Soil Fertility Studies with Potatoes in Central and Northern Alabama

CIRCULAR 200

AUGUST 1972

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

E. V. Smith, Director

Auburn, Alabama

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FIRST PRINTING 4M, AUGUST 1972

Soil Fertility Studies with Potatoes in Central and Northern Alabama

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POTATO PRODUCTION in Alabama prior to 1950 was concentrated in a few counties in the southwestern part of the State, primarily in Baldwin County. During the period of 1931 to 1951 acreage in potatoes in southwestern Alabama varied between 8,000 and 30,000 *(7)*. In 1970 the acreage was approximately 6,000 which is about the same as that now planted in northern Alabama, mainly in the Sand Mountain area.

During the 1940's and early 1950's fertilizer recommendations for potatoes ranged from 80 to 105 pounds of N, 66 to 88 pounds of P, and 83 to 116 pounds of K per acre. In seasons when rainfall was heavy immediately after planting, an additional 32 pounds of N was applied as a sidedress *(7)*. Studies conducted by Johnson and Wear in Baldwin County *(2)* showed equally good potato yields were obtained from either 1,800 pounds of 4-10-7 preplant plus 800 pounds sidedressed 1 month after planting or 1,000 pounds of 4-12-12 preplant plus 400 to 800 pounds of 8-8-8 fertilizer per acre sidedressed 1 month after planting. Increases in yields from added magnesium (Mg) were obtained only on the coarse-textured soils low in Mg. Work reported by Ware in 1939 *(5)* and by Ware and Johnson in 1949 *(6)* showed that 60 to 90 pounds of N, 66 pounds of P and 50 to 75 pounds of K per acre were usually adequate for good yields

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of potatoes on most soil types in the State; in some tests small increases in yields were obtained from higher rates depending on fertility of the soil.

The objective of this research was to determine the effects of rates of nitrogen (N), phosphorus (P), potassium (K), and magnesium (Mg) on potato production in central and northern Alabama.

EXPERIMENTAL PROCEDURES

The experiments were conducted on two fields in Chilton County, three fields in Cullman County, and on the Sand Mountain Substation at Crossville in Dekalb County. At the beginning of these experiments, soil samples were taken at each location and analyzed by the Auburn University Soil Testing Laboratory, Table 1. Treatments used in this study consisted of four rates of N, P, and K. The N rates were 0, 40, 80, and 120 pounds with P held constant at 52 pounds and K at 100 pounds per acre. The P rates were 0, 26, 52, and 78 pounds with N held constant at 80 pounds and K at 100 pounds per acre. The K rates were 0, 50, 100, and 150 pounds with N held constant at 80 pounds and P at 52 pounds per acre.

Two additional treatments were added. One treatment was a high rate of fertilizer consisting of 160 pounds of N, 104 of P, and 200 pounds of K per acre (equivalent to 2,000 pounds of 4-12-12 + 80 pounds N). The other treatment included the addition of 20 pounds Mg per acre. The Mg treatment received 80 pounds of N, 52 of P, and 100 pounds of K which was the standard in the rates studied.

TABLE 1. SOIL TEST VALUES FOR DIFFERENT LOCATIONS

Farms or area	Year	Soil content[1]			
		pH	Ca	P	K
			Lb./A.	*Lb./A.*	*Lb./A.*
Chilton County					
Williams	1959	5.8	1,030-(H)	146-(H)	238-(H)
Burgess	1959	5.3	2,500-(H)	129-(H)	113-(M)
Cullman County					
Smith	1959	6.1	1,400-(H)	243-(H)	170-(M)
Roden	1959	5.1	1,480-(H)	71-(M)	144-(M)
Shelton	1959	5.8	468-(L)	154-(H)	106-(M)
DeKalb County					
Sand Mountain Substation	1962	5.5	----	99-(M)	173-(M)

[1] Fertility level: Low (L), Medium (M), and High (H).

