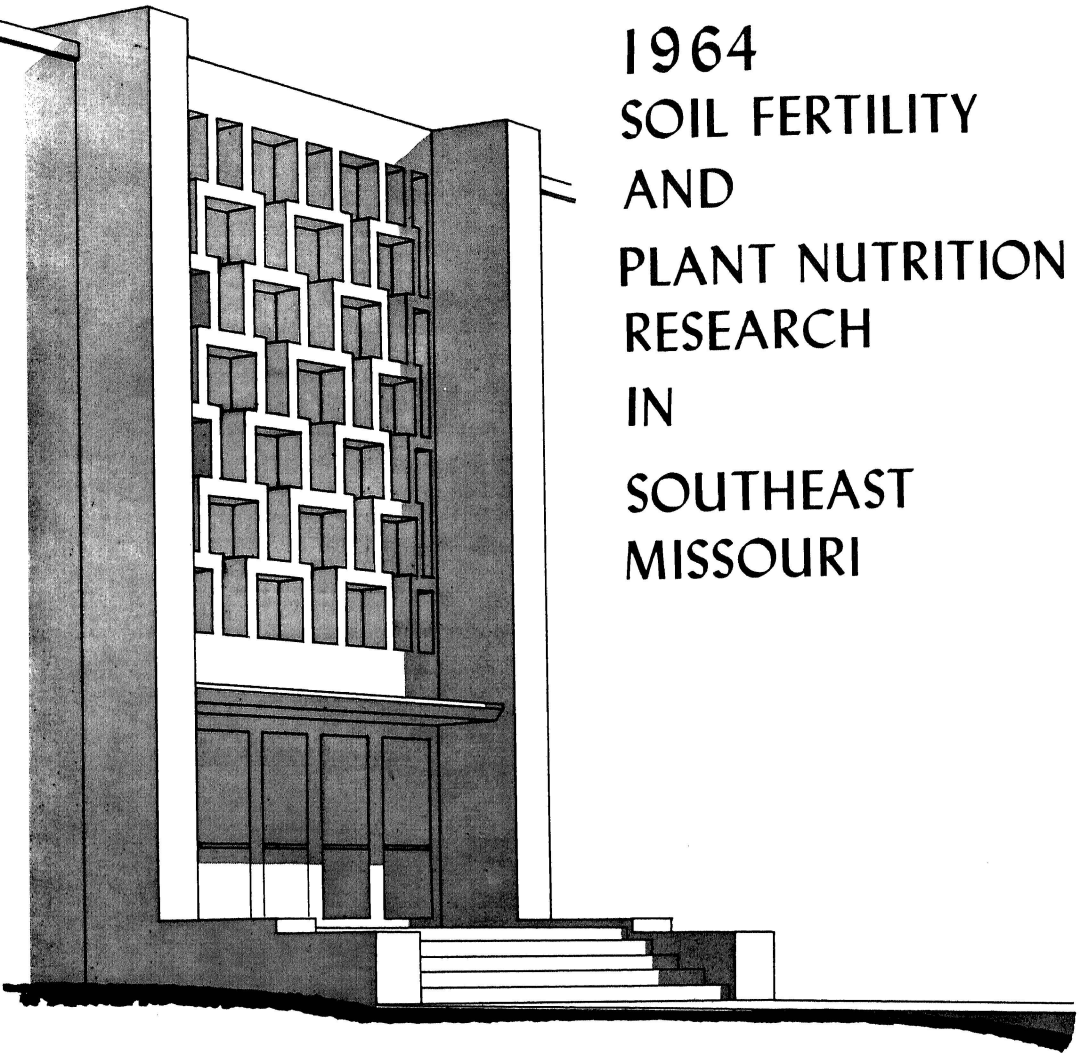

1964 SOIL FERTILITY AND PLANT NUTRITION RESEARCH IN SOUTHEAST MISSOURI

James A. Roth, Earl M. Kroth and George E. Smith
Department of Soils

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AGRICULTURAL EXPERIMENT STATION

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ACKNOWLEDGMENTS

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SOIL FERTILITY AND PLANT NUTRITION RESEARCH IN SOUTHEAST MISSOURI-1964

James A. Roth, Earl M. Kroth, George E. Smith

Soil fertility experiments were conducted at the Clarkten Field, the Sikeston Field, and on two soil types at the Delta Center at Portageville. Additional experiments with wheat and soybeans were conducted on land of cooperators to include other soil types with these crops.

The 1964 growing season was considerably below normal in rainfall with some areas experiencing severe drought. The sandy soils of the Sikeston and Dunklin ridges produced some of the lowest yields in many years where irrigation was not available. A wet and damp period prevailed in September which caused considerable damage to the open cotton and delayed harvesting. October and November weather conditions were excellent for harvesting cotton but dry for plantings of small grain.

Greenhouse work last winter indicated a need for trace minerals on the sandy soil from the Clarkten Field. In the spring a new experiment was initiated on the Clarkten Field which included various trace elements with special emphasis on boron. Boron applied with the preemergence herbicide indicated a response in seed cotton. High rates of limestone, above recommended rates, showed some boron deficiency symptoms on the cotton plants in the field.

Sugar beet research was expanded in 1964 to include experiments in fertility rates and time of application. Other experiments included kind and rate of limestone applications and the effect of irrigation on the sandy loam soil at Portageville. Nitrogen appears to be the most critical nutrient as it is necessary in large applications for highest yields but too much nitrogen may reduce percentage of sugar.

Nitrogen continues to be the most critical plant nutrient in cotton production. In many cases 100 pounds of nitrogen were detrimental to cotton in 1964 because of delay in maturity. Experiments indicate that nitrogen applied at recommended rates, 50 to 100 pounds per acre on clay soils, has little or no carryover effect on the following cotton crop. Fifty pounds of nitrogen applied in 1963 were comparable to 25 pounds of nitrogen applied in 1964 in yields. For most efficient use of nitrogen some phosphate and potash must be applied.

Skip row cotton experiments indicate an increase in yield as compared to planting solid on both the sandy loam and clay soils. The lower soil treatment appeared to be satisfactory for the skip row cotton. Irrigation increased yields on the sandy loam soil but depressed the yields on the clay or "gumbo" soil.

