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DEPARTMENT OF HORTICULTURE

Fertilizer Experiments with Tomatoes

BY
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BULLETIN 142

Fertilizer Experiments With Tomatoes

A. L. DACY.

The growing of tomatoes for the cannery, is an industry of considerable magnitude in Morgan County, West Virginia. The 30 or more canneries which are scattered throughout the county are in most cases located on the farm of the owner. Each cannery packs the product of from 25 to 200 acres of tomatoes, the owner usually growing from five to ten acres himself and contracting with his neighbors who grow the balance of his pack which varies from three to thirty-five car loads per year. The average yield of tomatoes per acre for the county is very small, not exceeding 150 bushels.

It was for the purpose of studying the needs of the tomato crop as grown on the soils of this County, and to find means of increasing the yield per acre that in the spring of 1909, W. M. Munson, then Horticulturist of the Station, outlined a series of fertilizer experiments, the results of which are reported in this bulletin. He made arrangements with several of the most progressive growers of the county, whereby they were each to furnish an acre or more of land on which the tests could be carried out, the Station agreeing to furnish the fertilizer and in some cases, to supervise the tests. Owing to Professor Munson's subsequent illness and death, which took place in the fall of that year, the carrying out of the details of the field work devolved upon the writer, who continued the experiments (with modifications) during 1910 and 1911.

The growers who co-operated with the Station in the tests included Messrs. P. W. Atkinson, Eli Rice, Michael Bros., I. N. Spielman, Jos. P. Hovermale, Chas. H. Rockwell, The Berkeley Springs Orchard Co., Wm. C. Grove, H. B. Hovermale, H. M. Ruppenthal, and Jos. A. Fearnow. The Station is also indebted to Mr. W. H. Brady, who furnished facilities for storing and mixing the fertilizer. The writer takes pleasure in acknowledging the assistance rendered and the many courtesies shown him by these gentlemen during the progress of the work. As the tests varied considerably from year to year, the data of each year will be presented by itself.

TESTS OF 1909.

In selecting the fields for the fertilizer plots care was taken to get as uniform soil conditions as possible. The different series of plots were typical of both the upland and the bottom soils that are found in the county, the latter being somewhat heavier and more fertile than the former. All were a shaly clay loam.

In seven of the eleven fields used, the plots were one-tenth of an acre in area and varied from eleven to thirteen in number. Four of the fields were one acre in extent and were divided into eight plots in each case. In all cases the fertilizer was weighed and mixed by the writer about ten days before it was applied, and placed in bags labeled in each case with the fertilizer it contained and the number of the plot to which it was to be applied. In the case of the seven fields first mentioned, the writer staked out the plots, applied the fertilizer and weighed all of the ripe and diseased fruit. In the case of the four fields mentioned above, the grower staked out the plots, applied the fertilizer and recorded the yields on blanks furnished by the writer.

The usual practice among the growers in this section is to plant the tomato seed in drills about a foot apart in the open ground in early April on a specially prepared garden spot or on a piece of ground where a brush heap has been burned. About the middle of May the tomato fields are plowed and harrowed and marked off both ways with a single shovel plow. About 200 lbs. to the acre of a fertilizer analyzing usually about 1% nitrogen, 7% to 9% phosphoric acid and 1% to 5% potash is then dropped at the intersection of the furrows made with the shovel plow and covered at once with a double shovel plow such as is used to cover corn. Planting usually takes place the first week in June.

In the case of the first series of plots mentioned above, one-half of the fertilizer was applied a few days before planting on all plots except the first (and in one other case noted below). The full amount of fertilizer was applied to plot one in a single application. The other half of the fertilizer was applied about two weeks after the plants had been set, being scattered around each plant and cultivated into the soil. The kind and amount of fertilizer applied to each plot in each field was as follows:

Plot 1.—20 lbs. of the brand of commercial fertilizer used by grower.

Plot 2.—25 lbs. Cottonseed Meal.

Plot 3.—10 lbs. Nitrate of Soda.

Plot 4.—20 lbs. Muriate of Potash.

Plot 5.—30 lbs. 14% Acid Phosphate.

Plot 6.—Check—Unfertilized.

Plot 7.—25 lbs. Cottonseed Meal.
30 lbs. Acid Phosphate.

Plot 8.—10 lbs. Nitrate of Soda.
30 lbs. Acid Phosphate.

Plot 9.—20 lbs. Muriate of Potash.
30 lbs. Acid Phosphate.

Plot 10.—10 lbs. Nitrate of Soda.
20 lbs. Muriate of Potash.

Plot 11.—10 lbs. Nitrate of Soda.
20 lbs. Muriate of Potash.
30 lbs. Acid Phosphate.

Plot 12.—40 lbs. of a 3-8-4 Commercial Fertilizer.

Plot 13.—60 lbs. of a 3-8-4 Commercial Fertilizer.

The plots were picked over at intervals of about one week from the middle of August to the middle of October. The detailed results of the various tests are shown in the following tables. The number of healthy (producing) plants was counted on each plot about the middle of September. The actual yield of the plots is given in pounds in each case except the "corrected yield of usable fruit." This was obtained for each plot by dividing the actual yield by the number of healthy plants in the plot and multiplying the result by the average number of healthy plants per plot for the whole field. The diseased fruit was that affected with blossom-end rot. The weight of green fruit was calculated from the weight of one row that was picked in each plot. The value of the increase per acre in the product of each fertilized plot over the unfertilized plot is given in each table, calculating the value of the crop at 25c per bushel, the average price paid by the canners. In the case of a decrease the plot is marked thus *. The cost of fertilizer per acre in the tables was based on the following price per ton for the various materials (including freight from Baltimore). Nitrate of Soda $62. Muriate of Potash $47. Sulphate of Potash $57. Cottonseed Meal $42. 14% Acid Phosphate $14. 3-8-4 Commercial Fertilizer $32, and 1.65-8-5 Commercial Fertilizer $27. The net value per acre of the increased product on the fertilized plots was obtained by deducting the cost of the fertilizer used from the gross increase in value.

Test With Mr. P. W. Atkinson.

This test was carried out on bottom land that had been in tomatoes the previous year, following sod. The plots were planted with B. B. (Bolgiano's Best) variety. The analysis of the fertilizer used on plot one was given as .82% nitrogen, 9% available phosphoric acid and 3% potash. It cost $21 per ton.

TABLE I. *Result of 1909 Test with Mr. P. W. Atkinson.*

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.	Value of Increase Per Acre Over Check Plot (No. 6)	Cost of Fertilizer Per Acre.	Net Value of Increase Per Acre From Use of Fertilizer.
1.	255	534.4	2.3	73.	610.7	524.7	.3	$10.93	$2.10	$ 8.83
2.	253	172.4		108.	280.4	170.7		*.38	5.25	*5.63
3.	253	184.8		104.	288.8	182.9		*.33	3.10	*3.43
4.	237	141.2		64.	205.2	149.2		*.47	4.70	*5.17
5.	254	726.	7.	88.	822.	716.	.8	18.91	2.10	16.81
6.	243	254.4	.4	88.	342.8	262.2	.1			
7.	252	837.	9.6	91.	937.6	832.	1.	23.74	7.35	16.39
8.	253	803.9	9.8	70.	883.7	795.9	1.1	22.23	5.20	17.03
9.	254	950.	9.6	104.	1063.6	937.	.9	28.11	6.80	21.31
10	246	295.1	.5	89.	384.6	300.5	.1	1.57	7.80	*6.23
11.	251	955.2	15.2	112.	1082.4	953.3	1.4	28.79	9.90	18.69
12.	254	863.4	7.8	100.	971.2	851.5	.8	24.55	6.40	18.15
13.	251	911.8	31.8	168.	1111.6	909.9	2.8	26.98	9.60	17.38

*Decrease.