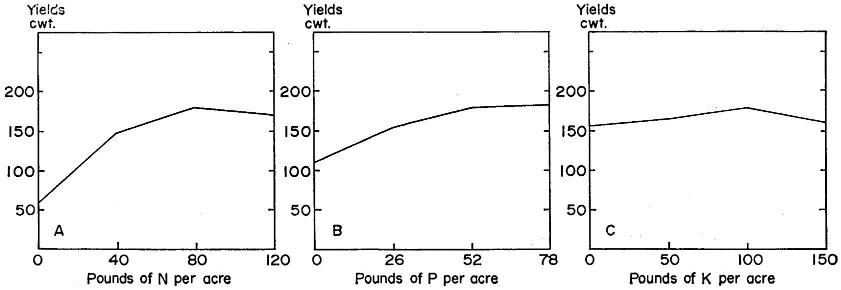

FIG. 1. Yields of No. 1 potatoes from rates of nitrogen, phosphorus, and potassium from average yields of 2 farms in Chilton County.

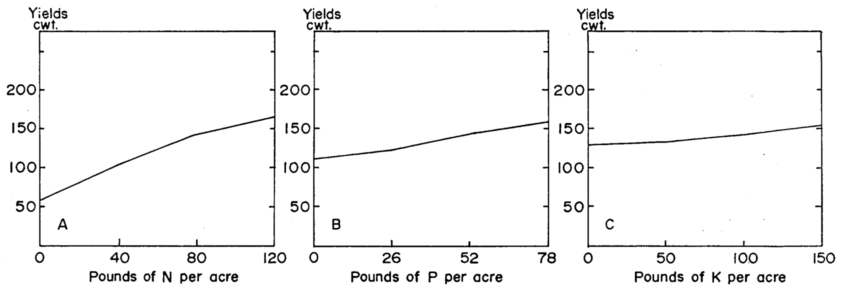

FIG. 2. Yields of No. 1 potatoes from rates of nitrogen, phosphorus, and potassium from average yields of 3 farms in Cullman County.

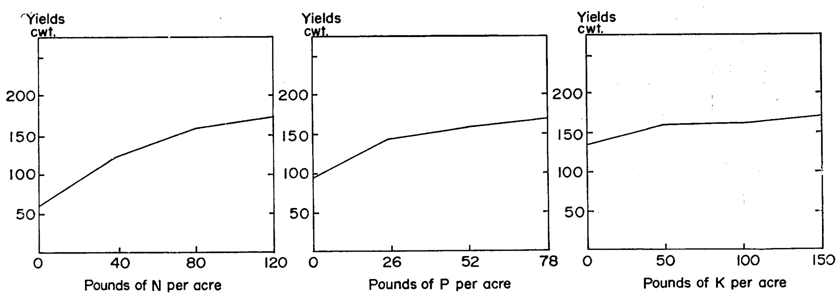

FIG. 3. Yields of No. 1 potatoes from rates of nitrogen, phosphorus, and potassium from average yields for 4 years on the Sand Mountain Substation.

One-half of the fertilizer was applied in two bands (both sides of seed pieces) at planting and the other half was sidedressed one month after planting when the rows were hilled. For the Mg treatment all was applied at planting.

Plots were four rows wide and the two middle rows were harvested for yield records. Treatments were replicated four times in a randomized block design. Red Pontiac variety was used in these experiments.

RESULTS

Yield data by location and by years are given in Figures 1, 2, and 3 and Appendix Tables 1, 2, and 3. Since grade No. 1 and total yields are somewhat similar in response, the yields of No. 1 potatoes are given in the figures and are generally discussed.

Chilton County

Yields from the experiments in Chilton County are given in Figure 1 and Appendix Table 1. Nitrogen and phosphorus increased yields more than K. The lowest yield was made on plots receiving no N, averaging only 37 per cent of the top yield, Figure 1A. Nitrogen rate of 80 pounds per acre increased yield 121 hundredweight over no N treatment. Increasing N to 120 pounds did not increase yield above that from 80 pounds per acre.

