

# Texas Agricultural Experiment Stations

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## Tomato Fertilizers at Troupe

By W. S. HOTCHKISS and EDWARD C. GREEN



Postoffice :  
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# Tomato Fertilizers at Troupe

BY W. S. HOTCHKISS AND EDWARD C. GREEN.

From the time of the establishment of the Troupe Experiment Station four years ago, especial attention has been given to the subject of tomato fertilizers. This is due to the commercial importance of the crop in East Texas, and from the fact that inquiries came in constantly which could not be answered at first hand without an investigation of the special needs of the soil in regard to this particular crop.

The fertilizer experiments on tomatoes, conducted by Dr. E. P. Stiles in 1902 and by Edward C. Green in 1903, were not sufficiently conclusive, owing to dissimilar soil conditions, making plat comparisons unreliable; but in both years the results indicated that phosphoric acid was the plant food most needed in the soil. In 1903 and 1904 nitrate of soda was used, as advised for early tomatoes by Prof. Edward B. Voorhees in his book on "Fertilizers;" and as this form of nitrogen gave no better results than cottonseed meal, it was subsequently dropped.

In continuing the work in 1905, a fertilizer similar in its amounts of plant food to that recommended by Prof. Hugh N. Starns in "Cyclopedia of American Horticulture" was used as a basis for one set of plats. Another set containing plats corresponding to those of the first was treated with the same fertilizer or mixtures, but only one-half the amounts were applied.

The soil upon which the experiments were conducted is a very fine gray sand, varying from eight to eighteen inches in depth, and underlaid with a red clay sub-soil.

## EXPERIMENTS IN 1904.

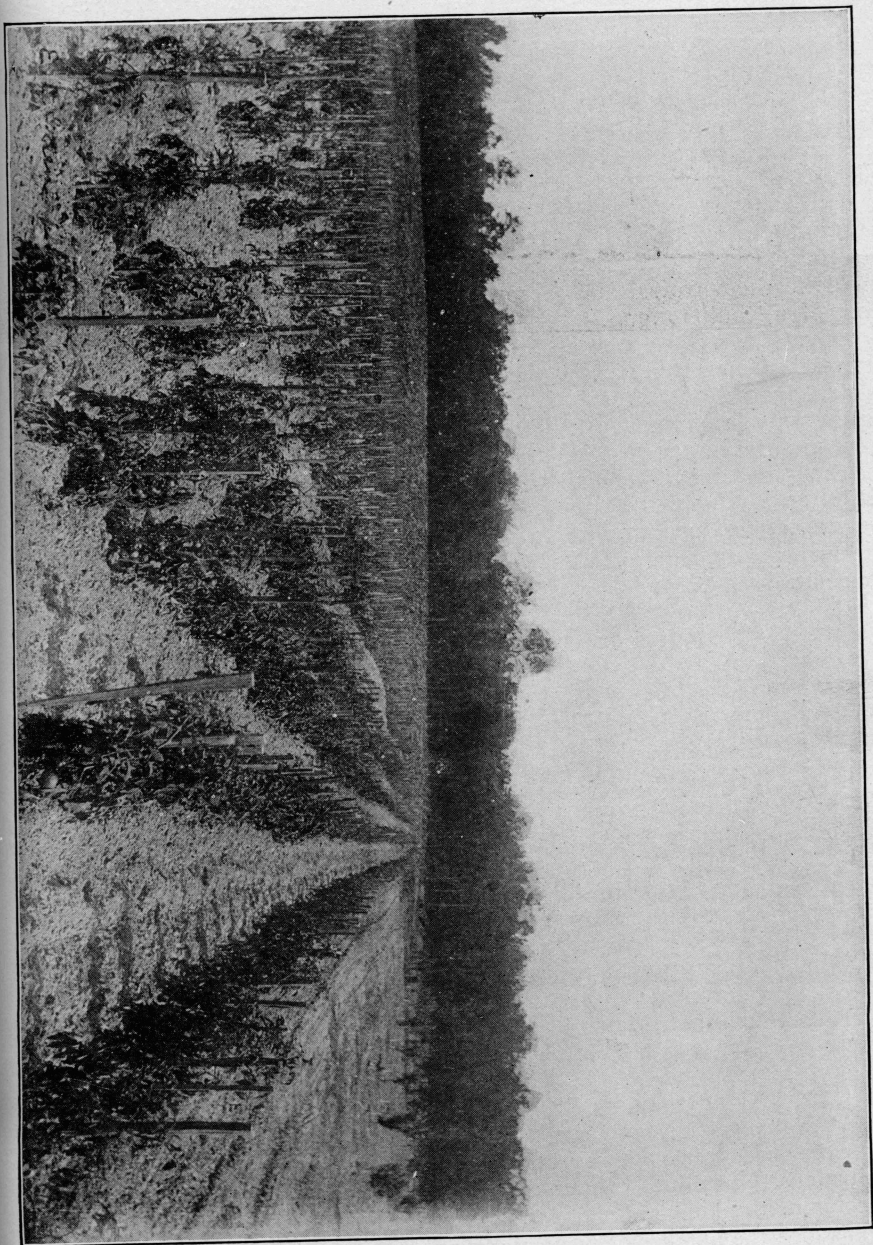
The land used in 1904 was comparatively new, having been cleared and cropped to cotton in 1900, planted to sorghum in 1901, and "laid out" during 1902 and 1903.