Test With Michael Bros.

This test was made on upland soil in a field that had been in pasture in 1907. The land occupied by all plots but 1, 2 and 11 (which had been in tomatoes) had been in buckwheat in 1908. The fertilizer analyzing 10% available phosphoric acid and 2% potash, costing $15 a ton, had been applied to the land occupied by plot 1 before the plots were staked out, about two weeks before the fertilizer was applied to the other plots. The plants were of the B. B. variety.

TABLE II. *Result of 1909 Test with Michael Bros.*

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.	Value of Increase Per Acre Over Check Plot (No. 6)	Cost of Fertilizer Per Acre.	Net Value of Increase Per Acre From Use of Fertilizer.
1	357	916.	9.	250.6	1175.6	869.	.8	$26.28	$1.50	$24.78
2.	353	747.6	2.2	380.1	1129.9	717.2	.2	19.96	5.25	14.71
3.	351	736.7	5.7	466.1	1208.5	710.9	.5	19.69	3.10	16.59
4.	340	378.2	.8	416.8	795.8	376.7	.1	5.77	4.70	1 07
5.	338	557.6	5.5	364.	927.1	558.7	.6	13.35	2.10	11.25
6.	325	228.6		250.7	479.3	238.2				
7.	341	1105.6	17.6	316.4	1439.6	1098.1	1.2	35.82	7.35	28.47
8.	332	907.6	22.6	417.7	1347.9	925.9	1.7	28.65	5.20	23.45
9.	341	962.3	19.4	327.3	1309.	955.8	1.5	29.90	6.80	23.10
10.	332	744.5	1.	359.6	1105.1	759.5	.1	21.72	7.80	13.92
11.	316	1110.9	9.6	369.1	1489.6	1190.7	.6	39.68	9.90	29.78

Test With Mr. I. N. Spielman.

This test was planted on bottom land which was in sod in 1907 and in corn preceding the tomatoes. The fertilizer applied to plot

1 analyzed 1.65% nitrogen, 8% available phosphoric acid and 2% potash and cost $18 a ton. The following table gives the result of the test:

Table III. *Result of 1909 Test with Mr. I. N. Spielman.*

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.	Value of Increase Per Acre Over Check Plot (No. 6)	Cost of Fertilizer Per Acre.	Net Value of Increase Per Acre From Use of Fertilizer.
1.	221	632.6	9.6	72.	714.2	814.9	1.3	$30.79	$1.80	$28.99
2.	286	225.4		179.	404.4	224.3		6.18	5.25	.93
3.	261	168.2	.6	176.	344.8	183.4	.2	4.47	3.10	1.37
4.	254	166.2		152.	318.2	186.3		4.60	4.70	*.10
5.	266	526.6	3.	180.	709.6	563.6	.4	20.32	2.10	18.22
6.	270	72.		105.	177.	75.9				
7.	295	608.9	6.6	120.	735.5	587.6	.9	21.32	7.35	13.97
8.	331	940.	24.6	91.	1055.6	808.5	2.3	30.52	5.20	25.32
9.	323	1322.	7.6	125.	1454.6	1165.2	.5	45.38	6.80	38.58
10.	336	175.		110.	285.	211.1		5.63	7.80	*2.17
11.	333	1369.2	18.	200.	1587.2	1170.6	1.1	45.61	9.90	35.71
12.	311	784.6	8.2	124.	916.8	718.2	.9	26.76	6.40	20.36
13.	315	816.6	19.2	105.	940.8	738.	2.	27.58	9.60	17.98

*Decrease.

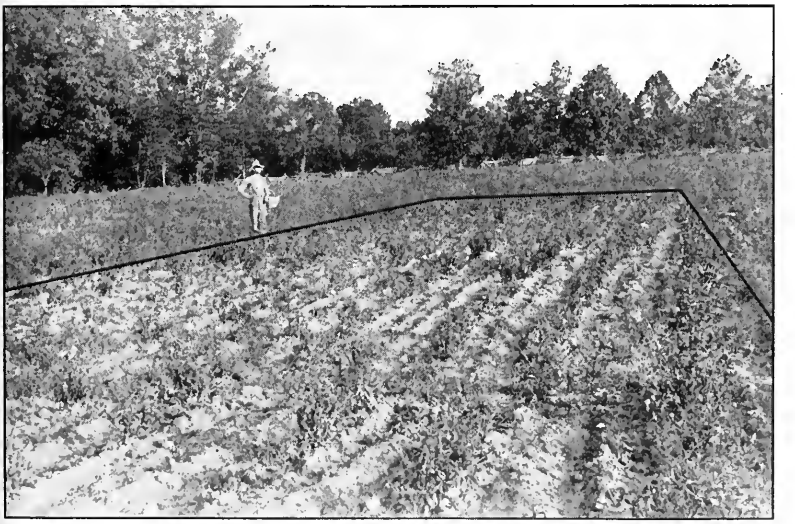

Fig. 1. Plot 6. Mr. I. N. Spielman's 1909 Test. Check. No Fertilizer. Yield 12.6 Bushels Per Acre. Photo Taken August 25, 1909.

Tests With Mr. Chas. H. Rockwell.

Two fields were planted for Mr. Rockwell, one of eleven and one of thirteen plots. Both fields were of the upland type, the latter being at a considerably higher elevation than the former and of more stony ground. Field number one had been in grass the previous

year and had received an application of about 1000 pounds of lime to the acre after having been plowed in 1909. Field number two was in a five year old apple orchard, each plot occupying the space between two rows of trees. It had been in clover the previous year. The fertilizer applied to plot 1 of each field analyzed .82% nitrogen, 9% available phosphoric acid and 3% potash and cost $21 a ton. The yields of the two fields are given in the following tables:

TABLE IV. *Result of 1909 Test with Mr. C. H. Rockwell.*

Field No. 1.

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.	Value of Increase Per Acre Over Check Plot (No. 6)	Cost of Fertilizer Per Acre.	Net Value of Increase Per Acre From Use of Fertilizer.
1.	337	1475.	81.6	358	1914.6	1451.3	4.2	$29.46	$2.10	$27.36
2.	334	1034.	40.2	462	1536.2	1026.5	2.6	11.76	5.25	6.51
3.	335	1065.	35.6	384	1484.2	1054.2	2.4	12.91	3.10	9.81
4.	329	1161.	22.8	388	1571.8	1170.1	1.4	17.74	4.70	13.04
5.	336	1037.8	56.6	336	1430.4	1024.1	3.9	11.66	2.10	9.56
6.	310	695.8	41.6	242	979.4	744.2	4.2			
7.	338	1038.	128.8	306	1472.8	1018.3	8.7	11.42	7.35	4.07
8.	338	1085.	180.6	294	1559.6	1064.4	11.5	13.34	5.20	8.14
9.	329	1156.4	141.	367	1664.4	1165.5	8.5	17.55	6.80	10.75
10.	334	948.8	107.8	368	1424.6	941.9	7.5	8.23	7.80	.43
11.	328	1495 8	181.2	522	2199.	1512.2	8.2	32.00	9.90	22.10

*Decrease.

