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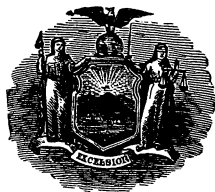
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COMMERCIAL FERTILIZERS FOR ONIONS.

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W. H. JORDAN AND F. A. SIRRINE.

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\* Connected with Fertilizer Control.

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## COMMERCIAL FERTILIZERS FOR ONIONS.

W. H. JORDAN AND F. A. SIRRINE.

### SUMMARY.

(1) Experiments in the use of different quantities of a complete fertilizer in growing onions were conducted at Florida, Orange Co., N. Y., for four years on the same field and for one year on a field of another farm.

(2) The quantities of fertilizer used were 0, 500 lbs., 1000 lbs., 1500 lbs., and 2000 lbs. per acre.

(3) On the Purdy field (4 years), when only 500 lbs. of fertilizer was used, the manure cost of the increase of crop was 16.6 cts. per barrel; with 1000 lbs., 79.3 cts.; with 1500 lbs., 80.4 cts., and with 2000 lbs., 227.8 cts.

(4) The profit from using the fertilizer came mostly from the first 500 lbs. applied, averaging \$35.84 per acre. With onions at \$1.25 per barrel the profit was slightly larger (about \$3.00 per acre), with both the 1000 lbs. and 1500 lbs. of fertilizer per acre; but 2000 lbs. was used at a loss.

(5) On the Mars field one experiment was conducted which showed no increase of yield from applying commercial fertilizer even in the larger quantities.

(6) The results of these experiments show clearly that the crops were limited more by other conditions than by the extent of the plant-food supply. With the best conditions of season and water supply the smallest amount of fertilizer supported the maximum crop.

(7) Considering the varying market price of onions from one year to another and the various vicissitudes to which the crop is subjected, the use of the larger quantities of fertilizer (above 500 lbs.) was attended by danger of financial loss.

### GENERAL CONDITIONS.

Experiments and investigations were begun by the Station in the Second Judicial Department of New York in the year 1894.

One of the conditions of practice prevalent in that portion of the State, especially with the market gardeners and potato and onion growers, was the excessive use of commercial fertilizers. The application of one ton or more per acre of a high grade, complete fertilizer was frequently observed.

Reasoning from general facts, it did not seem clear that such a large expenditure for commercial plant-food was justified from the standpoint of profit. In order to determine the correctness of this view, field experiments with fertilizers on potatoes were begun on Long Island in 1895, which were continued until 1900, during the last four years of which time observations were made on four farms located at different points in potato growing districts. The general outcome of these experiments was to show that, so far as profit from the potato crops was concerned, the use of 1,000 lbs. of fertilizer per acre was more profitable than the use of 500 lbs., 1,500 lbs., or 2,000 lbs.

In 1898 similar observations were begun at Florida, Orange County, on the use of commercial fertilizers in growing onions. These have been continued each year since, the experiment of 1901 being regarded as concluding the series.

## THE EXPERIMENTS.

### PLAN.

In these experiments, conducted for four years on one farm (Purdy field) and for one year on another (Mars field), approximately one acre of land was utilized in each locality. This acre was divided into ten plats, which were treated in accordance with the diagram shown below.

On the field where the experiment was continued for four years, each plat received the treatment as indicated each year of the entire time, with the exception noted under "Fertilizers used."

### FERTILIZERS USED.

The fertilizer was applied annually. For three years it was compounded in accordance with the formula for some time so popular with Long Island farmers; viz: four per ct. nitrogen, eight per ct. phosphoric acid and ten per ct. potash. In 1901, the potash was changed to five per ct.

Crimson clover was sown on the Purdy field in August of 1900, which grew to a height of from four to six inches and was plowed under the very last of November. With this exception the fertilizer was the only means employed of adding fertility to the land, other than the usual cultivation. In 1901 no fertilizer was applied to Plats 6 to 10 of the Purdy field.

ARRANGEMENT OF PLATS IN  
ONION FERTILIZER EXPERI-  
MENTS.

1. No fertilizer.
2. 500 lbs. fertilizer per acre.
3. 1000 lbs. fertilizer per acre.
4. 1500 lbs. fertilizer per acre.
5. 2000 lbs. fertilizer per acre.
6. No fertilizer.
7. 500 lbs. fertilizer per acre.
8. 1000 lbs. fertilizer per acre.
9. 1500 lbs. fertilizer per acre.
10. 2000 lbs. fertilizer per acre.