Experiments with soybeans were conducted in cooperation with five farmers of the area who had soils testing low in phosphate and potash. A response to potash was obtained on low testing soils but the application of phosphate did not increase yields even though the phosphate test was low. The responses to trace element mixtures at these locations were in general negative. Dry weather during the growing season had an adverse effect on the yields of soybeans at some locations. Obtaining increases in yield of soybeans by fertilization continues to be difficult in Southeast Missouri.

All harvest data were obtained by machines except that for sugar beets. The alluvial soils on which the experiments are located often vary within short distances within a replication. Because of frequent wide variation due to harvesting errors or soil differences, statistical significances were calculated at the 5 and 20 percent levels.

The data in this report are for one year and must be used with that in mind. A summary of the data for each experiment will be published at an appropriate time.

BASIC SOIL TREATMENTS

This experiment was designed to determine the effectiveness of plowing down heavy rates of fertilizer versus annual row-banded applications.

The data show that on the sandy soil of the Clarkten field nitrogen needed to be combined with phosphorus and potash to produce significant yield increases. 50+50+50 was better than 100+50+50 and 50+50+50 applied as a band was equal to heavy plow down applications of phosphorus and potash. On the clay soil nitrogen alone at 100 pounds per acre gave significant yield increases. No combinations of nitrogen, phosphorus and/or potash were more effective than nitrogen alone on this soil.

These 1964 data show that fertility requirements of cotton on these two soils can be supplied by annual banded applications. Plow down applications are probably not justified on these soils.

TABLE 1 -- EXPERIMENTAL RESULTS; ANNUAL APPLICATIONS

Clarkton and Portageville Fields

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca	pH	H	C. E. C.	Soil Type
Clarkton	0.8	141	230	80	500	4.1	3.0	5.0	Sand
Portageville	1.9	224+	310	940	6000	5.6	2.0	21.5	Sharkey Clay

Soil Treatment		Pounds Seed Cotton Per Acre			
		Clarkton		Portageville-Clay	
**Plowdown	Banded Annually				
$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	First Picking	Total	First Picking	Total
Annual Applications Only					
None	None	1590	1770	1240	1380
None	100+0+0	1500	1910	2020	2450
None	100+50+50	1710	2190	2070	2590
None	50+50+50	2090	2490	2020	2310
None	100+100+100	1970	2460	1930	2470
None	150+100+100	1820	2330	1940	2510
L.S.D.	.05	340	420	380	300
	.20	210	260	230	190

TABLE 2 -- EXPERIMENTAL RESULTS; PLOWDOWN TREATMENTS

Soil Treatment		Pounds Seed Cotton Per Acre			
**Plowdown	Banded Annually	Clarkton		Portageville-Clay	
$N+P_2O_5+K_2$)	$N+P_2O_5+K_2O$	First Picking	Total	First Picking	Total
Phosphorus Plowdown					
None	100+0+0	1500	1910	2020	2450
None	100+50+50	1710	2190	2070	2590
0+200+0	100+0+0	2070	2520	2120	2590
0+200+0	100+50+50	2110	2640	2080	2610
0+0+200	100+0+0	1920	2470	1870	2400
0+0+200	100+50+50	1850	2510	1840	2410
0+100+200	100+0+0	1880	2410	1980	2430
0+100+200	100+50+50	1950	2530	1960	2480
0+200+200	100+0+0	1990	2530	1880	2390
0+200+200	100+50+50	1990	2580	1780	2350
0+400+200	100+0+0	1800	2340	1850	2410
0+400+200	100+50+50	1780	2340	1810	2420
0+1000+200	100+0+0	1910	2380	1740	2250
0+1000+200	100+50+50	1980	2470	1770	2320
L. S. D.	.05	N. S.	N. S.	N. S.	N. S.
	.20	210	250	N. S.	N. S.
Potash Plowdown					
None	100+0+0	1500	1910	2020	2450
None	100+50+50	1710	2190	2070	2590

Table 2 (cont.)

0+200+0	100+0+0	2070	2520	2120	2590
0+200+0	100+50+50	2110	2640	2080	2610
0+200+100	100+0+0	1930	2420	1840	2380
0+200+100	100+50+50	1990	2490	1870	2450
0+200+200	100+0+0	1990	2530	1880	2390
0+200+200	100+50+50	1990	2580	1780	2350
0+200+400	100+0+0	1720	2300	2130	2680
0+200+400	100+50+50	1760	2350	2100	2670
0+100+100	100+0+0	1850	2300	1980	2450
0+100+100	100+50+50	1790	2280	1970	2510
0+400+400	100+0+0	1760	2210	1970	2460
0+400+400	100+50+50	1850	2350	1850	2410
0+200+200 Sul-Po-Mag	100+0+0	1590	1770	--	--
0+200+200 Sul-Po-Mag	100+50+50	1950	2450	--	--
L. S. D. .05		330	450	N. S.	N. S.
.20		210	290	180	170
L. S. D. .05	All Treatments	330	430	280	260
.20	All Treatments	210	270	180	160

**Plowdown fertilizer applied	Spring 1962	Spring 1961
Cotton planted	Auburn M-Apr. 29	Rex-May 5
Cotton Irrigated	June 22, July 6, 23, Aug. 10	None
Limestone applied	4 ton dolomitic 1962	None

LIMESTONE AND NITROGEN EXPERIMENTS
Clarkton Field

The experiment recorded below was designed to measure the effectiveness of kind and rates of limestone applications and the effect of nitrogen on the acidity of a sandy soil over a period of years. In two years the pH was raised from 4.0 to 5.4 by the heavier limestone applications.

Two tons of limestone applied in 1962 nearly doubled the quantity of seed cotton at the first picking in 1964. The total yield was increased by 50%. Higher rates of limestone and kind of limestone have had no effect on yield increases so far. A 50 pound application of nitrogen was significantly better than 25 pounds at the 5% level and a 100 pound application was better than 50 pounds at the 20% level. Small amounts of fine limestone were ineffective.

Greenhouse experiments indicate high rates of limestone may cause trace element deficiencies on this soil. Limestone applied at recommended rates should cause no trouble but the cotton will be checked during the next growing season for signs of boron deficiencies.