**Preparation of Soil.**—In December, 1903, the land was flat broken with a turning plow to a depth of six inches, and left to weather until about the middle of February, when it was thoroughly pulverized with a disc harrow. During the next few weeks heavy rains occurred which packed the ground, making it necessary again to disc the land. This was done about the middle of March, after which it was leveled by running a section harrow both ways over the field.

**Varieties.**—The Acme and Earliana were the varieties used in the experiments, and the former being the one most commonly grown for market was used as a standard with which to compare the Earliana. This variety, on account of its earliness, has been attracting considerable attention among truck growers.

**Planting.**—Seeds were received January 16th, from the Texas Seed &





PLAT. I. COTTON SEED MEAL.

Floral Company, of Dallas, and immediately planted in a hot bed prepared for them during the latter part of December. On February 25th the plants were removed to the cold frame, and set in checked rows five inches each way. They made a strong and uniform growth, and were carefully transplanted to the field on March 28th and 29th, being set in mellow soil three feet apart in the row, and four feet between rows. The Earliana plants were somewhat smaller than the Acme, but were decidedly earlier, all of them having fruit buds, and a large number being in blossom when taken to the field.

**Applying the Fertilizer.**—On March 26th the plats were laid off in rows with a middle burster, the fertilizer carefully weighed, distributed by hand in the furrows, and thoroughly incorporated with the soil by means of a "bull tongue."

**Cultivation.**—Once a week, from the time of transplanting until the fruit reached market maturity, the ground was well stirred with a five-tooth cultivator, but after the first picking the fourteen-tooth harrow was the only implement used, and then merely to preserve the moisture by maintaining a dust mulch. Once only was it necessary to use hand hoes to remove weeds and grass.

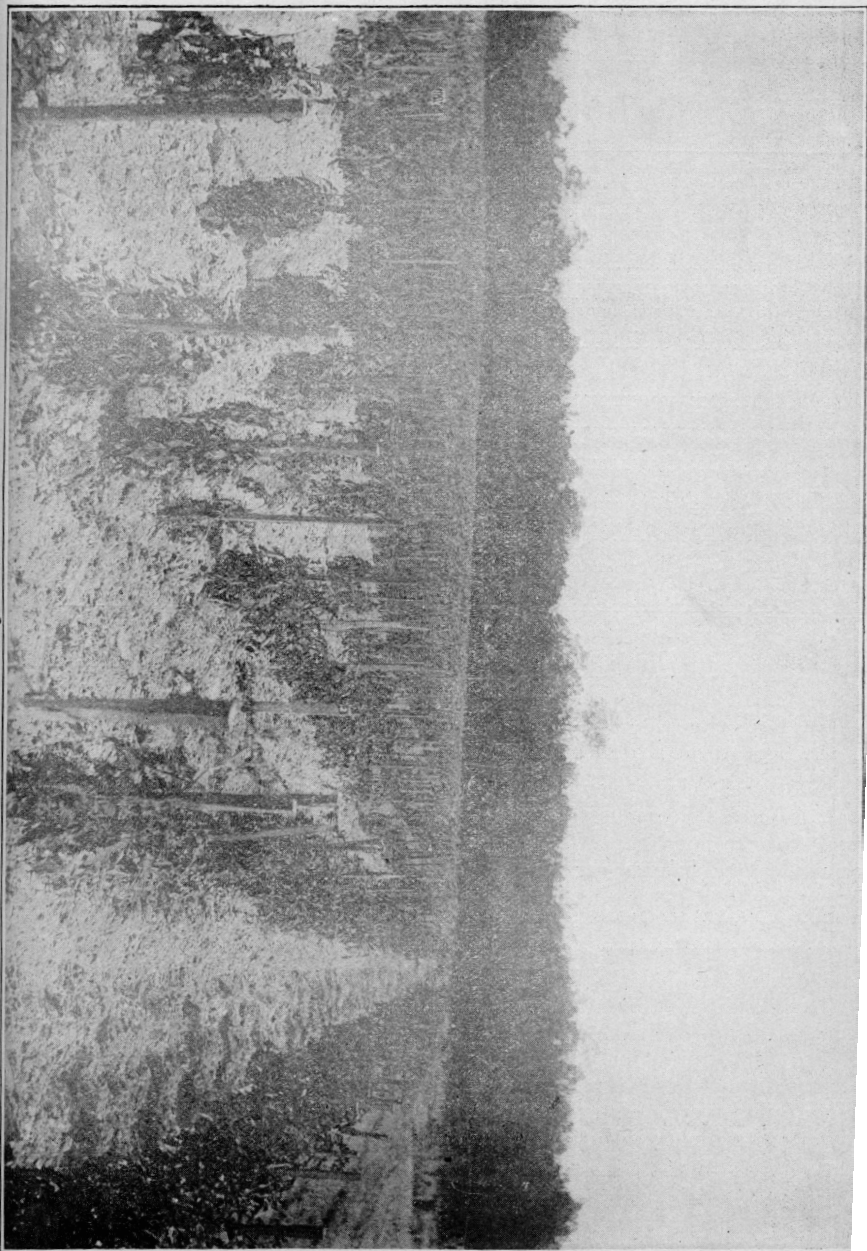
**Staking, Tying and Pruning.**—Between April 15th and 20th all plats were staked, tied and pruned, and subsequent tyings and prunings were made as necessity required. In every instance four clusters were left to each plant.