## LOCATION AND CONDITIONS OF THE EXPERIMENTS.

The location of the experiments was at Florida, Orange Co., N. Y., a region where onion growing is an important industry. The soil is the kind so highly regarded by onion growers, being black, peaty and friable, with a water table about two feet below the surface, except in the time of a severe drought. Such soil appears to allow the continuous production of the same crop without the appearance of the unfavorable conditions which follow with most soils where a rotation of crops is not practiced. During the course of the experiment insect and fungus troubles and excess of water caused more or less damage, the instances of which will be mentioned in the proper connections.

As stated, two fields were used, the Purdy field for four years and the Mars field for one year. In 1897 the former field produced a crop of onions, receiving a small application of commercial fertilizer. Previous to 1897 the crops had been grass, corn and potatoes. The Mars field had been generously manured in previous years.

## NOTES.

In the conduct of these experiments approved methods of culture were followed at the hands of experienced onion growers. The fertilizer was sown broadcast before the drilling of the seed. The planting generally occurred late in April and the harvesting of the crop during the last half of August.

Unfavorable conditions prevailed to some extent every year of the experiments.

In 1898, Plat 10 of the Purdy field was flooded for a short time soon after the young plants made their appearance. Again in 1900, Plats 7, 8, 9 and 10 were partially flooded on two occasions, but this occurred late in August not long before the crop was gathered and as the onions which had rotted were weighed, the figures given show the approximate yield. The crops suffered more or less every year from smut, mildew and the maggot but the plats appear not to have been injured to a sufficiently unlike extent to seriously impair the accuracy of the work in measuring the yield.

In 1900 and 1901, a mixture of sulphur and lime in the pro-

portion of 2 to 1 by weight was sown with the seed at the rate of 150 lbs. per acre. This was sown as a preventive of smut.

Several tables follow showing the plat yield, the acreage yield calculated both in pounds and bushels and the outcome of the experiments considered from a financial point of view.

TABLE I.—YIELD OF ONIONS ON PURDY FIELD FOR FOUR YEARS, 1898–1901, BY PLATS.

Plat No.	Quantity of fertilizer per acre.	Yield per plats. <sup>1</sup>				
		1898.	1899.	1900.	1901.	Average.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	None.....	494	823	1704½	605	906
2	500 lbs.....	681½	1045½	2704	1257	1422 ✓
3	1000 ".....	702½	1148	2813½	1425	1522 ✓
4	1500 ".....	831½	1416	2736	1423	1601
5	2000 ".....	821	1382½	2698½	1499	1600
6	None.....	602	858	2118	923 <sup>2</sup>	1125
7	500 lbs.....	693	1108	2665	1117 <sup>2</sup>	1396
8	1000 ".....	721	1259½	2636	1218 <sup>2</sup>	1458
9	1500 ".....	835	1341½	2588½	1398 <sup>2</sup>	1541 ✓
10	2000 ".....	814½	1298	2540	1371 <sup>2</sup>	1599 <sup>3</sup> ✓

<sup>1</sup> Size of Plats 1 to 9, .0794 acre; Plat 10, .0843 acre.

<sup>2</sup> Plats 6 to 10 received no fertilizer in 1901.

<sup>3</sup> Calculated to yield for .0794 acre.

TABLE II.—ACRE YIELD OF PURDY FIELD SHOWING INCREASE FROM FERTILIZERS.

Plat No.	Quantity of fertilizer per acre.	Average yield per acre for four years.			
		Pounds.	Barrels. <sup>1</sup>	Increase over no fertilizer.	Increase for each addition of 500 lbs. fertilizer.
				Bbls.	Bbls.
1	None.....	11,415	76.1 <sup>2</sup>		
2	500 lbs.....	17,917	119.4	34.1	34.1
3	1000 ".....	19,177	127.8	42.5	8.4
4	1500 ".....	20,173	134.5	49.2	6.7
5	2000 ".....	20,160	134.4	49.1	0
6	None.....	14,175	94.5 <sup>2</sup>		
7	500 lbs.....	17,590	117.3	32.	32.
8	1000 ".....	18,371	122.5	37.2	5.2
9	1500 ".....	19,417	129.4	44.1	6.9
10	2000 ".....	20,147	134.3	49.	4.9

<sup>1</sup> Barrel, 150 lbs.

