.

The average gain was 71.1 bu. per acre worth $28.44. Subtracting the expense of four sprayings, $4.13 per acre, we have *a net profit of* $24.31 *per acre.*

[8] Both on same side of check; 642 lbs. and 653 lbs.
[9] One on either side of check; 715 lbs. and 754 lbs.

THE PLATTSBURGH EXPERIMENT.

Conducted by Pardy Bros., Plattsburgh, N. Y. Ten acres of potatoes (variety, Rose of Erin) were sprayed five times — July 1, 13, August 7, 30 and September 4. Two of the ten acres received one additional spraying on July 2. The spraying was done with a two-horse, six-row "Aroostook" sprayer carrying one nozzle per row. The bordeaux was of the 6–6–50 formula. The water required was pumped by hand and hauled about one hundred rods. A strip of six rows was left unsprayed for a check. These rows received five applications of paris green on the same dates that the sprayed rows received arsenite of soda with the bordeaux. Early blight, flea beetles, bugs, grass-hoppers, tip burn and spray injury were all factors in this experiment. In an attempt to destroy the hordes of bugs and grass-hoppers arsenite of soda stock solution was used with the bordeaux in the dangerously large quantity of 4 quarts to 50 gallons. As a consequence, the foliage was consideraby injured. Yet neither bugs nor grass-hoppers were controlled in a satisfactory manner.[10] The sprayed rows appeared somewhat better than the unsprayed, but the difference was not great.

The expense account contained the following items:

310	lbs. copper sulphate @ 5c	$15 50
1½	bbls. lime @ $1	1 50
85	lbs. sal soda @ 1c	85
42	lbs. white arsenic @ 10c	4 20
59	hrs. labor for man @ 17½c	10 33
38	hrs. labor for team @ 20c	7 60
	Wear of sprayer	7 50
	Total	$47 48

The test rows (400 ft. by 34 in.) yielded as follows:

One sprayed row, 190 lbs. = 121.9 bu. per acre.

One unsprayed row, 135 lbs. = 86.6 bu. per acre.

Gain, 35.3 bu. per acre.

The gain of 35.3 bu. had a value of $17.65. Subtracting $4.56, the expense of spraying, leaves *a net profit of* $13.09 *per acre.*

[10] Owing to the ravages of insects there is some doubt as to the propriety of including this experiment.

THE GREENWICH EXPERIMENT.

Conducted by P. C. Billings, Greenwich, N. Y. Six and one-half acres of potatoes were sprayed three times — July 30, August 12 and 24. In the first two sprayings the bordeaux used was of the 5–6–50 formula; in the third spraying, 6–6–50. The sprayer was a two-horse, six-row "Aroostook" carrying one nozzle per row. The water supply was nearby and the pumping done by a windmill. There were three check rows. They received four applications of paris green, while on the sprayed rows paris green was used only once. Bugs were kept under control. Tip burn was severe. Considerable damage was done by flea beetles, also, some by early blight; but there was no late blight and no rot. When last seen by one of the writers on September 4th the sprayed rows appeared slightly better than the unsprayed ones. Mr. Billings reports that before the close of the season there was considerable difference.

The items of expense were as follows:

100 lbs. copper sulphate @ 6½c	$6 50
100 lbs. lime @ 1⅓c	1 33
8 lbs. paris green @ 22½c	1 80
12 hrs. labor for man @ 20c	2 40
12 hrs. labor for team @ 30c	3 60
Wear on sprayer	2 50
Total	$18 13

Average expense of three sprayings, $2.79 per acre.

The test rows were of the variety Knoxall. They were 461 ft. long by 3 ft. wide. The yields were as follows:

Two sprayed rows,[11] 729 lbs.= 191.3 bu. per acre.

Middle unsprayed row, 355 lbs.= 186.3 bu. per acre.

Gain, 5 bu. per acre.