#### Notes on Growth, May 31st, 1904.

- Plat 1. Made good growth, leaves dark and healthy.
- Plat 2. Small growth, plants weak, foliage light colored.
- Plat 3. Good growth, but not as strong as Plat 1.
- Plat 4. Strong growth, about same as 1.
- Plat 5. Moderate growth, color of foliage quite light.
- Plat 6. About same as 5.
- Plat 7. Good growth, not as vigorous as 1 and 4.
- Plat 8. Good growth, about same as 1.
- Plat 9. Good growth, about same as 8.
- Plat 10. Moderate growth, foliage inclined to be light colored.
- Plat 11. Strong growth, foliage dark and healthy.
- Plat 12. Poor growth, plants weak, foliage of poor color.
- Plat 13. Moderate growth, foliage of good color.
- Plat 14. Very strong, rank growth, foliage dark and healthy, many green tomatoes.

Plat 15. About same as 14.

The following page has been prepared to present in tabular form the results obtained from the use of different fertilizers when alone or in combinations. The first column shows the number of the plat; the second column, the kind of fertilizer used and the rate per acre; the double columns give the number of pounds of marketable and unmarketable tomatoes picked from each plat through two picking periods, and the last columns exhibit the total number of pounds picked per plat:



PLAT II ACID PHOSPHATE.

**TOMATO FERTILIZER TEST 1904, TROUPE.**  
Each Plat Contains 1-40 Acre.

Plat No.	FERTILIZER PER ACRE	Yield May 27 to June 14 in Pounds		Yield June 15 to June 30 in Pounds		Total Yield per Plat in Pounds	
		Mark-etable	Unmark-etable	Mark-etable	Unmark-etable	Mark-etable	Unmark-etable
1	Cottonseed Meal, 500 pounds..	72.90	28.57	136.57	43.25	209.27	72.82
2	Muriate of Potash, 300 pounds.	42.25	8.00	107.24	26.25	149.49	34.25
3	Acid Phosphate, 300 pounds...	110.62	21.00	187.62	50.00	298.24	71.00
4	Cottonseed Meal 500 pounds, Acid Phosphate 300 pounds, Muriate of Potash 300 pounds.....	79.89	28.75	161.49	52.61	241.38	81.36
5	Check.....	66.49	9.25	107.25	15.25	173.74	24.50
6	Wood Ashes, 2,000 pounds....	63.79	12.50	110.37	12.75	174.16	25.25
7	Muriate of Potash, 300 pounds, Acid Phosphate, 300 pounds.....	104.36	15.75	192.37	31.23	296.73	46.98
8	Cottonseed Meal, 500 pounds, Wood Ashes, 2,000 pounds.....	68.37	14.50	149.00	30.25	217.36	44.75
9	Cowpen Manure, 20,000 pounds	82.75	25.00	181.87	37.00	264.62	61.25
10	Check.....	60.73	10.00	116.37	33.75	177.10	43.75
11	Nitrate of Soda, 275 pounds..	47.25	12.50	114.12	23.00	151.37	35.50
12	Lime, 2,000 pounds.....	37.87	11.00	129.87	18.50	167.74	29.50
13	Houston Tankage, 500 pounds	62.75	16.50	167.00	39.50	229.75	56.00
14	Nitrate of Soda, 200 pounds, Acid Phosphate, 610 pounds, Muriate of Potash, 140 pounds.....	65.63	27.75	183.00	57.25	248.62	85.00
15	Nitrate of Soda, 300 pounds, Acid Phosphate, 357 pounds, Muriate of Potash, 200 pounds.....	87.62	30.25	179.25	42.25	266.87	72.50