<sup>2</sup> Average Plats 1 and 6, 85.3 bbls. taken as yield with no fertilizer.

TABLE III.—AVERAGE YEARLY PROFITS PER ACRE FROM USE OF FERTILIZERS ON PURDY FIELD.

Plat No.	Quantity of fertilizer used per acre.	Cost fertilizer per acre.	Value increase of crop.	Profit from fertilizer.	Profit for each addition of 500 lbs. fertilizer.
2	500 lbs.....	\$ 6.25	\$42.62	\$36.37	\$36.37
3	1000 " .....	12.50	53.12	40.62	4.25
4	1500 " .....	18.75	61.50	42.75	2.13
5	2000 " .....	25.00	61.37	36.37	-6.38
7	500 " .....	4.69	40.00	35.31	35.31
8	1000 " .....	9.37	46.50	37.13	1.82
9	1500 " .....	14.06	55.12	41.06	3.93
10	2000 " .....	18.75	61.25	42.50	1.44

## AVERAGES FOR PAIRS OF PLATS.

2 and 7	500 lbs.....	5.47	41.31	35.84	35.84
3 and 8	1000 " .....	10.94	49.81	38.87	3.03
4 and 9	1500 " .....	16.41	58.31	41.90	3.03
5 and 10	2000 " .....	21.87	61.31	39.44	-2.46

Note. Fertilizer reckoned at \$25 per ton and onions at \$1.25 per barrel.  
No fertilizer on Plats 6 to 10 in 1901.

TABLE IV.—FERTILIZER COST OF INCREASED YIELD OF ONIONS FROM USE OF FERTILIZER.

Quantity fertilizer per acre.	Acre cost of fertilizer.	Average total increase of yield.	Average increase yield for each addition 500 lbs. fertilizer.	Fertilizer cost each bbl. increase onions.	Fertilizer cost per bbl. of increase from each addition 500 lbs. fertilizer.
500 lbs.....	\$ 5.47	Bbls. 33	Bbls. 33	Cents. 16.6	Cents. 16.6
1000 " .....	10.94	39.9	6.9	27.4	79.3
1500 " .....	16.41	46.7	6.8	35.1	80.4
2000 " .....	21.87	49.1	2.4	44.5	227.8



TABLE V.—YIELD OF ONIONS ON MARS FIELD, ONE YEAR, 1900.

Plat No.	Quantity of fertilizer per acre.	Yield per plat.	Yield per acre.	Yield per acre.	Excess yield from fertilizer.
		<i>Lbs.</i>	<i>Lbs.</i>	<i>Bbls.</i>	
1	None .....	2946.5	29,465	196.4	
2	500 lbs. ....	2947	29,470	196.5	
3	1000 " .....	3060.5	30,605	204	
4	1500 " .....	3117	31,170	207 8	
5	2000 " .....	3051.5	30,515	203.4	
6	None .....	2866.5	28,665	191.1	
7	500 lbs. ....	3047.5	30,475	203.2	
8	1000 " .....	2775.5	27,755	185	
9	1500 " .....	2517	24,918	166.1	
10	2000 " .....	2729	25,925	172.8	

## SUMMARY.

			<i>Bbls.</i>	<i>Bbls.</i>
1 and 6	None, average.....		193.7	
2 and 7	500 lbs., average.....		199.8	6.1
3 and 8	1000 " " .....		194.5	.8
4 and 9	1500 " " .....		186.9	—6.8
5 and 10	2000 " " .....		188.1	—5.6

## RESULTS.

In discussing the results herewith presented we should keep in mind the limitations of field experiments as to accuracy. If an experimental field could be selected having an entirely uniform productive capacity in every part and untoward conditions such as fungi and injurious insects were to affect one part no more than another, then we could measure with great accuracy the relative influence of different fertilizers or different quantities of the same fertilizer. Such desirable conditions as these are not to be found. Only approximate accuracy is reached in field experiments, even under the most favorable circumstances and for this reason the accompanying figures should not be taken as representing fixed or absolute relations. The experiments convey lessons, however, which appear to the writer to be plain.