The expense of spraying being $2.79 per acre and the value of the increased yield (5 bu. at 50 cents) only $2.50, the spraying in this experiment appears to have been done at *a loss of 29 cents per acre.*

[11] One on either side of the check; 331 lbs. and 398 lbs.

THE GLENHEAD EXPERIMENT.

Conducted by G. T. Powell, Glenhead, Long Island. Fourteen acres of potatoes were sprayed five times on the following dates: June 15, 26, July 13, 26 and August 6. The sprayer used was a one-horse, four-row "Spramotor" carrying two nozzles per row. The bordeaux contained one pound of copper sulphate in each eight gallons. The facilities for the preparation of the bordeaux were convenient. The water was pumped by a gasoline engine from a well close by the potato field. A strip of four rows was left unsprayed for a check. Bugs were not troublesome. They were controlled on the sprayed rows by adding three quarts of arsenite of soda stock solution to each fifty gallons of bordeaux in the first two sprayings and on the check rows by one application of paris green made on June 15.

The contrast between sprayed and unsprayed rows was not great. There was no late blight. The important troubles were drought injury (tip burn) and flea beetle injury. The potatoes were of the variety Uncle Sam.

The expense account contained the following items:

375 lbs. copper sulphate @ 5c	$18 75
2 bbls. lime @ $1.25	2 50
100 lbs. sal soda @ 1¼c	1 25
20 lbs. white arsenic @ 10c	2 00
40 hrs. labor for man @ 20c	8 00
40 hrs. labor for horse @ 10c	4 00
Wear of sprayer	5 00
Total	$41 50

The test rows (560 ft. by 30 in.) yielded as follows:

One sprayed row, 310 lbs.= 160.7 bu. per acre.

One unsprayed row, 207 lbs.= 107.3 bu. per acre.

Gain, 53.4 bu. per acre.

Potatoes being worth seventy-five cents per bushel at digging time, the gain of 53.4 bu. had a value of $40.05. Subtracting the expense of spraying, $2.97 per acre, we have left *a net profit of* $37.08.

THE JAMESPORT EXPERIMENT.

Conducted by Henry A. Hallock, near Jamesport, Long Island. Twenty acres of potatoes were sprayed five times. The sprayer used was a one-horse, four-row Hudson sprayer carrying two nozzles per row. The dates of spraying were June 7, 20, July 9, 21 and 29. The bordeaux was made by the 7-4-50 formula. The water required was pumped by a gasoline engine and hauled ten to fifty rods. In the first two sprayings arsenite of soda was used with the bordeaux at the rate of four quarts of the stock solution to fifty gallons of bordeaux. There were four check rows. These received paris green twice — June 9 and 20. Throughout the 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 only trouble was dry-weather injury.

The expense account contained the following items:

700	lbs. copper sulphate @ 5c	$35 00
2	bbls. lump lime and 350 lbs. hydrated lime	6 75
200	lbs. sal soda @ ¾c	1 50
50	lbs. white arsenic @ 5¼c	2 63
5	days labor for man @ $2	10 00
5	days labor for horse @ $1	5 00
	Wear on sprayer	5 00
	Repairs on sprayer	2 50
	Total	$68 38

The test rows (variety, Green Mountain) were 455 ft. long by 3 ft. wide. They yielded as follows:

Two sprayed rows,[12] 409 lbs.=108.8 bu. per acre.

Two unsprayed rows, 349 lbs.=92.8 bu. per acre.

Gain, 16 bu. per acre.

At the time of digging the test rows the market price of potatoes was seventy-five cents per bushel. At this price sixteen bushels have a value of $12. After subtracting the expense of spraying, $3.42 per acre, there remains *a net profit of* $8.58 *per acre.*

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[12] One on either side of check.

THE SOUTHAMPTON EXPERIMENT.