TABLE 1 -- EXPERIMENTAL RESULTS

Clarkton Field

Soil Type: Sand

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Topsoil	1.0	131	350	40	600	4.0	2.5	4.5
Subsoil	1.0	52	310	40	600	4.0	2.5	4.5

Soil Treatment		Pounds Seed Cotton Per Acre		
*Limestone (Tons per acre)	Annual Fertilizer $N+P_2O_5+K_2O$	pH 1964	First Picking	Total
None	25+50+50	4.2	1490	1940
None	50+50+50	4.2	940	1560
None	100+50+50	4.1	820	1480
2 T Dolomitic	25+50+50	4.6	2060	2430
2 T Dolomitic	50+50+50	4.4	2130	2580
2 T Dolomitic	100+50+50	4.6	2150	2730
2 T Calcium Carbonate	25+50+50	4.7	1980	2340
2 T Calcium Carbonate	50+50+50	4.3	1860	2350
2 T Calcium Carbonate	100+50+50	4.4	1940	2600
4 T Dolomitic	25+50+50	4.8	1990	2300
4 T Dolomitic	50+50+50	5.0	2220	2610
4 T Dolomitic	100+50+50	4.7	2190	2720
4 T Calcium Carbonate	25+50+50	4.6	2020	2320
4 T Calcium Carbonate	50+50+50	4.6	2060	2420
4 T Calcium Carbonate	100+50+50	4.8	2160	2600
8 T Dolomitic	25+50+50	5.0	2120	2430
8 T Dolomitic	50+50+50	5.1	2280	2580
8 T Dolomitic	100+50+50	5.0	2200	2610
8 T Calcium Carbonate	25+50+50	5.3	2280	2560
8 T Calcium Carbonate	50+50+50	5.4	2340	2670
8 T Calcium Carbonate	100+50+50	5.4	2350	2740
12 T Dolomitic	25+50+50	5.2	2300	2590
12 T Dolomitic	50+50+50	5.7	2340	2730
12 T Dolomitic	100+50+50	5.4	2160	2640
** 1/4T Calcium Carbonate	25+50+50	4.7	1200	1680
** 1/4T Calcium Carbonate	50+50+50	4.2	1310	1840
** 1/4T Calcium Carbonate	100+50+50	4.2	1130	1810
Lime-nitrogen Interaction				
L. S. D. .05		N. S.	250	N. S.
.20		0.2	160	250

ANALYSIS OF VARIANCE

Limestone Application		pH 1964	Pounds Seed Cotton Per Acre: First Picking	Total
None		4.2	1080	1660
2 T Dolomitic		4.5	2110	2580
2 T Calcium Carbonate		4.5	1930	2430
4 T Dolomitic		4.8	2140	2540
4 T Calcium Carbonate		4.7	2080	2450
8 T Dolomitic		5.0	2200	2540
8 T Calcium Carbonate		5.4	2320	2660
12 T Dolomitic		5.4	2260	2650
** 1/4 T Fine Lime (Annually)		4.3	1210	1780
L. S. D.	.05	0.4	340	420
	.20	0.2	210	260
Nitrogen Applications				
25# Nitrogen Sidedress		4.8	1940	2290
50# Nitrogen Sidedress		4.8	1940	2370
100# Nitrogen Sidedress		4.7	1900	2440
L. S. D.	.05	N. S.	N. S.	90
	.20	N. S.	N. S.	60

* Calcium Carbonate fine lime from St. Genevieve, Mo. Dolomitic limestone from Piedmont, Mo. Applied broadcast and plowed down March 1962.

** Fine lime (200 mesh) calcium carbonate from St. Genevieve, Mo. banded by row annually.

Cotton irrigated June 22, July 6, July 23, and August 10.

Cotton sprayed for insects as needed.

Portageville

This experiment was designed to measure the effectiveness of kind and rate of limestone application and the effect of nitrogen on the acidity of loam and clay soils over a period of years.

The data indicate a raise in pH from 5.3 to 6.3 on the sandy loam soil due to 2 tons of fine lime or 8 tons of agricultural lime. Two tons of agricultural limestone raised the clay soil from pH 5.7 to 6.2 and 4 tons to 6.5.

The results show no statistical increase in yield due to limestone applications on either soil in 1964.

Fifty pounds of nitrogen were better than 25 pounds on the clay soil but no better on the loam soil.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Topsoil: Sandy Loam	1.6	212	300	280	2500	4.9	3.0	11.0
Topsoil: Sharkey Clay	1.3	224+	480	940	6000	5.5	2.5	22.0

Soil Treatment		Sandy Loam			Sharkey Clay		
			Pounds of Seed Cotton			Pounds of Seed Cotton	
*Limestone (Tons per Acre)	Annual Fertilizer $N+P_2O_5+K_2O$	pH 1964	First Picking	Total	pH 1964	First Picking	Total
None	25+50+50	5.3	1660	1980	5.7	1880	2140
None	50+50+50	5.2	1500	1910	5.7	1830	2200
None	100+50+50	5.3	1010	1470	5.8	1870	2390
1 Fine Lime	25+50+50	5.8	1710	2010	--	--	--
1 Fine Lime	50+50+50	5.9	1700	2060	--	--	--
1 Fine Lime	100+50+50	5.9	1310	1850	--	--	--
2 Fine Lime	25+50+50	6.3	1500	1920	--	--	--
2 Fine Lime	50+50+50	6.3	1270	1760	--	--	--
2 Fine Lime	100+50+50	6.1	960	1450	--	--	--
2 Agricultural	25+50+50	5.8	1650	2040	6.2	1780	2090
2 Agricultural	50+50+50	5.8	1560	2030	6.3	1860	2260
2 Agricultural	100+50+50	5.7	1240	1750	6.2	1650	2190
4 Fine Lime	25+50+50	6.3	1480	1880	--	--	--
4 Fine Lime	50+50+50	6.4	1440	1900	--	--	--
4 Fine Lime	100+50+50	6.4	1130	1640	--	--	--
4 Agricultural	25+50+50	6.2	1550	1990	6.5	1920	2240
4 Agricultural	50+50+50	6.0	1460	1920	6.5	2040	2370
4 Agricultural	100+50+50	6.0	1190	1770	6.5	1910	2490

TABLE 1 (cont.)