The most interesting feature brought out by this table is the constant beneficial results obtained from the use of acid phosphate, either alone or in combination. Plat 3, it will be observed, not only yielded more marketable tomatoes earlier than any other plat, but gave the largest yield at the end of the picking season. This plat received an application of acid phosphate only. Potash, when used in combination with acid phosphate, seemed to have but little effect one way or the other (see Plat 7); and when used alone, injured the plants and lessened the yield (see Plat 2, as compared with Plats 5 and 10.) The table would indicate that cottonseed meal, when used alone or in combination, tended to increase the yield; but retarded the ripening (see Plats 1 and 4). Nitrate of soda, when used alone was unsatisfactory (see Plat 11). It should be noted here that the heavily fertilized plats, 14 and 15, each had an abundance of green fruit June 30th, at the close of the picking season, which was fixed by the termination of the profitable market period.

Cow pen manure gave fairly good results, as shown in Plat 9.

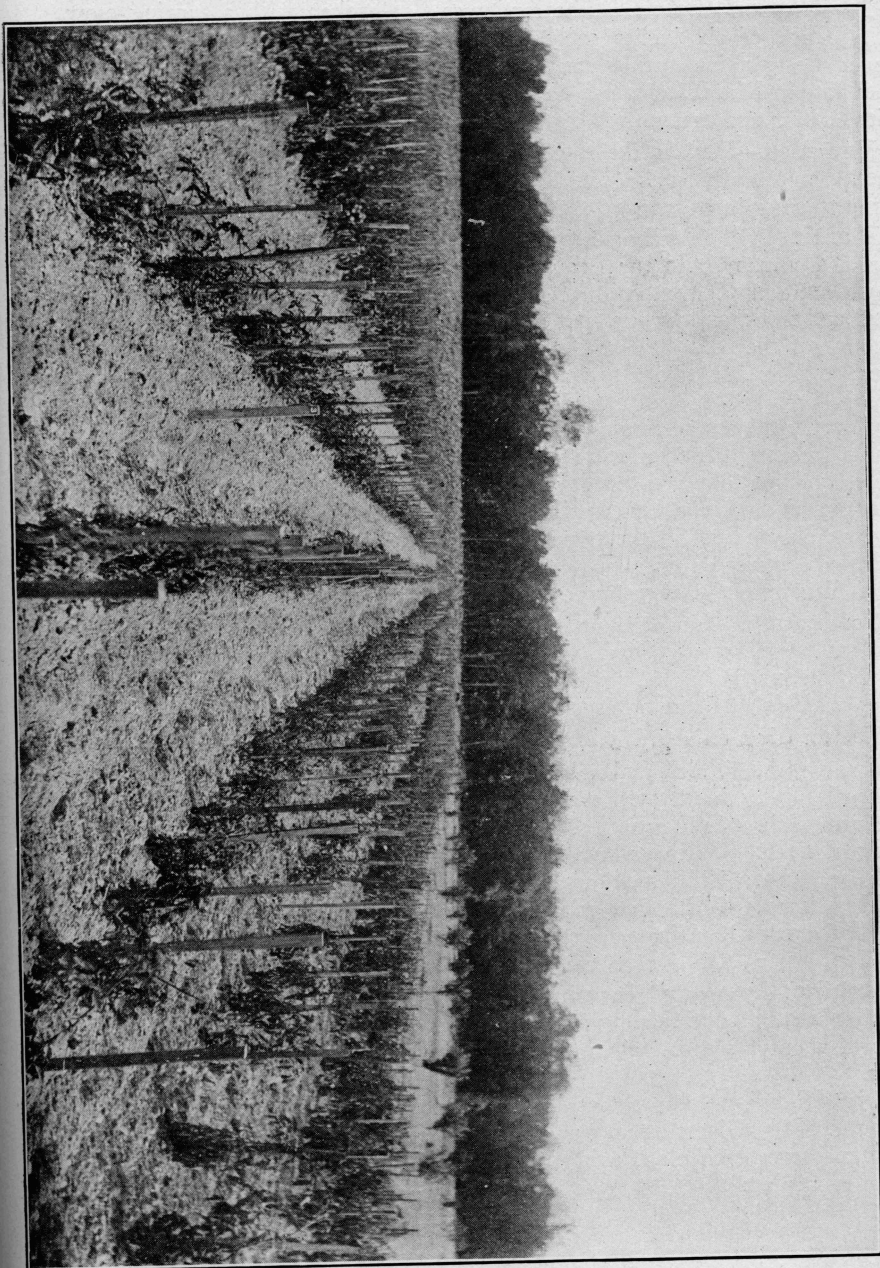
Wood ashes were unsatisfactory, either alone or in combination.