Soils receiving no P produced 61 per cent of the top yield. Phosphorus rates of 52 and 78 pounds per acre, respectively, increased yields 43 and 69 hundredweight over the no P treatment, Figure 1B.

The yield on soil receiving no fertilizer K was 87 per cent of the top yield. The rate of 100 pounds of K per acre had a yield of 23 hundredweight over the yield from the no K fertilizer rate.

The highest yield was with fertilizer applications of 80 pounds of N, 52 pounds of P, and 100 pounds K. (This is equivalent to 80-120-120 of N-P_2O_5-K_2O). When 160 pounds of N, 104 pounds of P, and 200 pounds of K were applied the yield was not increased, treatments 3 and 12.

Fertilizer Mg did not affect the yield, possibly indicating that this soil contained an adequate amount.

Cullman County

Yields from the experimental sites in Cullman County are given in Figure 2 and Appendix Table 2. Yield responses to rates of N, P, and K were similar to those in Chilton County except that maximum yields were obtained at the highest rates of N-P-K in Cullman County. Each 40-pound increment of N increased yield up to a maximum yield of 164 hundredweight per acre for 120 pounds of N. Without N, the yield was only 36 per cent of the top yield.

The yield without fertilizer P was only 71 per cent of the top yield of 157 hundredweight produced from 78 pounds of P per acre. Applications of 52 and 78 pounds of P per acre increased yields 31 and 47 hundredweight per acre, respectively, over yields from no P treatment.

Without fertilizer K, the yield was 82 per cent of the top yield. The top rate of 150 pounds of K increased yield 28 hundredweight over the treatment with no K, Figure 2C. Yield responses to individual rates of N, P, and K could be measured only up to 120 pounds N, 78 pounds P, and 150 pounds K, and these are the yields plotted in Figure 2. The highest yield was obtained from the highest rate of complete fertilizer (equivalent to 160-240-240 of N-P_2O_5-K_2O). Although, it is not known whether the higher yield was caused by the extra N, the extra P, the extra K, or a combination of them, N was most likely responsible.

The addition of Mg to the fertilizer did not increase the yield of potatoes in these experiments in Cullman County.

Sand Mountain Substation, Crossville

Yield. Yields from this study were obtained over a period of 4 years, 1963-66, from the same plots and are given in Figure 3 and Appendix Table 3. Average yields for the 4 years showed that only 35 per cent of the maximum yield of No. 1 potatoes was produced without fertilizer N. Yields were increased by each 40-pound increment of N up to 120 pounds per acre, the top yield being 171 hundredweight of No. 1 potatoes.

Yield was only 56 per cent of the maximum without fertilizer P. Yields were increased by each rate of P up to 52 pounds of P per acre.

The yield without fertilizer K was 80 per cent of the top yield with K, 166 hundredweight per acre. Most of the yield increase from applied K was to the first 50 pounds per acre.

A higher rate of complete fertilizer (equivalent to 160-240-240 in terms of N-P_2O_5-K_2O) gave a 13-hundredweight increase over the highest fertilizer rate (120-120-120 as N-P_2O_5-K_2O) in

TABLE 2. EFFECT OF RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON TOTAL SOLIDS AND SPECIFIC GRAVITY OF POTATOES FROM THE 1966 CROP, SAND MOUNTAIN SUBSTATION

Treat No.	Fertilizer per acre[1]				Total solids	Specific gravity
	N	P	K	Mg[1]		
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Pct.*	
1	0	52	100		15.97e[2]	1.0695g
2	40	52	100		16.91de	1.0740f
3	80	52	100	0	17.80bcd	1.0769cde
4	120	53	100		18.34abc	1.0789bc
5	80	00	100		17.54bcd	1.0743ef
6	80	26	100		18.49abc	1.0776cd
7	80	78	100		18.01abcd	1.0762cdef
8	80	52	0		19.16a	1.0828a
9	80	52	50		18.86ab	1.0808ab
10	80	52	150		16.98de	1.0746ef
11	80	52	100	20	17.80bcd	1.0758def
12	160	104	200		17.30cd	1.0736f

[1] One-half of N, P, K, and all Mg were applied at time of planting and ½ of N, P, and K was applied as sidedress 1 month after planting. Rates of 26, 52, 78, and 104 pounds of P per acre, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of P_2O_5. Rates of 50, 100, 150, and 200 pounds of K are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of K_2O. Mg at 20 pounds is equivalent to 120 pounds per acre of Magnesium sulphate.