8 Agricultural	25+50+50	6.6	1480	1920	6.8	1930	2250
8 Agricultural	50+50+50	6.5	1360	1860	6.8	2020	2350
8 Agricultural	100+50+50	6.6	1150	1720	6.6	1870	2390
12 Agricultural	25+50+50	6.9	1560	2010	6.7	1800	2030
12 Agricultural	50+50+50	6.7	1420	1930	6.7	1990	2320
12 Agricultural	100+50+50	6.7	1220	1780	6.7	1890	2380
24 Agricultural	25+50+50	--	--	--	6.9	1960	2180
24 Agricultural	50+50+50	--	--	--	6.8	2070	2360
24 Agricultural	100+50+50	--	--	--	6.9	1770	2190
** 1/4 Fine Lime	25+50+50	5.7	1710	2010	6.0	1770	2070
** 1/4 Fine Lime	50+50+50	5.3	1700	2060	6.1	1900	2220
** 1/4 Fine Lime	100+50+50	5.5	1310	1850	6.0	1760	2340
Lime-nitrogen Interaction							
L. S. D .05			N. S.	N. S.	N. S.	N. S.	N. S.
.20			N. S.	110	N. S.	N. S.	N. S.

Limestone applied on sandy loam soil in March, 1963, and on clay soil in March, 1961.

* Calcium carbonate limestone

Fine lime from St. Genevieve, Mo., of 200 mesh.

Agricultural limestone from Jonesboro, Ill.

** Fine lime banded by the row annually.

Sandy loam soil - Auburn M cotton planted April 29. Irrigated July 7 and Aug. 4.

Sharkey clay soil - Rex cotton planted May 5.

This experiment was designed to study the effect of limestone on the soils and what effect rate of nitrogen has on the effective duration of the limestone treatment.

The limestones used were materials with 50% passing through a No. 40 screen and a fine lime with 100% passing a No. 100 sieve. In addition, annual applications of 500 pounds of fine lime banded by the row have also been made.

ANALYSIS OF VARIANCE

Soil Treatment	Sandy Loam pH '64	Sandy Loam Pounds Seed Cotton First Picking	Sandy Loam Pounds Seed Cotton Total	Sharkey Clay pH '64	Sharkey Clay Pounds Seed Cotton First Picking	Sharkey Clay Pounds Seed Cotton Total
Limestone Rates						
No Treatment	5.3	1390	1790	5.7	1860	2240
1 T Fine Lime	5.9	1580	1970	--	--	--
2 T Fine Lime	6.2	1240	1710	--	--	--
2 T Agricultural Lime	5.8	1490	1940	6.2	1760	2180
4 T Fine Lime	6.4	1350	1810	--	--	--
4 T Agricultural Lime	6.1	1400	1890	6.5	1950	2370
8 T Agricultural Lime	6.6	1330	1830	6.7	1940	2330
12 T Agricultural Lime	6.8	1400	1910	6.7	1890	2240
24 T Agricultural Lime	--	--	--	6.9	1930	2240
1/4 T Fine Lime (Annually)	5.5	1510	1960	6.0	1810	2210
L.S.D. .05	--	N.S.	N.S.	0.3	N.S.	N.S.
.20	--	N.S.	N.S.	0.2	N.S.	N.S.
Nitrogen Rates						
25# Nitrogen Sidedress	6.1	1580	1970	6.4	1860	2140
50# Nitrogen Sidedress	6.0	1470	1930	6.4	1960	2300
100# Nitrogen Sidedress	6.0	1170	1700	6.4	1820	2340
L.S.D. .05	--	140	144	N.S.	100	90
.20	--	90	90	N.S.	60	70

RATE OF NITROGEN EXPERIMENTS

Clarkton Field

This experiment was designed to determine the rate of nitrogen with which to sidedress cotton on this sandy soil and what effect phosphate or potash might have on yields where it is sidedressed with the nitrogen.

The results above indicate the need for 50 to 75 pounds of nitrogen sidedressed in addition to the starter. The sidedressing of additional phosphate with the nitrogen produced no effect on yield.

There was no advantage in the sidedressing of potassium nitrate as compared to nitrogen alone. The soil test values for this soil are undoubtedly within the range at which no increase from phosphorous and potash would be expected.

TABLE 1 -- EXPERIMENTAL RESULTS; CLARKTON FIELD

Clarkton Field

Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Topsoil:	1.3	212	330	40	600	4.1	2.0	4.0	Sand
Subsoil:	0.8	80	300	40	600	4.9	2.0	4.5	Sand

*Soil Treatment Sidedress $N+P_2O_5+K_2O$	Pounds Seed Cotton Per Acre	
	First Picking	Total
No Treatment	1830	1990
25+0+0	2230	2570
50+0+0	2260	2660
75+0+0	2280	2780
100+0+0	2160	2710
125+0+0	2170	2660
150+0+0	2100	2680
25+8+0	2120	2450
50+16+0	2150	2560
75+24+0	2230	2660
100+33+0	2190	2670
50+12+50 (Potassium Nitrate)	2330	2670
L. S. D. .05	220	260
.20	140	170

Auburn M cotton planted April 29.

* All plots 13+50+50 applied to all plots at planting. Sidedressed May 16.

Irrigated June 22, July 6, July 23, August 10.

Two tons dolomitic limestone applied in 1961 and two tons in 1962.

Portageville Field

The experiments below on the two soil types of the Portageville Field were designed to measure the effects of sidedressing various rates of nitrogen on yields of cotton. A similar experiment was included at each of the fields at Clarkton and Sikeston.

On the sandy loam soil the data above indicate 50 pounds of nitrogen were sufficient whereas on the clay soil maximum yield was obtained with 100 pounds of nitrogen sidedressed.

The last column of the table shows the effect of nitrogen carryover on plots sidedressed with nitrogen in 1963. The results indicate that with 50 pounds on the loam soil and 100 pounds on the clay soil little or no nitrogen carryover can be expected. The 150 pound rate of nitrogen applied in 1963 on the clay soil was equivalent to the 50 pound rate applied in 1964.

RATES OF NITROGEN

Portageville Field Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Sandy Loam	1.7	224+	440	260	2500	4.8	3.0	11.0
Clay	2.4	189	455	940	6500	5.5	4.0	24.8

Soil Treatment		Pounds Seed Cotton Per Acre				
		Sandy Loam Soil		Clay Soil		
At Planting $N+P_2O_5+K_2O$	Nitrogen Sidedress	First Picking	Total	First Picking	Total	*Carryover Nitrogen Total
12+48+48	None	1480	1650	1500	1650	1860
12+48+48	25	1590	1860	2000	2250	1880
12+48+48	50	1650	1930	2180	2460	1920
12+48+48	75	1550	1800	2220	2620	1990
12+48+48	100	1550	1820	2020	2490	2160
12+48+48	125	1510	1760	2020	2520	2250
12+48+48	150	1550	1800	2080	2600	2470
L. S. D. .05		90	120	280	310	210
.20		60	80	170	200	130
Auburn M cotton planted		May 1		May 5		May 5
Nitrogen Sidedress		June 27		June 25		None

* Nitrogen sidedress in 1963 but none in 1964.