TABLE V. *Result of 1909 Test with Mr. C. H. Rockwell.*

Field No. 2.

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.	Value of Increase Per Acre Over Check Plot (No. 6)	Cost of Fertilizer Per Acre.	Net Value of Increase Per Acre From Use of Fertilizer.
1.	303	890.8	115.2	88.	1094.	911.6	10.5	$ 2.07	$2.10	$ *.03
2.	299	724.	36.6	147.	907.6	750.9	4.	*4.62	5.25	*9.87
3.	304	957.6	54.4	243.	1255.	976.8	4.3	4.78	3.10	1.68
4.	317	1186.	58.8	283.	1527.8	1160.1	3.8	12.42	4.70	7.72
5.	318	1604.4	125.	244.	1973.4	1564.5	6.3	29.27	2.10	27.17
6.	314	872.8	51.8	272	1196.6	861.9	4.3			
7.	320	1338.2	124.	268	1730.2	1296.8	7.1	18.12	7.35	10.77
8.	322	1355.	130.6	274	1759.6	1304.9	7.4	18.45	5.20	13.25
9.	299	1133.	98.8	242	1473.8	1175.	6.7	13.04	6.80	6.24
10.	281	736.6	47.6	232	1016.2	812.9	4.7	*2.04	7.80	*9.84
11.	321	1447.8	187.2	302	1937.	1398.6	9.6	22.36	9.90	12.46
12.	317	1286.2	124.2	280	1690.4	1258.2	7.4	16.51	6.40	10.11
13.	317	1299.8	160.2	280	1740.	1271.5	9.2	17.06	9.60	7.46

*Decrease.

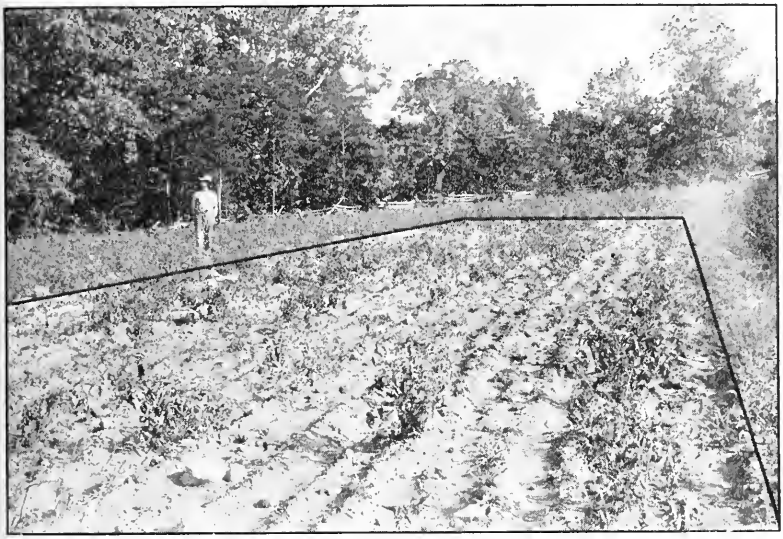

*Fig. 2. Plot 10. Mr. I. N. Spielman's 1909 Test. Nitrate of Soda and Muriate of Potash. Yield 35.2 Bushels Per Acre. Photo Taken August 25, 1909.

Test With Mr. Joseph P. Hovermale.

It was originally planned to break a piece of sod for this test, but Mr. Hovermale being unable to get it plowed in time it became necessary to use another field. Before it was decided to use this field some manure had been left in piles, distributed across all of the plots as afterwards staked out, with the exception of plots 1, 2 and 3. Plots 4, 5, 6, 7, 10 and 12 had received one pile, plots 8, 9 and 13 had received two piles and plot 11, four piles. The presence of the manure could be determined later in the season almost to a plant by the increased growth. For this reason the results of this test will not be included in the summary, but are given here as a matter of record. They follow the other fields quite closely in the relative effects of the different applications. The field was upland, very thin and decidedly lacking in organic matter. The yields from the plots were as follows:

*Note that while this plot yielded but 35.2 bushels per acre the plots on either side yielded 194.2 and 195.1 bushels per acre, respectively, bringing out very strikingly the need of phosphoric acid.

TABLE VI. *Result of 1909 Test with Mr. J. P. Hovermale*

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.
1.	301	175.6	1.	151.	327.6	172.6	.3
2.	308	132.4	.6	169.	302.	123.9	.2
3.	294	72.1	1.	104.	177.1	72.5	.5
4.	294	184.4	1.1	234.	419.5	185.6	.3
5.	305	460.6	7.4	294.	762.	446.8	.9
6.	314	188.2	2.	118.	308.2	177.3	.6
7.	298	448.2	30.	274.	752.2	445.	4.
8.	300	468.1	26.5	234.	728.6	461.7	3.6
9.	307	417.4	13.8	317.	748.2	402.3	1.8
10.	269	120.4	.6	229	350.	132.4	.2
11.	298	598.6	34.3	307	939.9	594.3	3.6
12.	279	486.2	23.5	259.	768.7	515.6	3.1
13.	280	430.2	23.2	239.	692.4	454.7	3.3

Test With Mr. Eli Rice.

This test was planted on bottom land. The field, which was in sod, was plowed about the 24th of May. It was planted with the Stone variety. On the 17th of June these plots suffered from the effects of a cloudburst, which caused the loss of some plants and retarded the growth of some others as they were badly covered with soil. For this reason the results of this test will not be considered in the summary but are presented as a matter of record. The plots behaved in much the same way as the other series of plots. The fertilizer used on plot 1 analyzed 1% nitrogen, 8% available phosphoric acid and 5% potash. The yields of the various plots were as follows:

TABLE VII. *Result of 1909 Test with Mr. Eli Rice.*

Number of Plot.	Number of Healthy Plants.	Yield of Usable Fruit.	Yield of Diseased Fruit.	Yield of Green Fruit.	Total Yield.	Corrected Yield of Usable Fruit.	Percentage of Diseased Fruit.
1.	270	527.6	6.	232.	765.6	510.	.8
2.	207	176.2	.4	120.	296.6	210.8	.1
3.	183	75.4		88.	163.4	107.5	
4.	276	229.2	1.9	192.	423.1	216.7	.4
5.	236	288.6	14.6	217.	520.2	319.1	2.8
6.	231	108.4	.2	116.	224.6	122.4	.1
7.	281	567.6	3.7	225.	796.3	527.2	.4
8.	298	577.8	3.6	471.6	1053.	506.	.3
9.	279	435.8	3.2	417.6	856.6	407.6	.3
10.	289	232.6	.4	333.	566.	210.	.1
11.	297	612.8	1.2	504.	1118.	538.5	.1
12.	277	363.4	6.	518.	887.4	342.4	.7
13.	269	654.4	18.	334.8	1007.2	634.9	1.7

Discussion of the Results of the Above Tests.