[2] Figures followed by the same letter do not differ significantly at the .05 level by Duncan's Multiple Range Test.

the rate treatments. It is not known which fertilizer element caused the yield increase, but it was probably N, as evidenced by the N-response curve of Figure 3A.

Addition of fertilizer Mg did not increase yield in this experiment on the Sand Mountain Substation.

Total Solids and Specific Gravity. In 1966 determinations for total solids and specific gravity were made on the potatoes. Results are given in Table 2. Total solids (dry weight) were increased from 15.97 to 18.34 per cent as rates of N were increased from 0 to 120 pounds per acre. A similar increase in specific gravity, 1.0659 to 1.0789, was obtained with increasing N rates. Total solids were decreased from 19.16 to 16.98 per cent and specific gravity from 1.0828 to 1.0746 as the rates of K were increased from 0 to 150 pounds per acre. At 150 pounds of K per acre, the total solids and specific gravity were significantly below those from 0 to 50 pounds of K. Therefore, potato quality was increased by additional N and decreased by the high rate of K. Rainfall during the year was well distributed throughout the growing period, resulting in the highest yields of the 4 years, in which test was conducted, Table 3 and Appendix Table 3. The distribution of rainfall for 1966 seems to have caused good early growth and resulted in plants reaching full maturity and maximum accumulation of solids in the tubers even at high N rates. This probably accounted for the increase in total solids and specific gravity.

Soil-Test Values. Prior to fertilizer applications in 1966, soil samples were taken from each plot to measure the effect of the 4 previous years of fertilizing on soil-test values. Over the 4-year period, there was a decrease in soil-test P where no P fertilizer was applied, but an increase in soil-test P where rates of 78 and 104 pounds of P were applied. There was essentially no change in soil-test P from 26- and 52-pound rates of P, Tables 1 and 4. The application of 100 pounds of K per year seemed to maintain the level of K in the soil, but reductions in soil-test K occurred with the high rates of N and P. A decrease in soil-test K resulted from 0 and 50-pound rate of K. There was an increase in soil-test K at the 150- and 200-pound rates of K.

DISCUSSION

Houghland *(1)* in his study on the importance of P in potato production showed that the need for P was highly critical during the early stage of growth for normal meristem development and rapid vine growth, thus assuring adequate plant development and potentially high yields.

In the Alabama work reported here, one-half of P and K was applied 1 month after planting. Since P fertilizer does not move as readily as N and K into soil from rainfall the sidedressed P may not have been fully available to the crop. Therefore, rates of P reported here might have been more efficiently used if all the P had been applied at time of planting. Applying all P at time of planting is important because potatoes are planted early when the soil temperature is low, therefore, requiring more readily available P for satisfactory early growth. Therefore, because of early planting when soil temperature is low, it is understandable that potato yields can be expected to increase when a readily available form of P is applied to soils even when they have a good supply of residual P.

Yields differ from year to year, as shown by the data from Sand Mountain in Appendix Table 3. Yields from the same treatments were lower in 1963 and 1965 than in 1964 and 1966. These differences in yields are possibly attributable to different moisture conditions during the growing period. Rainfall during the growing season is given for each year in Table 3. In 1963, there were drought periods of 2 weeks in April, 3 weeks in May, and 2 weeks in June; in 1965, there was a drought period of 7 weeks in April and May with not more than .63 inch of rainfall within any 1-week period. The highest yields were obtained in 1966, a year in which no drought periods occurred after mid-April. During that year, yields were more than double those produced in the drier years of 1963 and 1965. Therefore, it would appear that supplemental irrigation would be highly beneficial during dry years.