The sandy loam soil irrigated August 6 Clay soil not irrigated.

RATE AND TIME FOR NITROGEN APPLICATION

These experiments were designed to determine the need for nitrogen and the most favorable time of application.

Maddox and French: The results indicate the need for approximately 80 pounds of nitrogen on this soil. The high yield of 3300 pounds vs. 3000 pounds can not be explained with information at hand. These data were not subjected to statistical analysis.

Sikeston: This experiment was located on a soil at the Sikeston Field which had been in pasture for several years. 50+50+50 at planting gave a yield increase at the 20% level over no treatment. No other date of application or combinations of nutrients gave better yield increases. The yield of this no treatment plot was fairly high, indicating some nutrient availability from decay of soil organic matter as the soil test values for phosphorus and potash were fairly low.

Irrigation was essential in 1964 at Sikeston as surrounding cotton was damaged severely by dry weather.

TABLE 1 -- EXPERIMENTAL RESULTS

Maddox and French, Gideon, Mo.

Sikeston Field

Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Maddox & French-Topsoil	1.5	214	150	760	4600	5.3	2.0	17.0	Sharkey Clay
Subsoil	1.0	109	80	760	5400	5.4	1.5	18.0	Sharkey Clay
Sikeston Field - Topsoil	1.5	106	140	300	2500	5.2	1.5	9.0	Sandy Loam
Subsoil	1.4	134	150	480	2400	5.5	1.5	9.5	Sandy Loam

Soil Treatment		Pounds Seed Cotton Per Acre			
		Maddox & French		Sikeston Field	
At Planting $N+P_2O_5+K_2O$	Sidedress $N+P_2O_5+K_2O$	First Picking	Total	First Picking	Total
No Treatment		2150	2640	1960	2370
0+50+50		1960	2380	2040	2510
50+50+50		2040	2690	2020	2620
80+50+50		2070	3030	1980	2580
100+50+50		2050	2870	1900	2470
150+50+50		2410	2930	1920	2540
100+50+0		2290	3190	1810	2320
100+0+50		2120	3080	1950	2530
13+50+50		2520	3090	2240	2810
13+50+50	66+0+0	2260	3170	1920	2480
13+50+50	66+22+0	2180	3010	2010	2540

TABLE 1 (cont.)

Soil Treatment		Pounds Seed Cotton Per Acre			
		Maddox & French		Sikeston Field	
At Planting $N+P_2O_5+K_2O$	Sidedress $N+P_2O_5+K_2O$	First Picking	Total	First Picking	Total
13+50+50	100+33+0	2260	3190	2080	2690
13+50+50	100+0+0	2110	3050	2050	2600
13+50+50	50+50+50	2410	3320	2040	2780
50+50+50+Boron		2440	3330	--	--
50+50+50 (15-15-15)		2660	3300	--	--
100+100+100		2290	3200	--	--
L. S. D. .05		--	--	N. S.	N. S.
.20		--	--	N. S.	190
Cotton Planted		Stoneville 213-April 20		Auburn M-May 8	
Fertilizer sidedress		July 15		June 26	
Cotton irrigated two times at Sikeston.				July 3 and August 8	

RESPONSE OF VARIETIES TO FERTILITY TREATMENTS

These experiments were designed to measure the response of several cotton varieties to varying rates of nitrogen on different soil types. Cotton varieties will vary in their response to fertilizer. Dixie King has a tendency to grow too rank with large fertility treatments as compared to Rex which seems to maintain a more ideal height at the higher fertility levels.

Deltapine Smooth Leaf cotton was severely injured by fusarium wilt on the Clarkton field. Auburn M and Stoneville 213 were significantly better than Deltapine Smooth Leaf at this location. These two varieties also did somewhat better than Dixie King. However, on the loam soil at Portageville there were no statistically significant differences in varieties. Auburn M and Rex did slightly better than Dixie King and Stoneville 213. On the clay soil at Portageville, Rex was the highest yielding variety, being better than both Dixie King and Stoneville 213.

Considering all varieties, there were no significant differences in total yield of seed cotton on the Clarkton plots and the Portageville loam plots due to treatments. On the clay plots at Portageville, an additional 50 pounds N over 50+50+50 gave a statistically significant yield increase.

Contrary to expectation, no variety: nitrogen interactions were significant but some differences were shown on the clay soil when 150 pounds N were used instead of 100 pounds.

These experiments were placed on two series of ranges, each range being used in alternate years. The purpose of this rotation of plots is to remove any carryover effects of nitrogen. The data show that on the clay soil at Portageville there is carryover the first year after applying 100 pounds and 150 pounds of nitrogen to this soil. It may be necessary to place two crop years between successi studies of this kind on the same plots of this clay soil. The data also indicate that rates of 25, 50, and 100 pounds should be substituted for the present 50, 100, and 150 pound applications used in this experiment.

TABLE 1 -- EXPERIMENTAL RESULTS

Clarkton, Sikeston and Portageville Fields

Initial Soil Tests	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Clarkton	1.0	131	350	40	600	4.1	2.5	4.5	Sand
Sikeston	1.1	198	260	180	1800	4.5	2.5	8.0	Sandy Loam
Portageville-Loam	1.7	224+	440	260	2500	4.8	3.0	11.0	Sandy Loam
Portageville-Clay	2.4	189	455	940	6500	5.5	4.0	24.7	Sharkey Clay

Variety			Pounds Seed Cotton Per Acre					
Soil Treatment	Clarkton		Sikeston		Portageville-Loam		Portageville-Clay	
$N+P_2O_5+K$	First Picking	Total	First Picking	Total	First Picking	Total	First Picking	Total
Auburn M								
50+50+50	1730	2010	2180	2440	1710	1940	* 2180	* 2460
100+50+50	1760	2160	2180	2460	1510	1790	* 2020	* 2490
150+50+50	1670	2220	2090	2380	1670	2070	* 2080	* 2600
150+100+100	--	--	1830	2110	--	--	--	--
Rex								
50+50+50	1550	1970	2440	2750	1930	2190	1800	2000
100+50+50	1320	1903	2240	2580	1760	2140	1940	2300
150+50+50	1270	1900	1900	2310	1650	2100	1760	2220
150+100+100	--	--	1630	2040	--	--	--	--

TABLE 1 (cont.)