Conducted by Lewis E. Downs, Southampton, Long Island. Sixty-seven 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 21, 26, July 3, 9, 14, 20, 27 and August 2. The bordeaux used was prepared by the formula, six pounds copper sulphate in fifty gallons of water with sufficient lime added to satisfy the potassium ferrocyanide test. It was necessary to haul water about forty rods. An engine was used in pumping it. In two sprayings (the first and third) three quarts of arsenite of soda stock solution were added to each fifty gallons of the bordeaux. There were four unsprayed rows which were treated twice with paris green — on June 26 and July 2. There was no late blight, but early blight, tip burn and flea beetles were plentiful. During the latter part of the growth period the check rows were so much inferior to the sprayed ones that the contrast was very marked.

The expense of spraying sixty-seven acres eight times was as follows:

3,081	lbs. copper sulphate @ 5½c	$169 45
3,081	lbs. lime @ 1c	30 81
600	lbs. sal soda @ 1c	6 00
150	lbs. white arsenic @ 5c	7 50
3	days labor (preparing arsenic solution) @ $3	9 00
24	days labor for man @ $2	48 00
24	days labor for team @ $2	48 00
	Wear on sprayer	10 00
	Wear on tanks and pumping outfit	5 00
	Total	$333 76

The test rows were of the variety Carman No. 1. They were 1,200 feet long by 33 inches wide. The yields were as follows:

Two sprayed rows, 2,270 lbs. = 249.7 bu. per acre.

Two unsprayed rows, 1,670 lbs. = 183.7 bu. per acre.

Gain, 66 bu. per acre.

The market price of potatoes at digging time was sixty-five cents per bushel. Accordingly the gain of sixty-six bu. had a value of $42.90. After deducting the expense of spraying, $4.98 per acre, there remains *a net profit of $37.92 per acre.*

SUMMARY OF BUSINESS EXPERIMENTS IN 1909.

TABLE XX.— SHOWING RESULTS OF BUSINESS EXPERIMENTS IN 1909.

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
	A.		Bu.			
Southampton	67	8	66.	$4 98	$0 62	$37 92
Glenhead	14	5	53.4	2 97	60	37 08
Chateaugay	12	4*	71.1	4 13	1 03	24 31
Plattsburgh	10	5	35.3	4 56	91	13 09
Jamesport	20	5	16	3 42	68	8 58
Sterling Station	14.44	6–7	29.8	5 85	90	7 56
Ogdensburg	5.7	7	18.1	5 53	79	3 52
Elmira	22	2	6.9	1 65	83	1 80
Greenwich	6.5	3	5.	2 79	93	— 29
Batavia	15	6	—1.6	3 71	62	—4.51
Victor	12	8†	—1.6	6 27	78	—6.91
East Syracuse	4.5	3	—6.	3 99	1 33	—7.59

* Test rows sprayed four times, balance of field, three times.
† Test rows double-sprayed four times, balance of field twice.

Average increase in yield per acre, 24.4 bushels.
Average net profit per acre, $9.55.

SUMMARY OF BUSINESS EXPERIMENTS, 1903–1909.

TABLE XXI.— SHOWING RESULTS OF BUSINESS EXPERIMENTS, 1903–1909.

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.
		A.	Bu.			
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
1909	12	203.14	24.4	4 15	835	9 55

Average increase in yield, for seven years, 41.1 *bu. per acre.*
Average net profit, for seven years, $16.77 *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 two 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 twelve volunteer experiments reported in 1909:

TABLE XXII.—SHOWING RESULTS OF VOLUNTEER EXPERIMENTS IN 1909.