Total solids in potatoes are very important, especially for chip production. A grower that sells potatoes for chip production needs to use fertilizer rates that give the highest total solids per acre. In 1966, the 50-pound rate of K produced 4,360 pounds of total solids in the No. 1 grade as compared to 4,270 pounds from 100 pounds of K and 4,060 pounds from the 150 pounds of K. Therefore, the lower fertilizer K rate actually produced more total solids than the higher rates of K.

The specific gravity is correlated with total solids; when one is high the other is high. It is possible to increase the total solids and specific gravity of tubers by using a sulfate source of K rather than a chloride source, as was used in this study. Wilcox *(8)*, Lujan and Smith *(3)* and Timm and Merkle *(4)* have shown that the source and rate of potash affect specific gravity of potatoes. They found that as the rate of K was increased, a corresponding reduction of specific gravity of tubers occurred, and at the same level of K, the chloride source (KCl) usually lowered specific gravity more than the sulfate source (K_2SO_4).

Results of a study by Yungen, Hunter, and Bond *(9)* showed that increasing rates of N produced significant decreases in specific gravity of potatoes on 10 of 14 farms. They found that variations in specific gravity appeared to be related to degree of maturity at harvest. In the Alabama work, specific gravity and total solids of potatoes were increased by the higher rates of N. Under certain conditions, increasing the rate of N would not be expected to cause an increase in specific gravity and total solids. However, under conditions such as 1966, with adequate rainfall and rapid plant growth, nitrogen at the higher rates could be more fully utilized by the additional growth during the season, thereby permitting earlier maturity and maximum storage of dry matter in the tubers.

TABLE 3. RAINFALL DURING GROWING SEASON, SAND MOUNTAIN SUBSTATION

	Inches of rainfall by ¼ month periods[1]															
	March periods[1]		April periods				May periods				June periods				July periods	
Year	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
1963	.59	.81	.95	.00	.42	8.51	.00	.05	.53	1.90	.00	.00	5.96	1.47	.43	.53
1964	.51	5.24	5.38	3.28	1.02	1.58	2.38	.08	.01	.12	1.15	.00	1.00	.00	1.42	1.73
1965	2.90	4.36	2.31	.00	.38	.59	.00	.32	.63	.18	2.79	1.87	.26	.34	1.77	.14
1966	.82	.01	.27	.09	1.44	3.60	.77	3.73	2.22	1.11	1.41	.19	.68	1.19	1.42	1.35

[1] Periods represent ¼ of month (7 to 8 days each).

TABLE 4. SOIL TEST pH, P, K, AND Mg ON SOIL FERTILITY PLOTS FOR POTATOES ON SAND MOUNTAIN SUBSTATION, 1966[1]

Treat No.	Fertilizer per acre[2]				Soil test results			
	N	P	K	Mg	pH	P	K	Mg
	Lb.	*Lb.*	*Lb.*	*Lb.*		*Lb.*	*Lb.*	*Lb.*
1	0	52	100		5.3	96	161	28
2	40	52	100		5.2	99	153	26
3	80	52	100	0	5.2	104	168	27
4	120	52	100		5.1	95	149	27
5	80	0	100		5.2	47	169	24
6	80	26	100		5.2	92	167	26
7	80	78	100		5.1	119	139	23
8	80	52	0		5.2	103	116	33
9	80	52	50		5.2	93	140	26
10	80	52	150		5.1	105	202	24
11	80	52	100	20	5.1	102	148	33
12	160	104	200		5.2	160	218	20

[1] Soil test samples were taken prior to fertilizer application in 1966.
[2] These rates of fertilizer were applied to plots beginning in 1962. Therefore, 4 applications of these rates were made prior to soil test.