Deltapine Smooth Leaf								
50+50+50	1210	1470	1450	1920	1260	1890	1570	1830
100+50+50	1380	1820	1470	1980	1200	1990	1570	1990
150+50+50	1150	1650	1340	1840	1050	1720	1490	2020
150+100+100	--	--	1210	1680	--	--	--	--
Dixie King								
50+50+50	1370	1820	1900	2260	1380	1740	1360	1610
100+50+50	1190	1770	1800	2170	1300	1750	1390	1770
150+50+50	1160	1830	1610	1990	900	1260	1230	1680
150+100+100	--	--	1550	1970	--	--	--	--
Stoneville 213								
50+50+50	1750	2130	2320	2590	1250	1580	1540	1750
100+50+50	1590	2190	2020	2350	1070	1500	1370	1700
150+50+50	1460	2140	1660	2010	1200	1670	1160	1570
150+100+100	--	--	1830	2140	--	--	--	--
Variety Treatment Interaction								
L. S. D. .05 (Treatment)	N. S.	N. S.	--	--	N. S.	N. S.	N. S.	N. S.
.20	N. S.	N. S.	--	--	N. S.	N. S.	120	140
Date of Planting	April 29		April 25		May 1		May 4	
No. Times Irrigated	4		2		1		2	

50+50+50 banded at planting with additional nitrogen sidedress at bloom stage.

* Yields for Auburn M on Portageville-clay from rate of nitrogen test and not included in statistical analysis.

Deltapine Smooth Leaf cotton was severely injured by fusarian wilt at the Clarkton Field.

High nitrogen treatments produced very rank stalks at the Sikeston Field.

ANALYSIS OF VARIANCE FOR VARIETY

Variety	Clarkton		Sikeston		Portageville-Loam		Portageville-Clay	
	First Picking	Total	First Picking	Total	First Picking	Total	First Picking	Total
Auburn M	1720	2130	--	--	1630	1930	--	--
Rex	1380	1920			1780	2140	1830	2170
Deltapine-Smooth Leaf	1250	1640			1040	1870	1540	1940
Dixie King	1240	1810			1190	1590	1320	1680
Stoneville 213	1600	2150			1170	1580	1360	1670
L. S. D. .05	280	350			300	N. S.	300	280
.20	170	210			190	320	140	130

ANALYSIS OF VARIANCE FOR SOIL TREATMENT

Soil Treatment								
50+50+50	1520	1880	--	--	1500	1870	1570	1790
100+50+50	1450	1970			1290	1830	1570	1940
150+50+50	1340	1950			1290	1770	1410	1870
150+100+100	--	--			--	--	--	--
L. S. D. .05	110	N. S.			N. S.	N. S.	90	110
.20	70	N. S.			150	N. S.	50	60

RESIDUAL NITROGEN

Soil Treatment 1963		
50+50+50	930	1040
100+50+50	1180	1300
150+50+50	1630	1800
L. S. D. .05	70	90
.20	50	60

METHODS OF APPLYING FERTILIZER TO COTTON

Experiments reported in this table were designed to determine the most efficient method of applying fertilizer to cotton. Previous work had indicated that banding the fertilizer near the seed at planting increased early growth rate and was the most efficient use of fertilizer as measured by the total yield.

The 1964 data for the clay soil at Portageville show that any treatment was better than none and that 100+100+100 broadcast and bedded produced significantly better than 50+50+50 broadcast and bedded. Also, this yield was significantly greater than 50+50+50 banded. The limiting nutrient was probably nitrogen because 13+50+50 banded plus 37 pounds N sidedressed was equal to 100+100+100 applied previous to planting.

At Sikeston 50+50+50 broadcast and bedded was significantly better than no treatment. 50+50+50 banded was better than the same fertilizer broadcast. This method of applying fertilizer seemed to be the most economical one used in this study.

The soil test values for phosphorus and potash would indicate these nutrients were close to an optimum level and that 50+50+50 banded would supply the P and K needs of cotton. Need for additional nitrogen was indicated on the clay soil.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville & Sikeston Fields

Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Portageville	1.9	160	550	940	5600	4.6	5.5	24.0	Sharkey Clay
Sikeston	0.8	163	260	120	1300	4.9	2.0	6.0	Sandy Loam

Soil Treatment			Pounds of Seed Cotton Per Acre			
Preplant	Band at Planting	Sidedress	Portageville		Sikeston	
$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	First Picking	Total	First Picking	Total
No Treatment			1420	1520	1760	2080
50+50+50 Broadcast and bed			1950	2110	2240	2770
100+100+100 Broadcast and bed			2150	2370	2310	2950
50+50+50 Band under bed			1800	1900	2270	2800
100+100+100 Band under bed			2260	2480	2280	2830
	50+50+50		1770	2010	2410	2930
	100+100+100		1660	2030	2260	2910
	13+50+50	37+0+0	2050	2340	2324	2880
	26+100+100	74+0+0	1840	2230	2300	2900

TABLE 1 (cont.)

	13+50+50	60+0+0	1930	2310	2290	2920
	13+50+50	60+20+0	1930	2300	2330	2940
	13+50+50	20+0+0 at squareing 20+0+0 at blooming 20+0+0 at boll	1790	2170	2210	2870
	13+50+50		1440	1570	2050	2380
L.S.D. .05			290	280	280	330
.20			190	180	180	210

Rex cotton planted	May 5	April 24
Irrigated	July 11	July 3 & Aug 8
Sidedress	June 25	June 26

FERTILIZING SKIP-ROW COTTON

Skip-row cotton has become a popular method of planting cotton in Southeast Missouri. A. S. C. regulations permit planting cotton with as little as one skip row and the skips are not included in the cotton allotment. Outside rows of cotton usually yield more and this is the reason skip-row cotton yields higher than solid planted cotton. Though there is not a crop in the skip rows, cotton usually yields more than enough to offset what a crop of soybeans would return. Planting a crop, such as soybeans, in the skip rows in most cases offsets the benefit to the cotton crop. It is the general practice not to plant a crop in the skips but to cultivate to control weeds and conserve moisture.

Experiments were initiated in 1964 to determine the need for fertilizer and irrigation with two skip-row methods of planting cotton as compared to planting solid. Half of the rows were irrigated and the other half received no supplemental water.