Lime was evidently injurious, as shown in Plat 12.

### EXPERIMENTS IN 1905.

The land employed in the fertilizer experiments in 1905 differed from that used in 1904, in that it was in an old field that had been cropped to cotton several years in succession. There is no record of fertilizer ever having been used.





PLAT III. MURIATE OF POTASH.



**Preparation of Soil.**—The land was flat broken with a turning plow to a depth of six inches early in November, 1904, but owing to continued heavy rains during the winter further working was not attempted until late in March, at which time it was thoroughly pulverized and leveled with a disc and spike-tooth harrow, respectively.

**Varieties.**—Besides the Acme and Earliana used in the experiments of 1904, the Beauty was included in the tests, as this variety had become a favorite in many localities.

**Planting.**—The Earliana seeds were received from the Texas Seed & Floral Company, and the Beauty and Acme were obtained from the Livingston Seed Company of Columbus, Ohio. All were sown January 23rd and 24th, and by the first of February were up to a good stand. On account of the cold and cloudy weather, lasting from February 1st to the 15th, considerable difficulty was experienced in carrying the plants through, and despite the best of care only 3000 were saved from a lot of 10,000. Because of the severe loss a second sowing was made February 16th. The plants from the first lot were taken to the cold frame on March 7th, and the second lot followed ten days later. The young plants were small, but strong and thrifty. On April 4th and 5th all plants were transferred to the field and set in the same manner as in the preceding year; namely, four feet between rows and three feet in the row. Early and late plants were distributed in equal ratio to each plat.

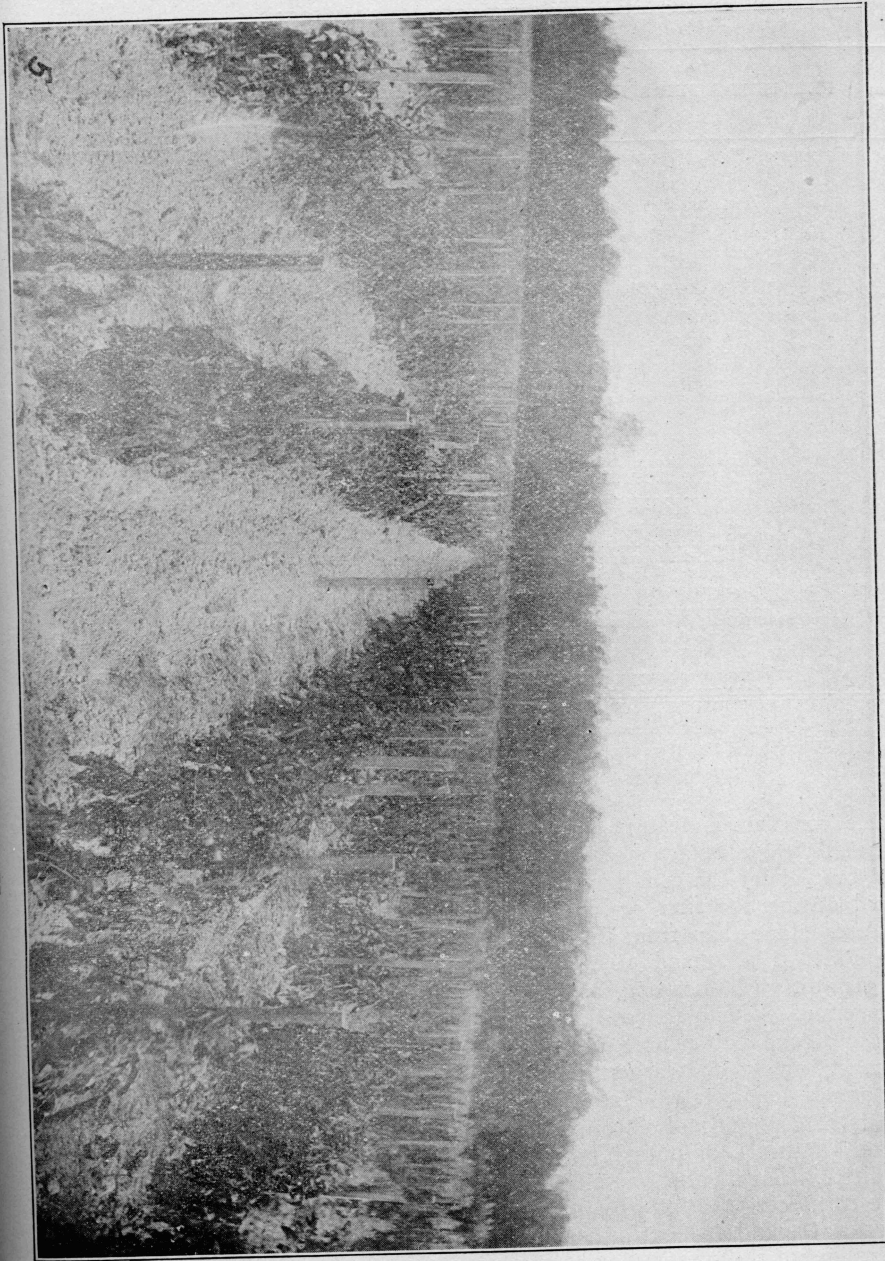
**Cultivation.**—On account of the continued rains throughout the early part of the season, cultivation was extremely difficult, and many times it was necessary to follow with the fourteen-tooth harrow immediately after the five-tooth in order to prevent the ground "baking."