SUMMARY

Field experiments to study the effects of rates of N, P, and K, and the addition of Mg on production of potatoes were conducted for 1 year at two locations in Chilton County, for 1 year at three locations in Cullman County, and for 4 years at the Sand Mountain Substation in Dekalb County.

The results from the experiments on farms in Chilton County indicated that 80 pounds of N, 52 of P and 100 pounds of K per acre were sufficient for best production of potatoes in central Alabama. The experiments in Cullman County and at the Sand Mountain Substation indicated that individual rates of N, P, and K used were not high enough to produce maximum yields in northern Alabama. This is substantiated by the fact that higher yields of potatoes were produced from a higher rate of complete fertilizer containing 160, 104, and 200 pounds of N, P, and K, respectively.

Fertilizer Mg at the rate of 20 pounds per acre did not increase yields at any of the test areas.

Results obtained at Sand Mountain Substation in 1966 indicate that total solids and specific gravity of potatoes can be increased with increase in rates of N, up to 120 pounds per acre, in years when rainfall is well distributed throughout the growing season so that there is a continuous supply of moisture.

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ACKNOWLEDGMENTS

Credit for information in this publication is given the Substation Superintendents who supervised the field phase of the studies. Especially recognized are C. C. Carlton, M. H. Hollingsworth, and S. E. Gissendanner.

The assistance of L. M. Ware, Professor Emeritus, in planning these experiments is acknowledged.

APPENDIX

APPENDIX TABLE 1. YIELDS OF POTATOES FROM RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON FARMS IN CHILTON COUNTY, 1959

Treatment No.	Fertilizer per acre[1]				No. 1 and total yields per acre					
					William's farm		Burgess' farm		Average of farms	
	N	P	K	Mg[1]	No. 1	Total	No. 1	Total	No. 1	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	0	52	100		43d[2]	61c	73e	85e	58c	73c
2	40	52	100		147ab	166ab	145cd	165cd	146ab	166ab
3	80	52	100	0	173a	198a	185ab	200ab	179a	199a
4	120	52	100		156ab	180a	181ab	204ab	169a	192a
5	80	0	100		86cd	109bc	133d	160d	110b	135b
6	80	26	100		134bc	180a	171bc	188bc	153ab	184a
7	80	78	100		154ab	178a	207a	224a	181a	201a
8	80	52	0		145ab	168ab	167bc	184bc	156ab	176ab
9	80	52	50		159ab	186a	171bc	188bc	165a	187a
10	80	52	150		142ab	180a	178abc	196b	160a	188a
11	80	52	100	20	159ab	187a	190ab	210ab	175a	181a
12	160	104	200		159ab	194a	180abc	193b	170a	194a

[1] One-half of N, P, K, and all Mg were applied at time of planting and ½ N, P, and K applied to side 1 month after planting. Rates of 26, 52, 78, and 104 pounds of P are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of P_2O_5. Rates of 50, 100, 150, and 200 pounds of K are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of K_2O. Treatment 3 is equivalent to 1,000 pounds of 8-12-12 grade fertilizer per acre. Mg at 20 pounds is equivalent to 120 pounds per acre of magnesium sulphate.

[2] Figures followed by the same letter do not differ significantly at the .05 level by Duncan's Multiple Range Test.

APPENDIX TABLE 2. YIELDS OF POTATOES FROM RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON FARMS IN CULLMAN COUNTY, 1959