The data from these experiments show that there is no interaction between rate of planting and nitrogen applications, that is, all methods respond in the same general way to nitrogen treatments.

On the sandy loam soil no increase was obtained due to treatment but irrigating the crop gave increased yields over no irrigation. The clay soil on the other hand, responded to increased nitrogen applications but not above 50 pounds per acre. Irrigating the clay soil reduced yields of all treatments but added nitrogen helped overcome the adverse effect of irrigation.

Benefit from skip row planting was obtained on the sandy loam, two rows cotton-one skip being the better method. Under irrigation, this method was also better than solid planting and equal to the two rows cotton-skip two method.

No large benefit from skip row planting on clay soil was found in this study. Skip row planting gave only small increases and these on the non-irrigated plots. Apparently the suspected benefit due to skip-row planting on clay soil was not realized because of limiting factors other than soil moisture and sunlight.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field								
Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Sandy Loam	2.5	208	300	320	4200	5.0	2.0	14.0
Clay	2.7	346	360	940	7000	5.9	2.0	24.0

Method of Planting	Soil Treatment		Pounds Seed Cotton Per Acre							
			Sandy Loam				Clay			
			Non-Irrigated		Irrigated		Non-Irrigated		Irrigated	
	At Planting	Nitrogen Sidedress	First Picking	Total	First Picking	Total	First Picking	Total	First Picking	Total
	$N+P_2O_5+K_2O$									
Solid Planting										
	None		1120	1880	1350	1890	1260	1460	1020	1140
	25+25+25		1050	1850	1510	2130	1640	1830	1350	1500
	50+50+50		1040	1830	1400	2070	1800	2110	1580	1800
	50+50+50	50	840	1590	1260	1990	1610	1950	1620	1880
Two Rows Cotton - One Skip										
	None		1200	2170	1610	2370	1480	1710	1310	1490
	25+25+25		1220	2210	1460	2260	1900	2190	1610	1820
	50+50+50		1330	2320	1770	2660	2050	2370	1620	1860
	50+50+50	50	1260	2290	1450	2410	2100	2510	1880	2180

TABLE 1 (cont.)

Method of Planting	Soil Treatment		Pounds Seed Cotton Per Acre							
			Sandy Loam				Clay			
			Non-Irrigated		Irrigated		Non-Irrigated		Irrigated	
	At Planting $N+P_2O_5+K_2O$	Nitrogen Sidedress	First Picking	Total	First Picking	Total	First Picking	Total	First Picking	Total
Two Rows Cotton - Two Skip										
	None		1310	2210	1520	2360	1700	1940	1570	1740
	25+25+25		1280	2220	1540	2500	1930	2220	1660	1890
Rate of Planting Treatment	50+50+50		1180	2140	1480	2360	2090	2440	1780	2060
	50 +50+50	50	1020	1970	1580	2500	1920	2310	1780	2120
Interaction										
L. S. D.	.05		N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.
	.20		140	N. S.	170	N. S.	N. S.	N. S.	N. S.	N. S.
ANALYSIS OF VARIANCE FOR TREATMENT										
	None		1210	2090	1490	2200	1480	1700	1300	1460
	25+25+25		1180	2090	1500	2290	1820	2080	1540	1740
	50+50+50		1180	2100	1550	2360	1980	2300	1660	1900
	50+50+50	50	1040	1950	1430	2300	1880	2260	1760	2060
L. S. D.	.05		120	N. S.	N. S.	N. S.	140	140	190	200
	.20		80	100	N. S.	N. S.	90	90	120	140

ANALYSIS OF VARIANCE FOR METHOD OF PLANTING

Solid Planting	1010	1790	1380	2020	1580	1830	1390	1580
Two Rows Cotton - One Skip	1250	2250	1570	2420	1880	2200	1600	1840
Two Rows Cotton - Two Skip	1200	2140	1530	2430	1910	2230	1700	1950
L. S. D. .05	110	140	130	160	N. S.	N. S.	N. S.	N. S.
.20	70	90	80	100	210	220	N. S.	N. S.
Auburn M Cotton planted			May 5				May 4	
Irrigated			August 3				August 10	

CROP ROTATION EXPERIMENT

The purpose of this experiment is to study the effect of the preceding crops on the yield of cotton grown on two soil types. The experiment is located at the Portageville experiment field. Cotton is grown in rotation with various combinations of other crops. This experiment is in the second year and the full effect of preceding crops is not yet apparent.

So far the data indicate a definite advantage to rotating the cotton with other crops on the sandy loam soil. All rotations were significantly better than continuous cotton and cotton preceded by fescue was slightly better than any other rotation. This area had been in cotton for many years before the experiment field was established.

On the clay soil cotton produced a significantly greater yield following corn and soybeans, compared with cotton following cotton. Cotton following soybeans was somewhat better than cotton following corn. This area, unlike the loam soil, previously was used for growing rice and soybeans. Cotton is difficult to produce on this soil type due to tillage problems.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field

Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Sandy Loam	1.4	224+	540	160	1700	4.8	2.5	8.1
Clay	3.2	160	500	940	7000+	5.3	3.8	22.1

Crop Sequence			Pounds Seed Cotton Per Acre			
			Sandy Loam Soil		Clay Soil	
First Year	Second Year	Third Year	First Picking	Total	First Picking	Total
Cotton	Soybeans	Corn	1900	2266	2530	2890
Cotton	Soybeans	Wheat-Sudan	2000	2310	2410	2720
Cotton	Soybeans	Wheat-Soybeans	1950	2290	2400	2750
Cotton	Soybeans	Soybeans	1980	2280	2580	3035
Cotton	Fescue	Fescue	2040	2340	2280	2740
Cotton	Cotton	Cotton	1590	1830	2320	2710
L. S. D. .05			180	190	160	150
.20			110	120	100	90
Cotton Variety			Auburn M		Rex	
Date of Planting			May 1		May 5	
Fertilizer Applied at Planting			50+50+50		50+50+50	
50 pounds Nitrogen Sidedressed			May 20		June 24	
Irrigated			August 7		No water	

All crops in rotation fertilized at optimum rates.

COVER CROP EXPERIMENT

The cover crop experiment was designed to determine if the beneficial effects of a different crop preceding cotton could be obtained by using a winter cover crop.

On the loam soil, rye plus vetch and field brome were slightly better than no cover crop. Austrian winter peas had an apparent adverse effect. Observations in the spring after cotton was up indicated a decrease in stand on the plots which had cover crops. The cover crops were turned under just prior to planting.