Commencing on April 5th, the plats were cultivated as follows:

- April 5th. Cultivated with five-tooth cultivator.
- April 8th. Cultivated with diverse cultivator.
- April 18th. Cultivated with diverse cultivator.
- April 27th. Cultivated with five-tooth cultivator.
- May 6th. Cultivated with five-tooth cultivator.
- May 17th. Cultivated with diverse cultivator.
- May 27th. Cultivated with five-tooth cultivator.
- June 3rd. Cultivated with five-tooth cultivator.

**Staking, Tying and Pruning.**—All plats were staked, tied and pruned April 26th and 27th, and three subsequent prunings were made at intervals of about a week, the single stem system being used as in the previous year.

The following table shows the plan of the experiment; the kind and amount of fertilizers used per acre; the number of pounds of tomatoes gathered from each plat during two picking periods, and the total amount from each plat:



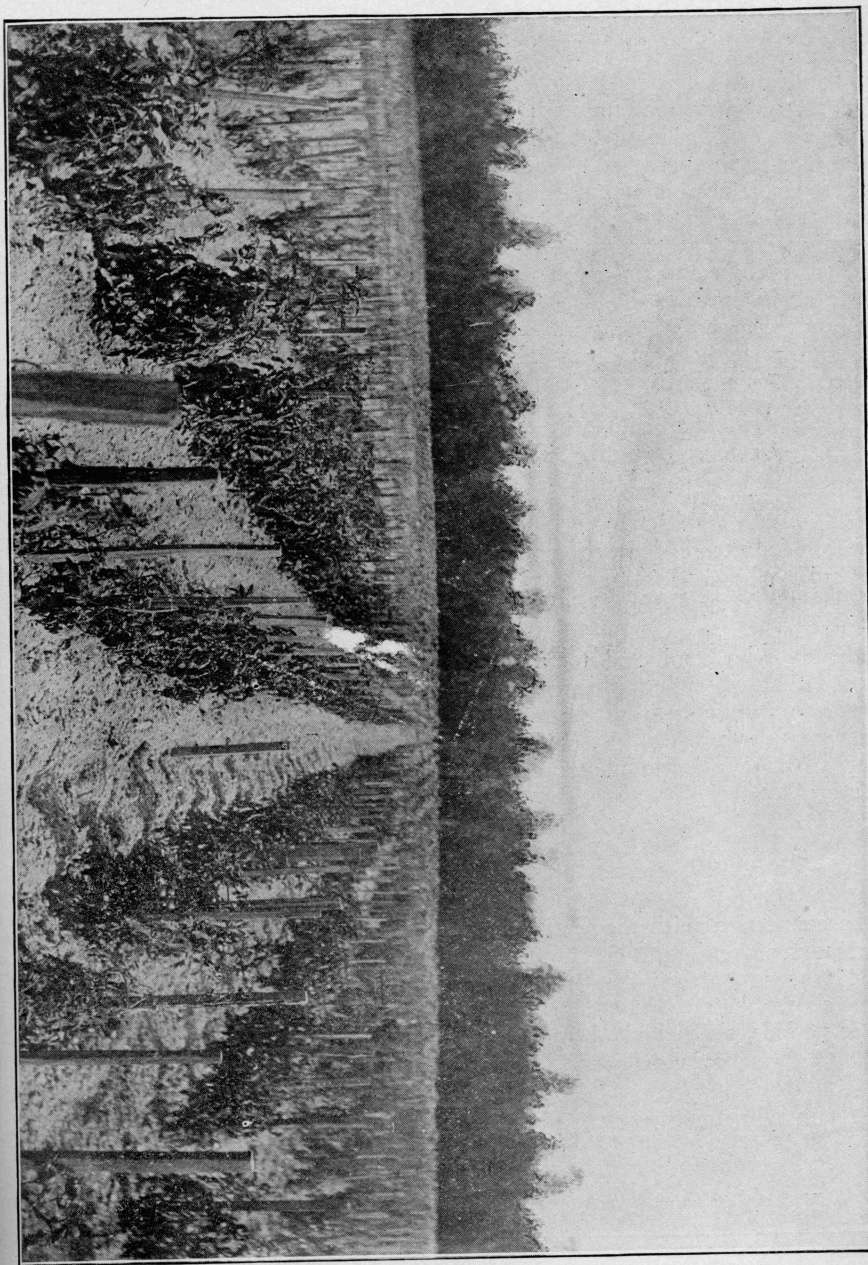
PLAT 5. COTTON SEED MEAL AND ACID PHOSPHATE.

