COLORADO AGRICULTURAL EXPERIMENT STATION
Colorado State College
Fort Collins

Report of investigations on POTATO FERTILIZER AND CHEMICAL SOIL TREATMENTS in 1942, Fruita district, in cooperation with the Mesa County Research Committee

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Introduction

The Horticulture Section of the Experiment Station was requested to include potato fertilizer trials with the other research projects in Mesa County in 1942. The following trials were run with the cooperation of Mr. Guy McDaniels on his farm near Fruita. Soil tests by laboratory methods showed this soil to be high in nitrogen and to have abundant potash, while the phosphate level tested quite low. On soils of this type and where the pH is above neutral, the growth of plants is frequently a better indication of soil fertility than are chemical tests.

Fertilizer Trials

Sixteen different fertilizers plus an unfertilized control treatment were each tested in five places in the field on the White Rose variety (McDaniels seed stock). The trial was an attempt to determine which balance of nitrogen, phosphorus and potassium would give the best yield and most No. 1's for size and quality. In other trials in Colorado, it has been shown that the balance between the three fertilizer elements has been more important than the amounts of one or two of the elements. Each fertilizer in this trial is a complete fertilizer.

The ratios in the following table indicate the balance between N, P, and K, such as 1-3-1, 2-5-1, etc.

Table 1.- Fertilizer Trials on White Rose. Mesa County 1942

Ratio of N, P, K.	Lbs. available per acre N, P, K.	YIELD Sacks per acre	YIELD Percent U.S.No. 1 per acre	YIELD U. S. No. 1 Sacks per acre
1-3-1	20- 60-20	242.44	25.3	61.34
1-3-2	20- 60-40	219.24	25.1	55.04
2-3-1	40- 60-20	242.44	25.2	61.10
2-3-2	40- 60-40	256.94	23.0	59.10
1-4-1	20- 80-20	240.70	19.9	47.91
1-4-2	20- 80-40	226.20	17.2	38.92
2-4-1	40- 80-20	222.14	24.3	53.97
2-4-2	40- 80-40	284.78	19.6	55.80
1-5-1	20-100-20	256.36	18.8	48.20
1-5-2	20-100-40	235.48	20.9	49.21
2-5-1	40-100-20	281.30	18.4	51.77
2-5-2	40-100-40	232.00	16.9	39.21
1-6-1	20-120-20	237.22	22.7	53.85
1-6-2	20-120-40	225.04	20.3	45.68
2-6-1	40-120-20	249.40	23.4	58.35
2-6-2	40-120-40	261.58	23.9	62.52
No fertilizer; Control	0- 0- 0	243.02	23.2	56.38

A difference of 48.95 sacks per acre is required for statistical significance between yields.

The greatest yield increase over the unfertilized control (41.76 sacks) was in the 2-4-2 fertilizer. In general high nitrate with high potash gave high yields. On the other hand, low nitrate with high potash reduced yield. (1-3-2, 1-5-2, 1-6-2). High nitrate and low potash gave a slight general increase in percent of No. 1's, although not enough to be considered of value.

The average of all 1-part nitrate to 1-part potash gave an average of 53.13 sacks of No. 1's per acre; 1-part N to 2-parts K an average of 47.21; 2-parts N to 1-part K = 56.29, while 2-parts each of N and K = 54.14. In general high potash reduced the yield and the number of U. S. No. 1's; high nitrate increased yield and number of No. 1's; while variation of phosphate from 3 to 6 parts had relatively little effect on total No. 1's or yield.

Soil Treatments

Chemicals were applied at planting time to determine if any beneficial effects could be noticed on the potato crop. The amounts of Limeate Sulphur and Gypsum applied are shown in the following table. If a chemical could be found that was cheap enough and would help loosen the soil structure, it would be highly beneficial to potato production in this area. The White Rose variety was used.

Table 2. Soil Treatment Trials on White Rose. Mesa County, 1942

Treatment Pounds per acre	YIELD		
	Sacks per acre	Percent U.S. No. 1	U.S. No. 1 per acre
Sulphur . . . 225	254.62	25.2	48.85
Sulphur . . . 450	242.44	23.5	54.52
Sulphur . . .1000	229.68	19.4	44.02
Gypsum. . . .1000	229.68	18.8	39.44
Gypsum. . . .2000	227.94	25.4	57.77
Limeate . . . 700	225.04	19.0	41.47
Limeate . . .1400	237.22	21.2	48.49
Limeate . . .2800	243.60	20.6	48.14
No treatment:Control	230.26	31.8	73.83

A difference of 27.26 sacks per acre is required for statistical significance between yields.