The following table presents for comparison the average gross increase in value per acre for each plot in the first five fields, and the average net increase in value per acre after deducting the cost of fertilizer:

Table VIII. *Showing average gross and net increase per acre from use of fertilizer in first five fields.*

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7
Gross Increase	$19.91	$6.58	$8.30	$8.01	$18.70	Check	$22.08
Net Increase	17.98	1.33	5.20	3.31	16.60	Check	14.73

	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12x	Plot 13x
Gross Increase	$22.63	$26.79	$7.02*	$33.69	$22.60	$23.87
Net Increase	17.43	19.99	3.89*	23.79	16.20	14.27

* Decrease. x Average of three fields.

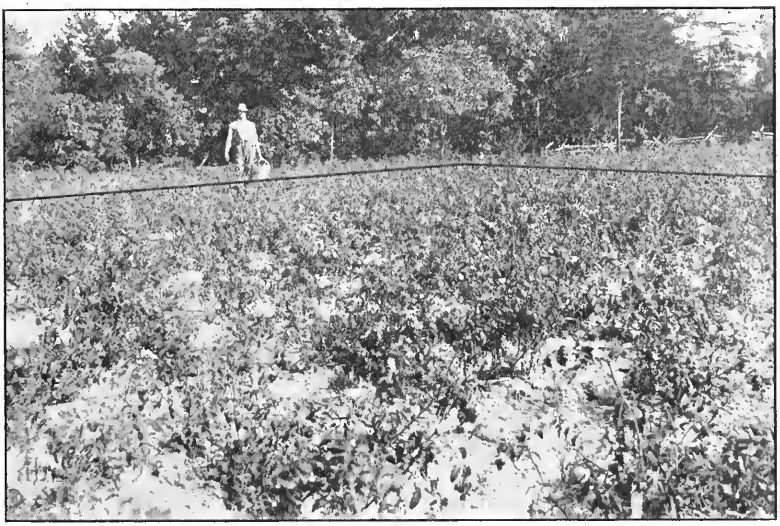

Fig. 3. Plot 8. Mr. I. N. Spielman's 1909 Test. Nitrate of Soda and Acid Phosphate. Yield 134.7 Bushels Per Acre. Photo Taken August 25, 1909.

It will be seen from an examination of the above table that in every case but plot 10 the fertilizers applied, gave an average net increase in the value of the product over that of the unfertilized or check plot, ranging from $1.33 to $23.79 per acre.

The largest increase was secured from plot 11 which was a home-mixed complete fertilizer costing more than that applied to any other plot. The plant food contained in this fertilizer was the equivalent of what would be found in a commercial fertilizer

analyzing 2.65% nitrogen, 7% phosphoric acid and 16% potash applied at the rate of 600 pounds to the acre.

The second largest net increase was obtained from the use of a combination of muriate of potash and acid phosphate used at the rate of 200 pounds of the former, and 300 pounds of the latter to the acre.

A comparison of plots 2, 3, 4, and 5 which were fertilized with the single elements nitrogen (in organic and mineral form), phosphoric acid and potash shows that by far the largest net increase was obtained from the use of 300 lbs. of acid phosphate to the acre, nitrate of soda, muriate of potash and cottonseed meal following in the order named.

Comparing plots 8, 9 and 10 with plot 11 the results show that in combination the different elements ranked in value as follows: phosphoric acid, potash and nitrogen.

The value of phosphoric acid is very strikingly illustrated in figures 1 to 6.

Comparing plots 2 and 3 and 7 and 8 the results show that both alone and in combination with acid phosphate, nitrogen in the mineral form (nitrate of soda) gave larger increases than in the organic form (cottonseed meal).

A comparison of plots 12 and 13 shows that the larger application of the 3-8-4 fertilizer (600 lbs. to the acre) did not give as large a net increase as the lighter application of 400 pounds to the acre.

Tests With Messrs. Joseph Fearnow, William C. Grove, H. B. Hovermale and H. M. Ruppenthal.

In addition to the foregoing tests, co-operative fertilizer tests were carried on in 1909 with Messrs. Joseph Fearnow, William C. Grove, H. B. Hovermale, and H. M. Ruppenthal. The Station furnished the fertilizer and the writer mixed the various ingredients for each plot and delivered it in bags properly labeled to the grower, who applied the fertilizer, tended the crop and recorded the yield on blanks furnished by the Station.

The kind and amount of fertilizer applied to the various plots in the four fields with the cost of the fertilizer per plot, was as follows:

Plot 1.—25 lbs. Sulphate of Potash.
37½ lbs. Acid Phosphate.
Cost of fertilizer per plot $ .97

Plot 2.—12½ lbs. Nitrate of Soda.
25 lbs. Sulphate of Potash.
37½ lbs. Acid Phosphate.
Cost of fertilizer per plot 1.35

Plot 3.—31 lbs. Cottonseed Meal.
25 lbs. Sulphate of Potash.
37½ lbs. Acid Phosphate.
Cost of fertilizer per plot 1.62

Plot 4.—31 lbs. Cottonseed Meal.
37½ lbs. Acid Phosphate.
Cost of fertilizer per plot .91

Plot 5.—Check—Unfertilized.

Plot 6.—25 lbs. of the grower's fertilizer.
Cost of fertilizer per plot .25

Plot 7.—50 lbs. Commercial Fertilizer analyzing 1.65-8-5
Cost of fertilizer per plot .67

Plot 8.—75 lbs. Commercial Fertilizer analyzing 1.65-8-5
Cost of fertilizer per plot 1.01

The following table shows the yield of usable tomatoes from the plots with the different growers, expressed in bushels per plot:

TABLE IX. *Yield of Usable Tomatoes in Bushels per Plot in 1909.*

Grower	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
Jos. Fearnow.....	27.9	29.4	33.8	36.8	17.5	36.8a	36.8	36.4
Wm. C. Grove.....	23.5	22.	21.5	16.5	12.	15.5b	21.	20.5
H. B. Hovermale..	18.5	21.	20.	17.5	11.5	18. c	19.	19.
H. M. Ruppenthal	*49	61.	60.	58.	33.	44. d	50.	52.

* These plots were located on new ground.
a. Analysis .82-9-3
b. Analysis 12-5
c. Analysis .82-7-1
d. Record not taken

The following tables show the value per acre of the increased yield from each fertilized plot over that from the unfertilized plot, reckoning the product at 25c per bushel, the net value per acre of the increase after deducting cost of fertilizer, and the average net value per acre of the increase for each plot in the test.