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.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	
1	Canton	H. E. Cook	6.5	9	376.2	248.5	127.7	107	40	8-row, 2-horse, Mascot.
2	Fayetteville	F. E. Dawley	7	5	322.7	198	124.7	......	60	4-row, 2-horse, Watson.
3	West Rush	T. E. Martin	18	?	314.5	255	59.5	......	50	6-row, 1-horse, home-made.
4	Lancaster	F. W. Handy	9	5	204.3	158.7	45.6	......	60	4-row, 2-horse, Iron Age.
5	Dewittville	G. A. Kirkland	5.5	6	166.9	122.1	44.8	117	50–60	4-row, 1-horse, Spramotor.
6	Phelps	J. L. Salisbury	12	4	140.2	96.7	43.5	104	45	6-row, 2-horse, Aroostook.
7	Spencerport	F. E. Gott	12	3	285.6	257.6	28	......	40	4-row, 1-horse, Aspinwall.
8	Dryden	D. R. Trapp	8	6	288	264	24	......	50	4-row, 2-horse, Iron Age.
9	Memphis	M. Bowes	12	4	228.7	207.8	21	86	45	4-row, 1-horse, home-made.
10	La Fargeville	F. Lantier	15	4	106.1	95.5	10.6	......	50	4-row, 1-horse, Watson.
11	Peru	J. Mannix	4	3	125.9	122.8	3.1	60	50	5-gallon, compressed air.
12	Cutchogue	W. W. Sterling	6	4	338.8	338.8	0	......	60–75	4-row, 1-horse, Hudson.

ADDITIONAL NOTES ON THE VOLUNTEER EXPERIMENTS IN 1909.

Experiment No. 1. This experiment was conducted on the farm of the New York State School of Agriculture at St. Lawrence University, Canton, N. Y. The chief features of the experiment are the thoroughness of the spraying and the remarkably large increase in yield when tip burn was the only important foliage trouble present. In nine applications the total quantity of bordeaux used was 875 gallons per acre.[13] The pumping was done by a 3 H. P. "Mascot" gasoline engine and a high pressure (75 to 100 lbs.) maintained.

The total expense of spraying was $9.49 per acre, the items being as follows:

Labor	$2 64
Copper sulphate	5 50
Lime	35
Wear of sprayer	1 00
Total	$9 49

With potatoes selling at 40 cents per bushel the net profit from spraying was $41.57 per acre.

Experiment No. 2. The chief troubles affecting the foliage were tip burn and flea beetles. The materials required for spraying were "most of one barrel of lime, 40 lbs. arsenate of lead and about 120 lbs. of copper sulphate." At each application one man and a team did the spraying all in one day.

Experiment No. 3. The exact number of applications is uncertain, but it is known that the total quantity of bordeaux used on 18 acres was 18,425 gallons, which is at the rate of 1,023½ gal-

[13] An account of this experiment has been published previously ([Cook, H. E.] Circular of information of the New York State School of Agriculture at St. Lawrence University, Canton, N. Y. *University Bulletin,* Series 4, No. 2, pp. 49–51. Apr. 1910.) On page 51 of this publication there is a table which purports to show the number of gallons of bordeaux applied per acre in each spraying, the total being 4175 gallons. Dean Cook informs us that this is an error and that the quantities given are for the entire field (nearly five acres) not per acre

lons per acre. The items of expense for spraying 18 acres throughout the season were as follows:

1,675	lbs. copper sulphate @ $4.85 per cwt	$81 24
	Freight on copper sulphate	2 01
15	bbls. Ohio lime	15 75
25	days labor for man and horse @ $3	75 00
	Total	$174 00

Total expense of spraying per acre, $9.67.

There was no blight, but flea beetles were very troublesome and considerable damage was caused by tip burn. The market price of potatoes being 50 cents per bushel the net profit from spraying in this experiment was $20.08 per acre. Five rows which were double sprayed, receiving 2,047 gals. per acre, yielded at the rate of 27 1/5 bu. more than single-sprayed rows and the net profit was thereby increased to $24.01 per acre. But, one row which was triple-sprayed, receiving 3,070 gals. per acre, yielded at the rate of 25½ bu. per acre *less* than unsprayed rows. It is unlikely that this reduction in yield was due to spraying, but the real cause is unknown.

Experiment No. 4. There was no blight, but flea beetles were plentiful.