**TOMATO FERTILIZER TEST 1905, TROUPE.**  
Each Plat Contains 3-80 Acre.

Plat No.	FERTILIZER PER ACRE	Yield June 2 to June 13 in Pounds		Yield June 14 to June 29 in Pounds		Total Yield per Plat in Pounds	
		Mark-etable	Unmark-etable	Mark-etable	Unmark-etable	Mark-etable	Unmark-etable
1	Cottonseed Meal, 500 pounds...	88.75	30.75	103.25	57.50	192.00	88.25
2	Acid Phosphate, 600 pounds...	85.00	13.25	115.00	54.75	200.00	68.00
3	Muriate of Potash, 140 pounds...	45.00	2.75	41.50	27.25	86.50	30.00
4	Check.....	49.25	3.75	44.75	21.00	94.00	24.75
5	Cottonseed Meal, 500 pounds, Acid Phosphate, 600 pounds	128.00	26.50	141.75	82.25	269.75	108.75
6	Acid Phosphate, 600 pounds, Muriate of Potash, 140 pounds.....	55.75	16.25	62.50	27.00	118.25	43.25
7	Check.....	37.75	4.25	35.75	6.50	73.50	10.75
8	Cottonseed Meal, 500 pounds, Muriate of Potash, 140 pounds.....	54.00	27.00	69.25	58.00	123.25	85.00
9	Cottonseed Meal, 250 pounds..	63.75	10.25	54.25	32.25	118.00	42.50
10	Acid Phosphate, 300 pounds...	51.75	13.50	71.50	29.00	123.25	42.50
11	Muriate of Potash, 70 pounds..	40.25	4.00	46.75	13.75	87.00	17.75
12	Cottonseed Meal, 250 pounds, Acid Phosphate, 300 pounds	126.50	24.25	110.00	73.25	236.50	97.50
13	Acid Phosphate, 300 pounds, Muriate of Potash, 70 pounds.....	77.75	10.50	82.50	32.00	160.25	42.50
14	Check.....	13.25	1.00	14.00	9.00	27.25	10.00
15	Cottonseed Meal, 250 pounds, Muriate of Potash, 70 pounds.....	79.00	14.50	33.50	11.75	112.50	26.25
16	Cottonseed Meal, 250 pounds; Muriate of Potash 70 pounds, Acid Phosphate, 300 pounds.....	82.00	22.75	80.25	41.75	162.25	64.50
17	Cottonseed Meal, 500 pounds, Acid Phosphate 600 pounds, Muriate of Potash, 140 pounds.....	90.00	21.50	97.50	48.25	187.50	69.75
18	Check.....	9.50	.....	3.00	.....	9.50	.....

NOTE.—The approximate cost of fertilizers f. o. b. Troupe in the Spring of 1905 was as follows: Acid Phosphate, \$19.00 per ton; Cottonseed Meal, \$25.00 per ton; Muriate of Potash, \$55.00 per ton.