TABLE X. *Value per Acre of the Increase in Yield Over Plot 5.*

Grower	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
Jos. Fearnow.....	$20.80	$23.84	$32.64	$38.56	Check	$38.56	$38.56	$37.76
Wm. C. Grove.....	23.04	20.00	19.04	9.04	Check	7.04	18.00	17.04
H. B. Hovermale.....	14.00	19.04	17.04	12.00	Check	13.04	15.04	15.04
H. M. Ruppenthal.....	32.00	56.00	54.00	50.00	Check	22.00	34.00	38.00
Average	$22.44	$29.72	$30.68	$24.70	Check	$20.16	$26.40	$26.96

TABLE XI. *Net value per acre of increase from fertilized plots.*

Grower	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
Jos. Fearnow.....	$13.04	$13.04	$19.68	$31.28	Check	$36.56	$33.20	$29.68
Wm. C. Grove.....	15.28	9.20	6.08	1.76	Check	5.04	12.64	5.96
H. B. Hovermale.....	6.24	8.24	4.08	4.72	Check	11.04	9.68	9.96
H. M. Ruppenthal.....	24.24	45.20	41.04	42.72	Check	20.00	28.64	29.92
Average	$14.70	$18.92	$17.72	$20.12	Check	$18.16	$21.04	$18.88

Discussion of the Results of the Above Tests.

It will be seen from the figures in the last line of Table XI that the largest average net increase was secured from the use of 400 lbs. per acre of a 1.65-8-5 commercial fertilizer on the number 7 plot.

The next largest average net increase was that secured from the use of cottonseed meal and acid phosphate on the number 4 plot. A comparison of plots 2 and 3 indicates that it was more profitable to apply nitrogen in the form of the nitrate than in the organic form. A comparison of plots 7 and 8 shows that the application of 400 lbs. to the acre was more profitable than the 600 lbs.

TESTS OF 1910.

In 1910 tests were carried on with Messrs. Atkinson, Rockwell, Fearnow, and Grove. The fertilizer in every case was mixed by the writer and delivered to the grower in bags, properly labeled. It was applied all at one time by the grower who kept an account of the yield from each plot.

The kinds and amounts of fertilizer used were different in some cases from those used in 1909.

Tests With Messrs. Atkinson and Rockwell.

With both of these gentlemen two series of plots were planted; one on the same land occupied in 1909 by plots 5 to 13 (see Tables I and V) which will be designated as field number one, the other on land of the same type adjacent to the 1909 plots having also been planted with tomatoes in that year, which will be designated as field number two.

The cost of the fertilizers used in this year's tests was based upon the following prices per ton f. o. b. Berkeley Springs. Dried Blood, $61; Nitrate of Soda, $48; Muriate of Potash, $40; Sulphate of Potash, $47; Bone Meal, $27; Basic Slag, $17; Acid Phosphate, $14.25; 3-8-10 Commercial Fertilizer, $32; .65-6-3 Commercial Fertilizer, $16.50.

In field number one the treatment of the plots and the cost of the fertilizer was as follows, the 1909 numbers of the plots being retained:

Plot 5.—30 lbs. Acid Phosphate.
Cost of fertilizer per plot $ .21

Plot 6.—Check—no fertilizer.

Plot 7.—20 lbs. Dried Blood.
30 lbs. Acid Phosphate.
Cost of fertilizer per plot .82

Plot 8.—20 lbs. Nitrate of Soda.
30 lbs. Acid Phosphate.
Cost of fertilizer per plot .69

Plot 9.—20 lbs. Muriate of Potash.
30 lbs. Acid Phosphate.
Cost of fertilizer per plot .61

Plot 10.—20 lbs. Nitrate of Soda.
20 lbs. Muriate of Potash.
Cost of fertilizer per plot .88

Plot 11.—20 lbs. Nitrate of Soda.
30 lbs. Acid Phosphate.
20 lbs. Muriate of Potash.
Cost of fertilizer per plot 1.09

Plot 12.—40 lbs. of a 3-8-10 Commercial Fertilizer.
Cost of fertilizer per plot .64

Plot 13.—60 lbs. of a 3-8-10 Commercial Fertilizer.
Cost of fertilizer per plot .96

The single element plots, (numbers 2 to 4) of the 1909 test were not included in the test this year because of the very poor yields obtained from them. It will be noticed that in plot 7 dried blood was substituted for cottonseed meal as a source of organic nitrogen, that in plots 8, 10 and 11 the amount of nitrate of soda was increased from 10 lbs. to 20 lbs. per plot, and that the commercial fertilizer used on plots 12 and 13 was a 3-8-10 goods instead of a 3-8-4 mixture.

The following table gives the actual yield of the various plots in pounds; the increase in value of the product of the fertilized plots over plot 6 (the unfertilized plot) at 25c per bushel; the net increase per acre after deducting the cost of the fertilizer used in each plot, and the average net increase per acre from the plots of the two number one fields:

TABLE XII. *Result of 1910 Tests with Messrs. Atkinson and Rockwell. Field No. 1.*

Number of Plat.	Mr. Atkinson's Field No. 1.			Mr. Rockwell's Field No. 1.			Average Net Value of Increase Per Acre.
	Yield of Plot in Lbs.	Value of Increase Over Plot 6.	Net Value Per Acre of Increase After Deducting Cost of Fertilizer.	Yield of Plot in Lbs.	Value of Increase Over Plot 6.	Net Value Per Acre of Increase After Deducting Cost of Fertilizer.	
5	1260	$3.56	$33.50	850	$1.35	$11.40	$22.45
6	405			525			
7	1282.5	3.65	28.30	855	1.37	5.50	16.90
8	1320	3.81	31.20	980	1.89	12.00	21.60
9	1687	5.34	47.30	790	1.10	4.90	26.10
10	870	1.93	10.50	590	.27	* 8.53	.98
11	1890	6.18	50.90	1310	3.27	21.81	36.35
12	1140	3.06	24.20	1315	3.29	26.50	25.35
13	1327	3.84	28.80	1315	3.29	23.30	26.05

In field number two of the test with Messrs. Atkinson and Rockwell, 15 lbs. of sulphate of potash was substituted for the 20 lbs. of muriate in each case as a source of potash. Dried blood was substituted for nitrate of soda and bone meal and basic slag were added to compare with acid phosphate as carriers of phosphoric

Fig. 4. Plot 6, Mr. P. W. Atkinson's Field No. 1. Test of 1910. Check. No Fertilizer. Yield 67.5 Bushels Per Acre. Photo Taken August 9, 1910.

acid. The test with Mr. Atkinson included a comparison between equal amounts of a high grade and a low grade commercial fertilizer. In the test with Mr. Rockwell, plot 6, the check plot in Table XII was taken as the one with which to compare the yields of the other plots of this field. The numbers of the plots in the following table are not the real numbers of the plots in the two different fields, but the plots are numbered so as to allow a consideration of both fields in the same table. The same is true in the following list which gives the treatment of each plot in the table:

Plot 1.—30 lbs. Acid Phosphate.		
	Cost of fertilizer per plot	$ .21
Plot 2.—30 lbs. Basic Slag.		
	Cost of fertilizer per plot	.25
Plot 3.—30 lbs. Bone Meal.		
	Cost of fertilizer per plot	.40
Plot 4.—20 lbs. Dried Blood.		
15 lbs. Sulphate of Potash.		
	Cost of fertilizer per plot	.96
Plot 5.—20 lbs. Dried Blood.		
30 lbs. Acid Phosphate.		
	Cost of fertilizer per plot	.82
Plot 6.—20 lbs. Dried Blood.		
30 lbs. Acid Phosphate.		
15 lbs. Sulphate of Potash.		
	Cost of fertilizer per plot	1.17
Plot 7.—30 lbs. Acid Phosphate.		
15 lbs. Sulphate of Potash.		
	Cost of fertilizer per plot	.56
Plot 8.—Check—No fertilizer.		
Plot 9.—30 lbs. of a 3-8-10 Commercial Fertilizer.		
	Cost of fertilizer per plot	.48
Plot 10.—30 lbs. of a .65-6-3 Commercial Fertilizer.		
	Cost of fertilizer per plot	.25

TABLE XIII. *Result of* 1910 *Tests with Messrs. Atkinson and Rockwell. Field No. 2.*

Number of Plot.	Mr. Atkinson's Field No. 2.			Mr. Rockwell's Field No. 2.			Average Net Value of Increase Per Acre.
	Yield of Plot in Lbs.	Value of Increase Over Plot 8.	Net Value Per Acre of Increase After Deducting Cost of Fertilizer.	Yield of Plot in Lbs.	Value of Increase Over Plot 8.	Net Value Per Acre of Increase After Deducting Cost of Fertilizer.	
1	2032	$3.59	$33.80	835	$1.29	$10.80	$22.30
2	2325	4.81	45.60	995	1.95	17.00	31.30
3	2302	4.71	43.10	1185	2.75	23.50	33.30
4	907	* 1.09	* 20.50	707	.75	* 2.10	* 11.30
5	1582	1.71	8.90	905	1.58	7.60	8.25
6	1957	3.27	21.00	1080	2.31	11.40	16.20
7	1549	1.57	10.10	835	1.29	7.30	8.70
8	1170			525			
9	2302	4.71	42.30	1005	2.00	15.20	28.75
10	2040	3.62	33.70				

*Decrease.

Discussion of Results.

The last column of Table XII which gives the average net increase due to the use of fertilizers in the two number one fields shows that as in 1909 the largest average net increase was obtained from plot 11 which received a home-mixed complete fertilizer which this year contained an amount of plant food equivalent to that found in an application of 700 lbs. per acre of a commercial fertilizer analyzing 4.5% nitrogen, 6.8% phosphoric acid and 13.7% potash, and the second largest from plot 9 which received phosphoric acid and potash.

Contrary to the results in 1909 the 600 lbs. per acre of a 3-8-10 commercial fertilizer applied to plot 13 gave a larger average net increase than the 400 lbs. per acre applied to plot 12. This may have been due to the larger percentage of potash contained in the fertilizer this year.

A comparison of plots 7 and 8 shows that nitrogen in the mineral form (nitrate of soda)) gave a larger average net increase than it did in the organic form (dried blood), confirming the previous season's results.

Comparing plots 8, 9, and 10 with plot 11, the three elements, in combination, ranked in value as follows: phosphoric acid, potash and nitrogen, as was the case in the 1909 tests.

The last column of Table XIII which gives the average net increase due to the use of fertilizers in the two number two fields, shows that the largest average net increase was obtained from plot

3 which received 300 lbs. per acre of bone meal. This was closely followed by plot 2 which received an equal amount of basic slag, and this in turn was followed by plot 9 which received the same amount of a 3-8-10 commercial fertilizer.

It will be noticed in comparing plots 9 and 10 of Mr. Atkinson's field number two that the high grade fertilizer gave a much larger net increase than an equal amount of a low grade fertilizer.

A comparison of plots 4, 5, and 7 with plot 6 shows that in combination the three elements ranked in value as follows: phos phoric acid, potash and nitrogen as was the case in the 1909 tests.

A comparison of plots 1, 2 and 3 indicates that as carriers of phosphoric acid, bone meal, basic slag and acid phosphate ranked in the order named.

Tests With Messrs. Grove and Fearnow—1910.

The 1910 tests with Messrs. Grove and Fearnow were both planted on new locations. Each plot contained one eighth of an acre. The kind and amount of fertilizer applied to each plot together with the cost of the same was as follows:

Plot 1.—37½ lbs. Bone Meal.
Cost of fertilizer per plot $ .50

Plot 2.—37½ lbs. Basic Slag.
Cost of fertilizer per plot .31

Plot 3.—50 lbs. of a 3-8-10 Commercial Fertilizer.
Cost of fertilizer per plot .80

Plot 4.—25 lbs. Dried Blood.
37½ lbs. Acid Phosphate.
Cost of fertilizer per plot 1.02

Plot 5.—37½ lbs. Acid Phosphate.
20 lbs. Sulphate of Potash.
Cost of fertilizer per plot .73

Plot 6.—Check Plot—No fertilizer.

Plot 7.—25 lbs. Dried Blood.
37½ lbs. Acid Phosphate.
20 lbs. Sulphate of Potash.
Cost of fertilizer per plot 1.49

Plot 8.—25 lbs. Dried Blood.
20 lbs. Sulphate of Potash.
Cost of fertilizer per plot 1.23

The following table gives the yield of each plot in pounds, the value of the increased yield of each fertilized plot over that of the check or unfertilized plot, at 25c per bushel, the net value per acre of the increase after deducting the cost of the fertilizer applied to each plot, and the average net value of the increase per acre for each plot in the two fields.

TABLE XIV. *Result of* 1910 *Tests with Messrs. Grove and Fearnow.*

Mr. Grove's Plots.				Mr. Fearnow's Plots.				
Number of Plot.	Yield of Plot in Lbs.	Value of Increase Over Plot 6.	Net Value Per Acre of Increase.	Number of Plot.	Yield of Plot in Lbs.	Value of Increase Over Plot 6.	Net Value Per Acre of Increase.	Average Net Value of Increase Per Acre.
1	1500	$2.12	$12.96	1	1380	$1.35	$ 6.80	$ 9.88
2	1560	2.37	16.48	2	1110	.22	* .72	7.88
3	1950	4.00	25.60	3	1395	1.41	4.88	15.24
4	1770	3.25	17.84	4	1455	1.66	5.12	11.48
5	1890	3.75	24.16	5	1215	66	* .56	11.80
6	990			6	1056			
7	2130	4.75	26.08	7	1275	.91	* 4.64	10.72
8	1080	.37	* 6.88	8	765	* 1.21	* 19.52	* 13.20

*Decrease.

Fig. 5. Plot 16. Mr. P. W. Atkinson's Field No. 1. Test of 1910. Nitrate of Soda and Muriate of Potash. Yield 145 Bushels Per Acre. Photo Taken August 9, 1910.

Discussion of the Results Obtained With Messrs. Grove and Fearnow.

The last column of Table XIV indicates that the largest average net increase was obtained from the use of 400 lbs. per acre of a 3-8-10 commercial fertilizer and that the bone meal was superior to the basic slag as a carrier of phosphorus.

TESTS OF 1911.