Experiment No. 5. Tip burn, which was quite prevalent, appeared to be considerably checked by spraying. There was no late blight and flea beetles were not particularly troublesome. The expense of spraying was as follows:

266	lbs. copper sulphate @ 5½c	$14 63
17½	lbs. paris green @ 22½c	3 94
6	sacks lime @ 25c	1 50
74	hrs. labor for man and horse @ 25c	18 50
	Total	$38 57

Experiment No. 6. Mr. Salisbury doubts that the difference in yield of sprayed and unsprayed rows was all due to spraying. Although poison was applied to the unsprayed rows twice and seemed very effective in destroying the bugs, the unsprayed rows may have been injured a little more by bugs than were the sprayed rows. However, it appears that the difference was not great enough to warrant the rejection of the experiment. There was no late blight, but flea beetles were numerous.

Experiment No. 7. There was no blight and but few flea beetles in this experiment.

Experiment No. 8. Tip burn was more injurious on the unsprayed than on the sprayed rows. The unsprayed rows were not injured by bugs, there were few flea beetles and no blight. The expense for spraying materials was as follows:

240 lbs. copper sulphate @ 6c	$14 40
30 lbs. paris green @ 25c	7 50
300 lbs. lime	1 80
Total	$23 70

Experiment No. 9. In the eight-acre field containing the test rows the total cost of four sprayings was $27.64 for labor and materials. There were four unsprayed rows 643 feet long. The amount of the increase in yield due to spraying was computed from the difference in yield between the middle two unsprayed rows and the second and third sprayed rows on either side as follows:

Two sprayed rows on the left, 1,206 lbs.

Two sprayed rows on the right, 1,226 lbs.

Middle two unsprayed rows, 1,106 lbs.

There was no blight and but few flea beetles.

Experiment No. 10. Tip burn was quite general, but there was no blight and flea beetles were not troublesome.

Experiment No. 11. The plants were free from blight and flea beetles.

Experiment No. 12. At one end of the field where there had been potatoes the previous year, some kind of blight injured the unsprayed rows somewhat more than the sprayed ones. Flea beetles were plentiful. Yet there was no difference in yield. Two unsprayed rows 600 feet long yielded 14 bushels while two sprayed rows adjacent on the west side yielded 13½ bushels and two other sprayed rows adjacent on the east side yielded 14½ bushels.

SUMMARY OF VOLUNTEER EXPERIMENTS, 1904–1909.

The following table shows the results obtained in the volunteer experiments during the past six years — 1904 to 1909, inclusive:

TABLE XXIII.— SHOWING RESULTS OF VOLUNTEER EXPERIMENTS, 1904–1909.

YEAR.	Number of experiments.	Total area sprayed.	Average gain per acre due to spraying.		Average market price per bushe of potatoes at digging time.
		A.	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
1909	12	115	44	22	51

Average gain for 6 years (200 experiments), 52 bu. per acre.

POTATO TROUBLES IN NEW YORK IN 1909.

Over the entire State the season of 1909 was a very dry one. At Geneva the total rainfall from June 1 to October 1 was 8.64 inches, the least amount recorded since 1882. Consequently, tip burn, or the browning of the tips and margins of the potato leaves, was widespread and caused much damage. Next in importance were the flea beetles which, in many cases, were very numerous and destructive. The browning of the leaves due to the combined effect of tip burn and flea beetle injury was frequently mistaken for blight. Of the real potato blight there was but little. Traces of early blight (*Alternaria solani*) occurred in a considerable number of fields, but it was destructive in only a few instances. Late blight (*Phytophthora infestans*) and the rot which follows it were entirely absent. The writers realize that a positive statement of this kind can rarely be made with assurance of its accuracy, but in the present case the circumstances seem to warrant it. We neither saw nor heard of any late blight or Phytophthora rot any where in the State, not even on Long Island where the disease occurs almost every year. Moreover, in the latter part of the season the weather was so uniformly dry as to preclude the possibility of the occurrence of late blight.

DIRECTIONS FOR SPRAYING.[14]

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 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.

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[14] Copied from Bulletin No. 290, p. 320. The experiences of the past three seasons do not warrant any material alteration in the recommendations there made.

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.