Treatment No.	Fertilizer per acre[1]				No. 1 and total yields per acre							
	N	P	K	Mg[1]	Roden's farm		Shelton's farm		Smith's farm		Average of farms	
					No. 1	Total	No. 1	Total	No. 1	Total	No. 1	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	0	52	100		68d[2]	91e	36e	68e	72e	96c	59f	85g
2	40	52	100		130c	153cd	74d	105cd	106de	125c	103e	128f
3	80	52	100	0	162bc	186bcd	104abcd	138abc	158bcd	176bc	141bc	167bcd
4	120	52	100		187ab	213ab	120ab	153ab	184abc	204ab	164b	190ab
5	80	0	100		127c	143d	76cd	98de	127cde	147bc	110de	129ef
6	80	26	100		131c	156cd	91bcd	125bcd	141bcde	163bc	121cde	148def
7	80	78	100		166bc	184bcd	112abcd	145ab	192ab	212ab	157b	180bc
8	80	52	0		133c	153cd	97abcd	126bcd	150bcd	165bc	127cde	148def
9	80	52	50		160bc	181bcd	106abcd	131abcd	136bcde	161bc	134bcd	158cde
10	80	52	150		176ab	192bcd	111abcd	143ab	178abc	203ab	155b	179bc
11	80	52	100	20	179ab	196abc	114abc	137abc	157bcd	176bc	150bc	170bcd
12	160	104	200		215a	236a	134a	162a	222a	244a	190a	207a

[1] One-half of N, P, K, and all Mg were applied at time of planting and ½ of N, P, and K was applied to side 1 month after planting. Rates of 26, 52, 78, and 104 pounds of P are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of P_2O_5. Rates of 50, 100, 150, and 200 pounds of K are equivalent to 60, 120, 180, and 240 pounds per acre of K_2O. Treatment 3 is equivalent to 1,000 lb. of 8-12-12 grade fertilizer per acre. Mg at 20 pounds is equivalent to 120 pounds of magnesium sulphate.

[2] Figures followed by the same letter do not differ significantly at the .05 level by Duncan's Multiple Range Test.

APPENDIX TABLE 3. YIELDS OF POTATOES FROM RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON SAND MOUNTAIN SUBSTATION, 1963-66

Treatment No.	Fertilizer per acre[1]				No. 1 and total yields per acre									
					1963		1964		1965		1966		4-year av.	
	N	P	K	Mg[1]	No. 1	Total	No. 1	Total	No. 1	Total	No. 1	Total	No. 1	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	0	52	100		30f[2]	47f	86f	103f	43d	54e	81f	123f	60i	82i
2	40	52	100		79de	104de	145e	163e	114ab	128abc	148e	196e	122g	148f
3	80	52	100	0	94bcd	114bcd	179bc	195bc	110ab	128abc	240b	291b	156cd	182d
4	120	52	100		115a	137ab	198b	213b	122a	145ab	249b	290b	171b	196b
5	80	0	100		74e	88e	139e	153e	68c	82d	90f	123f	93h	112g
6	80	26	100		98abc	117bcd	175bcd	191bcd	93b	113c	201cd	246cd	142ef	167e
7	80	78	100		113ab	138a	196b	213b	130a	152a	228bc	279bc	167bc	196b
8	80	52	0		86cde	110cd	152de	170de	119a	140ab	171de	219cd	132fg	160e
9	80	52	50		98abc	119abcd	185bc	204bc	111ab	125bc	231bc	274bc	156cd	181d
10	80	52	150		110ab	133ab	192bc	210bc	124a	140ab	239b	288b	166bc	193bc
11	80	52	100	20	100abc	126abc	170cd	187cd	115ab	138ab	215bc	270bc	150de	180d
12	160	104	200		110ab	134ab	222a	243a	112ab	133abc	290a	329a	184a	210a

[1] One-half of N, P, K, and all Mg were applied at time of planting and ½ N, P, and K was applied as sidedress 1 month after planting. Rates of 26, 52, 78, and 104 pounds of P are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of P_2O_5. Rates of 50, 100, 150, and 200 pounds of K are, respectively, equivalent to 60, 120, 180, and 240 pounds per acre of K_2O. Treatment 3 is equivalent to 1,000 pounds of 8-12-12 grade fertilizer per acre. Mg at 20 pounds is equivalent to 120 pounds per acre of magnesium sulphate.

[2] Figures followed by the same letter do not differ significantly at the .05 level by Duncan's Multiple Range Test.