The tests in 1911 were confined to 20 plots of one tenth of an acre each on land owned by the Berkeley Springs Orchard Co., to whom the Station was indebted for the use of the land and to the actual care of the plots and the securing of the records of yield. The Station furnished the fertilizer for the tests as in 1909 and 1910 and the writer weighed and mixed the fertilizers and supervised their application. The farm on which the tests were carried out was that previously owned by Mr. Chas. Rockwell and the soil was very similar to that on which the tests reported in Tables XII and XIII were carried out. The land had been in pasture for several years previous to 1910 and had a very thin stand of grass on it. It was plowed in the spring of 1910, fertilized at the rate of 200 lbs. of 16% acid phosphate to the acre and sowed to cow peas. These were allowed to remain over winter and in the spring of 1911 they were plowed under and the piece was planted to apple trees. Each plot in the test occupied the space between two rows of trees. The test of this year included stable manure alone at the rate of five and ten loads to the acre; burnt lime at the rate of a ton to the acre alone and in combination with 5 loads of manure to the acre; a comparison of acid phosphate, basic slag and bone meal as sources of phosphoric acid; a comparison of a high grade and a low grade commercial fertilizer; a comparison of fertilizers containing varying percentages of potash, and a comparison of the yields from different distances of planting.

The following table gives the treatment, the cost of fertilizer and the yield in pounds of each plot, the value of the increase in yield of the fertilized plots over the average yield of the three check or unfertilized plots, at 25c per bushel, and the net value of the increase after deducting the cost of fertilizer. The cost of fertilizer was based on the following prices, f. o. b. Berkeley Springs: Manure, $1.00 a load; 2.47-8-10 Commercial Fertilizer, $32 a ton; .82-9-3 Commercial Fertilizer, $21 a ton; Steamed Bone Meal, $30 a ton; Nitrate of Soda, $50 a ton; Sulphate of Potash, $50 a ton; Basic Slag, $19 a ton; 16% Acid Phosphate, $15 a ton; and Lime, $6 a ton.

TABLE XV. *Results of Tests with Berkeley Springs Orchard Co.*, 1911.

Plot.	Treatment of Plot.	Yield in Lbs.	Value of Increase Over Average Yield of Check Plots.	Cost of Fertilizer Per Plot.	Net Value of Increase Per Acre After Deducting Cost of Fertilizer.
1.	½ load of Manure	1230	$2.12	$ .50	$16.20
2.	1 load of Manure	1410	2.87	1.00	18.70
3.	½ load of Manure and 200 lbs. of Lime	1215	2.08	1.10	9.80
4.	40 lbs. of 2.47-8-10 Commercial Fertilizer	1000	1.18	.64	5.40
5.	40 lbs. of .82-9-3 Commercial Fertilizer	1100	1.60	.42	11.80
6.	Check—No fertilizer	610			
7.	10 lbs. Nitrate of Soda 30 lbs. Acid Phosphate	940	.93	47	4.60
8.	30 lbs. Acid Phosphate 12½ lbs. Sulphate of Potash	985	1.12	.53	5.90
9.	10 lbs. Nitrate of Soda 30 lbs. Acid Phosphate 12½ lbs. Sulphate of Potash	1025	1.29	.78	5.10
10.	20 lbs. of Lime	655	* .25	.60	* 3.50
11.	Check—No fertilizer	630			
12.	10 lbs. Nitrate of Soda 37½ lbs. Acid Phosphate 5 lbs. Sulphate of Potash	1185	1.95	.65	13.00
13.	37½ lbs. Acid Phosphate 5 lbs. Sulphate of Potash	1040	1.35	.40	9.50
14.	37½ lbs. Acid Phosphate 10 lbs. Nitrate of Soda	1075	1.50	.53	9.70
15.	30 lbs. Acid Phosphate	990	1.14	.22	9.20
16.	30 lbs. Basic Slag	830	.47	.28	1.90
17.	30 lbs. Steamed Bone Meal	1000	1.18	.45	7.30
18.	200 lbs. Lime	740	.10	.60	* 5.00
19.	Check—No fertilizer 4 rows, 4 x 4 feet	905			
20.	No fertilizer. Five rows, 3½ x 4 feet	1042	.56b		6.60b

*Decrease. b Increase over plot 19.

Discussion of 1911 Results.

The last column of Table XV shows that the greatest net increase was secured from the use of ten loads of stable manure per acre on plot 2, and the next largest from the use of five loads per acre on plot 1.

The use of fresh burnt lime at the rate of a ton to the acre alone resulted in a loss, and in combination with five loads of manure to the acre gave a decrease from the use of manure alone. This result should not discourage the use of lime by the farmers of Morgan County. It simply shows that the tomato is one of the few crops which does not respond to the addition of lime to the soil. The beneficial effect of the lime was quite marked as shown by the much finer growth of crimson clover and vetch on the limed than on the unlimed plots, strips running crosswise of the plots having

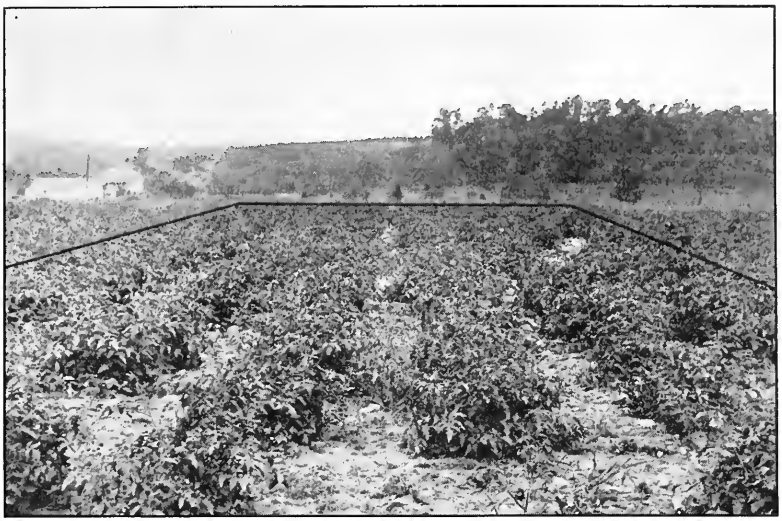

Fig. 6. Plot 11. Mr. P. W. Atkinson's Field No. 1. Test of 1910. Complete Home-Mixed Fertilizer. Yield 315 Bushels Per Acre. Photo Taken August 9, 1910.

been seeded with these cover crops at the last cultivation of the tomato.

In this year's test acid phosphate gave the best results as a source of phosphoric acid, followed by bone meal and basic slag.

Comparing plots 7 and 8 with plot 9, potash seems to have been of more value than nitrogen in combination, but comparing plots 13 and 14 with plot 12, the reverse is true.

The low grade commercial fertilizer used on plot 5 gave a larger net increase than the higher grade used on plot 4.

The test as to distance of planting, shown in plots 19 and 20 resulted in an increased yield per acre for the closer planting, i. e. 3½ x 4 feet, over that of the wider distance of 4 x 4 feet.

RECOMMENDATIONS.

At the beginning of this Bulletin (Page 4) attention was called to the fact that the usual custom of the growers of Morgan County is to apply to the tomato crop about 200 lbs. per acre of a relatively low grade fertilizer, costing from $15 to $21 per ton.

This practice has become quite general, first because of the uniformly good results secured from such applications, and second,

because of the belief that they could not afford to invest in larger quantities of higher grade goods.