One conspicuous feature brought out in the table is the constant increase in yield on plats where acid phosphate was used. It is a fact, however, that under the conditions prevailing this season, more tomatoes were picked during the first period from the plats on which cottonseed meal was used alone than from those on which acid phosphate was used alone (see Plats 1, 2, 9 and 10). It will be noticed that Plat 5 produced the greatest yield, not only at the end of the season, but also during the first period. This plat was fertilized at the rate of 500 pounds of cottonseed meal and 600 pounds of acid phosphate per acre. The plat giving the next earliest and largest yield was No. 12, which received the same mixture of fertilizer as Plat 5, but only one-half the quantity per acre; that is, 250 pounds of cottonseed meal and 300 pounds of acid phosphate. Muriate of potash, when used alone or in combination, has but little, if any, value on soil similar to that on which the experiments were conducted. Plats 16 and 17 were considerably later than the other plats, and at least one-fourth of the crop was left on the vines at the end of the marketing season. Plats 14 and 18 were badly damaged by soil washing, due to heavy rains, and they should not be considered in comparison with other plats.



PLAT 17. COMPLETE FERTILIZER.  
Heaviest vine growth and large *Vitis* crop.



### CONCLUSIONS RELATIVE TO FERTILIZERS

The results obtained from the tests in 1904 indicate very strongly that an application of acid phosphate is all that is necessary on new land comparatively rich in humus, and the results in 1905 show that on old land, deficient in humus and fertility, the addition of cottonseed meal to the acid phosphate is essential to the production of the earliest and largest yield (see plats 5 and 12). In comparing the two best plats (Nos. 5 and 12) in the 1905 table, it will be seen that the heavier application of fertilizer does not produce a proportionate, nor a profitable increase in yield as a consequence. Both years' tests indicate that potash, when used alone or in combination, is unsatisfactory, at least; and in most cases it appears to cause direct injury.

Judging from the results of two years, the following formula is suggested for soils similar to that of the Troupe Experiment Station:

Acid phosphate .....	1,200 pounds.
Cottonseed meal .....	800 pounds.
Total .....	2,000 pounds.

From four to six hundred pounds per acre of the above formula should be used.

The above conclusions, in regard to acid phosphate, are still further strengthened by statements made by former superintendent, Dr. E. P. Stiles, who conducted tomato fertilizer experiments at the station in 1902. The following is taken from his notes: "The most conspicuous fact brought out, both on the ground and in Table 1, is, that the superior plats are those which received acid phosphate. There is no exception. Those containing acid phosphate are superior; those containing none are inferior."

### THE VARIETY TEST.

In connection with the fertilizer experiments, a comparative test of the earliness of Acme and Earliana was conducted in 1904, and in 1905 the test was repeated with the addition of the Beauty. The following table shows the average number of pounds gathered at each picking during three periods, six pickings being included in a period:

1904.

THE AVERAGE NUMBER OF POUNDS GATHERED AT EACH PICKING FROM

VARIETY	May 27 to June 6		June 7 to June 18		June 19 to June 30	
	Mark- etable	Unmark- etable	Mark- etable	Unmark- etable	Mark- etable	Unmark- etable
Earliana.....	51.71	13.64	61.76	13.02	77.89	11.65
Acme.....	12.12	4.87	60.35	21.01	102.46	20.07
Each variety covered 3-16 acre.						



1905.

## THE AVERAGE NUMBER OF POUNDS GATHERED AT EACH PICKING FROM

VARIETY	June 2 to June 10		June 11 to June 19		June 20 to June 29	
	Mark- etable	Unmark- etable	Mark- etable	Unmark- etable	Mark- etable	Unmark- etable
Beauty.....	25.71	5.89	47.98	16.12	70.76	23.77
Acme.....	39.67	4.10	44.74	21.58	69.30	26.61
Earliana.....	64.69	7.46	43.64	32.26	36.00	26.77

Each variety covered approximately 1-4 acre.

The above tables show clearly that the Earliana produces more early tomatoes than either Acme or Beauty. This fact, however, should not be taken as conclusive evidence that the Earliana, on account of its earliness, is the most profitable on the whole. It merely suggests that for very early express shipments, this variety probably would be more profitable than either of the others. No doubt some difficulty would be experienced in selling it in mixed cars with Acmes and Beauties, as it differs in appearance from them, and is but little known to most buyers. As it grows here, it is large and attractive.

## SUMMARY.

1. Acid phosphate produced more constant beneficial results than any other single fertilizer.
2. On new land an application of 300 pounds of acid phosphate per acre gave best results.
3. On old land, which had never been fertilized, an application of 300 pounds of acid phosphate and 250 pounds of cottonseed meal per acre gave the most satisfactory returns.
4. Potash, either alone or in combination, was at least unsatisfactory.
5. Lime was injurious.
6. Wood ashes were valueless.
7. The Earliana was earlier than Acme or Beauty, and commends itself as a profitable variety for early express shipments. It is not recommended for the general crop.