In the first place, it is entirely clear that the limit of production as determined by season and other conditions outside of the supply of food was nearly reached in the Purdy field with the first 500 lbs. of fertilizer applied. This is equivalent to stating that

the profits were mostly realized from the first 500 lbs. of fertilizer, the manure cost of the gain in yield being only 16.6 cents per barrel. While with the increasing quantities of fertilizer used there was on the average a corresponding increase of crop, this greater production but very little more than paid for any application of fertilizer above 500 lbs. The data show that the additional yield of onions resulting from each 500 lbs. increase of fertilizer above the first 500 lbs. had a fertilizer cost of \$0.79 to \$2.28 per barrel. The profits of such manuring are uncertain, depending upon market conditions.

It is to be noticed, moreover, that the added growth due to the first 500 lbs. of fertilizer was not uniform in the different years. In 1900 conditions were favorable for an onion crop, a fairly large yield being secured, and the highest returns of any year were obtained from the commercial plant-food added to the soil. The year 1898 gave the smallest crop of any of the four. Comparing the effect of the fertilizers in these two years, we see that 500 lbs. of fertilizer caused an increase in 1900 of 64.6 bbls. of onions per acre and in 1898 only 11.7 bbls. It should be noted that in 1898 the yield, though small, was progressive with the increase of fertilizer, while in 1900 the yield with 500 lbs. of fertilizer was as large as with the heavier manuring. All this emphasizes the truth that the supply of plant-food is only one factor of crop production. Farmers often remark that "fertilizers are of little use in a dry year," which is one way of saying that in order for any manure to exercise its maximum influence, other conditions such as temperature, soil texture and water supply must be favorable. It is evident, then, that considering the varying price of the marketable product, the close margin of profit from heavy manuring with fertilizers even with fairly good prices for the crop product, and the vicissitudes of the crop due to the limitations of season, the onion grower runs great risk of diminished profits when he uses 1,500 and 2,000 lbs. of commercial fertilizer per acre. It should be remembered by growers of all crops that the largest yields may be the least profitable under certain conditions.

It may be suggested that the consideration merely of the gross weight of onions produced does not fairly represent the full rela-

tive influence of the several quantities of fertilizer, because the quality of the crop may be better with the heavier manuring. Data were secured from the experiment of 1901, the fourth year, which bear on this point. Attention is called to the figures of the next table.

TABLE VI.—QUALITY OF ONIONS, CROP OF 1901.

Plat.	Quantity of fertilizer.	Yield graded onions.	Yield pickle onions.	Percentage of pickle onions.
		<i>Lbs.</i>	<i>Lbs.</i>	<i>Per ct.</i>
1	None .....	526	79	13.
2	500 lbs .....	1218	38	3.
3	1000 " .....	1398	27	1.9
4	1500 " .....	1379	44	3.1
5	2000 " .....	1434	65	4.3

The proportion of small onions appears to be less where fertilizer was applied than where it was not, but not less with the heaviest manuring than with the lightest.

In 1898 it was noticed that the onions where no fertilizer was applied weighed less per barrel than those from the manured plats and should be graded mostly as scullions. The barrel weight seemed to be somewhat more where 1500 and 2000 lbs. of fertilizer were applied per acre than where only 500 and 1000 lbs. were used.

Again, the question of the after effect of heavy fertilizing with purchased plant-food may well be introduced at this point. The experiments now considered furnish some evidence on this point. In 1901 no fertilizer was applied to Plats 6 to 10 of the Purdy field, crimson clover being turned under in the fall. An influence from fertilizers used in the three previous years is clearly indicated, as the yield from Plats 7 to 10 was considerably larger than on the check plat (No. 6) and nearly as large as on Plats 2 to 5, which received the usual quantities of fertilizer. The after effect of a chemical manure should be considered, therefore. Here we are again reminded that conditions other than the supply of the compounds needed for growth limited the crop.

The experiment on the Mars field should not pass unnoticed.

The experiment was conducted in 1900 when a fairly large crop was secured, ranging from 188 to 199.8 bbls. of onions with the different quantities of fertilizer. The most noteworthy fact shown in this experiment is that the fertilizer, even in large quantities, failed to increase the crop. The average yield on the check plats was 193.7 bbls. and on the manured plats, 192.3 bbls.

The comment of Mr. Sirrine, in immediate charge of the experiment, was that the owner of the land "had used stable manure and fertilizers in such quantities during previous years that there was little need of fertilizer the present year." Certainly an increase of available plant-food had no effect on the growth of the crop. It is suspected that this instance illustrates a mistake in practice that is very frequently committed by farmers who follow intensive farming, viz.: the use of manure on soil already sufficiently charged with the available materials necessary to plant growth.