The average net value of the increase in yield secured from the use of the grower's brands of fertilizer as recorded in plot 1, Table VIII and plot 6, Table XI, show that this practice has been a profitable one. The results as a whole demonstrate without any question that the increased yields have been due largely to the fact that in the brands of fertilizer commonly used, phosphoric acid (the element most needed) is the predominating ingredient.

The results do more than that, however. They show in every series of tests that even larger average net returns were obtained from the use of either higher grade fertilizers, larger applications of relatively low grade fertilizers or stable manure.

These results are simply an added confirmation of the advice which has been given by this Station for many years, namely, "avoid low grade fertilizers—like amounts of higher grade fertilizers will give larger returns on the investment."

The principal reasons why it is poor policy to use low grade fertilizers, aside from the greater profits to be derived from the use of higher grade materials, are briefly as follows: First; In practically all commercial fertilizers analyzing less than 1.65% of nitrogen, this element is necessarily in such an inert form as to be of little or no use to the grower while it costs him three or four times as much pound for pound as phosphoric acid and potash. Second; The freight, hauling and applying of a ton of low grade fertilizer costs the same as an equal amount of a high grade fertilizer. The former, however, contains a considerable amount of "filler" which is of absolutely no use to the grower.

In answer to the objection as to the increased cost of the higher grade goods and lack of capital with which to buy the same, the writer would put this question to the growers of Morgan County: Since in either case you have until harvest time to pay your fertilizer bill, which is the better policy, to buy from the agent a ton of a low grade fertilizer which applied to ten acres will yield a **net return** of $180.70 (the average net increase from use of grower's fertilizer in Tables VIII and XI) or to buy two tons of a high grade fertilizer which applied to ten acres will yield a **net return** of $202.95 (the average net increase from use of 400 lbs. to the acre of a 3-8-10 fertilizer in Tables XII and XIV)? It would seem as though the extra revenue of $22.25 would be pretty good pay for handling the extra ton of fertilizer. In the opinion of the writer, the results of the tests recorded in this bulletin warrant the recommendation that hereafter the growers of Morgan county use 400 lbs. to the acre of a commercial fertilizer analyzing 3% nitrogen, 8% available phosphoric acid and 10% potash. If the grower desires to mix his

own fertilizer, an approximately equivalent amount of plant food would be obtained by the use of the following ingredients:

75 lbs. Nitrate of Soda
200 lbs. 16% Acid Phosphate
80 lbs. Muriate of Potash.

or

75 lbs. Nitrate of Soda
150 lbs. Steamed Bone Meal
80 lbs. Muriate of Potash

While confident that the general use of the above kinds and amounts of fertilizer will greatly increase the revenue obtained from the tomato crop of Morgan County, certain observations have convinced the writer that maximum yields of tomatoes will not be obtained in this county until the amount of organic matter in the soils is greatly increased.

The soil on the majority of Morgan County farms is rather poor and thin. Naturally of a clayey nature they have become so depleted of humus that they are inclined to wash badly, break up cloddy if plowed when too wet and if too dry cannot be plowed at all. It is the custom with many growers to clear a few acres of woodland each year on which to plant the tomato crop, because in many instances the yield obtained from such pieces is double that of older and less fertile fields. This is rather a doubtful practice in view of the fact that most of such growers already have more tillable land than they can properly care for.

A wiser plan would be to increase the fertility of the older fields by adding organic matter to the soil by one of the following means:

1. By the application of stable manure. The tests of 1911 and that of Mr. J. P. Hovermale in 1909 gave abundant evidence of the value of stable manure. Morgan County farmers should take better care of the manure already made on the farm and this amount might well be increased by the keeping of more beef or dairy cattle.

2. By the use of cover crops. Good stands of crimson clover or winter vetch can be secured by sowing the seed at the last cultivation of either corn or tomatoes. Rye could be sown later, if desired. These plowed under in the spring add much humus and in the case of the clover and vetch, nitrogen as well.

3. By growing leguminous crops such as cow peas or soy beans. In the opinion of the writer they would be more profitable crops than the wheat crop so commonly grown and at the same time would increase the fertility of the soil.

SUMMARY.

This bulletin records the results obtained in fertilizer experiments with tomatoes grown for the cannery in Morgan County, in 1909, 1910 and 1911.

The yields reported include the product of 145 tenth acre plots and of 48 eighth acre plots, totaling 20½ acres of tomatoes. The 16 different fields included in the experiments were located in different parts of the county and were typical of both bottom and upland soils of the county, all of which are a shaly clay loam.

All of the ingredients used on the various plots were weighed and with the exception of the commercial fertilizers used, were mixed by the author. In the case of 87 tenth acre plots in 1909 the fertilizer was applied and the records of yield were obtained by the writer. In the balance of the experiments such work was done by the grower.

With the exception of 25 tenth acre plots in 1909, the value of the increased (or decreased) yield due to the use of the fertilizer applied, the cost of the fertilizer and the net increase in value after deducting the cost of the same is given for each plot in the tests.

As a result of the tests the following conclusions may be drawn:

1. The element most deficient in the soils of this county as judged by the needs of the tomato crop is unquestionably phosphorus. This is followed in turn by potash and nitrogen, the relative value of the last two elements not being nearly so marked as is that of the phosphoric acid.

2. Comparative tests as to the efficiency of bone meal, basic slag and acid phosphate as carriers of phosphoric acid were somewhat contradictory. In 1910 they ranked in value as follows: bone meal, basic slag and acid phosphate, while in 1911 the order was acid phosphate, bone meal and basic slag.

3. Both alone and in combination with the other elements, nitrogen in the form of nitrate of soda gave better net returns than either dried blood or cottonseed meal.

4. Stable manure is one of the most valuable fertilizers at the disposal of Morgan County farmers.

5. In 1911 quick lime at the rate of a ton to the acre alone was applied at a loss and in combination with stable manure gave a lower yield than the same amount of manure without the lime.

The beneficial effect of the lime was quite marked, however, on the clover and vetch which was sown in the tomatoes at the last cultivation.

6. High grade commercial fertilizers (with one exception) gave better average net results than the same amounts of low grade goods.

7. Applications of 400 lbs. to the acre of high grade commercial fertilizers in seven out of nine trials gave better average net returns than applications of 600 lbs. to the acre.

Based on the results of the tests recorded in this bulletin and the observations of the writer during his work in Morgan County, the following practices are recommended to the tomato growers of this county, as desirable:

1. The application of 400 lbs. to the acre of a commercial fertilizer analyzing 3% nitrogen, 8% available phosphoric acid and 10% potash; or if the grower wishes to mix his own fertilizer either of the following mixtures:

75 lbs. Nitrate of Soda.
200 lbs. 16% Acid Phosphate
80 lbs. Muriate of Potash

or

75 lbs. Nitrate of Soda
150 lbs. Steamed Bone Meal
80 lbs. Muriate of Potash

2. The addition of humus or organic matter to the soils by (a) the use of stable manure, (b) the sowing of crimson clover or winter vetch as cover crops at the last cultivation of corn or tomatoes or rye after these crops have been harvested and (c) by the substitution of such leguminous crops as cow peas or soy beans for the wheat crop.