In the above table, the use of 225 pounds of sulphur per acre shows an increase in yield of 24.36 sacks per acre over the untreated control. This looks promising from a yield standpoint, but the amount of No. 1's is decidedly lower than the untreated plot. In every treatment there was a decrease in the percent of No. 1's and the total of No. 1's, even though several treatments increased total yield. (Sulphur, 225 lbs. per acre, and 450 lbs. per acre; and limeate, 2800 lbs. per acre.)

Minor Element Trials

In this plot, copper sulphate, iron sulphate, zinc sulphate and manganese sulphate were added at 25 pounds per acre of each chemical in

all possible combinations of the four chemicals. Recent work has shown each of these to be responsible for serious plant troubles when not present in sufficient amounts. Some of the troubles caused by a lack of "minor" elements are: Blackheart of beets; chlorosis of citrus, walnut, apple, grape, peach, etc., internal cork of apples and califlower. In addition small amounts of these elements have been able to stimulate plant growth and yield.

An early strain of Triumph was used in this plot

Table 3.- Minor Element Trial on Triumph. Mesa County, 1942.

Treatment	YIELD		
	Sacks per acre	Percent U.S. No.1	Sacks U.S. No. 1 per acre
1. No treatment	124.7	61.73	76.98
2. Cu	147.9	77.17	114.13
3. Fe	124.7	73.83	92.07
4. Zn	110.2	76.20	83.97
5. Mn	107.3	71.33	76.54
6. Cu, Fe	171.1	78.73	134.71
7. Cu, Zn	118.9	73.77	87.71
8. Cu, Mn	139.2	74.87	104.22
9. Fe, Zn	104.4	64.80	67.65
10. Fe, Mn	153.7	81.60	125.41
11. Zn, Mn	113.1	66.73	75.47
12. Cu, Fe, Zn	121.8	74.63	90.90
13. Cu, Fe, Mn	110.2	73.90	74.05
14. Cu, Zn, Mn	107.3	71.70	76.93
15. Fe, Zn, Mn	110.2	73.83	73.98
16. Cu, Fe, Zn, Mn	124.7	77.17	96.23

Note: Cu, Copper
Fe, iron
Mn, manganese
Zn, zinc

A difference of 42.69 sacks per acre is required between yields for statistical significance.

It can be seen in the above table that large difference in yield were found. These range in the neighborhood of 60 sacks per acre. Copper alone increased the yield while iron alone had little or no effect when compared with no treatment. Copper and iron together, however, gave the highest yield and the greatest amount of U. S. No. 1's per acre. Zinc alone and manganese alone decreased yield as did zinc and manganese together. While iron alone did not change the yield and manganese alone decreased yield, iron and manganese together increased yield, but Cu, Fe, Mn, and Zn, Fe, Mn did not.

It appears that copper and iron or iron and manganese have definite value and should be further tested, possibly in combination with fertilizers in this area.

Differences in skin color have been observed in various parts of the state when these minor elements were used. Mr. Sparks is measuring the differences in the laboratory and the information on this will be provided at a later date.

Summary

In reviewing the above report the response due to phosphate is not as great as would be expected from the results of soil testing. It may be that other factors are interfering with phosphate uptake by the plant. In this regard the differences found with minor elements make it appear that something besides phosphate is the limiting factor.

Future work in this region should deal with the effect of minor elements, organic matter, soil structure, and various other factors in relation to their effect on the utilization of fertilizer elements by the potato plant.

The effect of sulphur on yield should be further investigated since noticeable yield increases were found, although the percentage of No. 1 tubers was low.

Experimental plots are necessarily small, although repetition of treatments within a plot gives a good measure of the reaction of each treatment compared with each other treatment. The variation due to weather conditions and different soils under different rotative systems could easily change results from year to year. For this reason the results herein presented should be taken for their indicative value only, and not as established facts. Any grower wishing to try any chemical treatment or minor element should do so on a small scale, and where he can compare it directly with the remainder of his crop.

Acknowledgement

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