Cover crops on the clay soil indicate a depression of yields as compared to the check plot. This same effect has occurred in previous seasons. Studies with rates of nitrogen indicate that on this soil 100 pounds N is optimum. Where cover crop residues are turned down just preceding planting, higher rates of N may be necessary.

It has been very difficult to obtain perfect stands of cover crops the last three years due to the dry fall months. Cover crop planting should be done in September. This is too late to apply irrigation water because of probable injury to the standing cotton crop. Good methods of establishing cover crops in standing cotton have yet to be developed.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C.E.C.
Sandy Loam	1.3	224+	520	160	1700	4.9	2.0	7.8
Clay	2.8	176	530	948	6300	6.0	4.0	24.4

	Pounds Seed Cotton Per Acre			
	Sandy Loam		Clay	
Cover Crop	First Picking	Total	First Picking	Total
None	1550	1810	2290	2700
Rye	1570	1880	2150	2570
Rye & Vetch	1560	1970	2020	2510
Dixie Crimson Clover	1620	1910	2130	2560
Austrian Winter Peas	1330	1720	1790	2360
Field Brome	1660	2020	2140	2660
Rye Grass	1520	1890	2210	2630
L.S.D. .05	N.S.	N.S.	N.S.	N.S.
.20	140	140	200	N.S.

Cotton planted		Auburn M - May 1	Rex - May 5
Fertilizer applied	Starter	12+48+48	50+50+50
	Sidedress June 24	50+0+0	50+0+0

MINOR ELEMENT EXPERIMENT

Objective of this experiment was to verify some of the experimental work conducted in the greenhouse during the winter 1963-1964. In the greenhouse, soil from Clarkton Field indicated a boron deficiency where large amounts of limestone were applied. In the field, during the growing season deficiency symptoms did not develop.

Data in the table indicate an increase in yield on the area where an additional 4 tons of fine lime was applied. On the area where no fine lime was applied in 1964 the preemergence herbicide with 0.75 pound of boron yielded the highest and was one of the highest producing treatments on the fine lime area. This treatment, as well as 2.0 pounds of boron either banded or broadcast, produced some increase.

This experiment will be continued as boron deficiencies tend to vary with the season. In 1964 there were no fields reported or observed with boron deficiency symptoms in the delta area.

The greenhouse studies also indicated a response to copper and zinc but the response to these elements in the field was not statistically significant.

TABLE 1 -- EXPERIMENTAL RESULTS

Clarkton Field

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Topsoil:	0.7	202	130	160	1300	4.9	2.0	6.0	Sand
Subsoil:	0.6	90	130	140	1700	4.2	2.0	7.0	Sand

*Soil Treatment (Pounds per Acre)	Pounds Seed Cotton Per Acre			
	** No Fine Lime		** 4T Fine Lime '64	
	First Picking	Total	First Picking	Total
No Trace Elements	1490	1940	1640	2220
0.5 Boron Banded	1370	1720	1550	1940
0.5 Boron Broadcast	1610	2070	1640	2120
1.0 Boron Banded	1570	1950	1750	2240
1.0 Boron Broadcast	1550	1980	1780	2250
2.0 Boron Banded	1680	2160	1820	2500
2.0 Boron Broadcast	1460	1930	1880	2430
4.0 Boron Broadcast	1430	2030	1760	2300
0.75 Boron with Herbicide	1810	2300	2010	2500
20 Copper Sulphate Banded	1600	2010	1740	2270
20 Zinc Sulphate Banded	1710	2220	1650	2250
L. S. D. .05	N. S.	N. S.	N. S.	N. S.
.20	N. S.	N. S.	N. S.	240

Auburn M cotton planted April 29

Irrigated as needed.

** Four ton dolomitic limestone applied to all plots in 1963.

* All plots 50+50+50 banded at planting.

NITROGEN REQUIREMENTS OF CORN

This experiment was designed to determine the optimum rates of planting and nitrogen application for corn in southeast Missouri. At the lower rates of nitrogen the 12,000 and 15,000 plants were superior to the higher planting rates.

One hundred pounds of N at the 15,000 plant population produced 13 bushels per acre. An additional 100 pounds of N produced a yield of 137 bushels per acre, which may not have been an economical increase. However, the 200 pounds N produced 144 bushels per acre at the 19,000 plant population. This could be an economical yield increase.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Experiment Field

Soil Type: Sandy Loam

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Topsoil:	2.2	224+	440	300	2800	4.8	3.5	12.5
Subsoil:	2.0	185	260	320	3100	5.0	3.0	12.5

Soil Treatment			Yield in Bushels per Acre with per Acre Planting Rates of:			
Plowdown	Starter	Sidedress				
$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	12,000	15,000	19,000	24,000
	0+25+25		51	29	17	21
	25+25+25		60	41	28	33
25+0+0	25+25+25		91	69	42	63
50+0+0	25+25+25		95	105	82	101
75+0+0	25+25+25		117	130	104	114
75+0+0	25+25+25	50+0+0	123	133	133	139
75+0+0	25+25+25	100+0+0	128	137	144	140

L. S. D. .05 For plant population 28 bushels

L. S. D. .05 For nitrogen treatment 7 bushels

Single Cross corn planted April 16. Harvested September 8.

Plowdown soil treatment applied April 11; Starter April 16; and Sidedress May 20.

Irrigated June 6, 16, 22, July 1, and July 10.

FERTILIZER REQUIREMENTS OF CORN

This experiment indicates that the corn fertilizer (125+50+50) sidedressed a month after planting yielded as well as the corn that had starter (25+25+25) plus nitrogen (100+25+25) sidedressed. The highest yield obtained had a soil treatment of 150+50+50 sidedressed in addition to the 25+25+25 starter. The very high soil test values for phosphorus and potash would indicate that nitrogen would be the only element that would give yield increases.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field

Initial Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Topsoil:	2.2	224+	440	300	2800	4.8	3.5	12.5	Sandy Loam
Subsoil:	2.0	185	260	320	3100	5.0	3.0	12.5	Sandy Loam

Soil Treatment		Bushels Per Acre Yield
Starter	Sidedress	
None	None	46
None	125+50+50	140
25+25+25	None	38
25+25+25	50+50+50	97
25+25+25	75+75+75	123
25+25+25	75+0+0	108
25+25+25	100+25+25	134
25+25+25	100+50+50	126
25+25+25	150+50+50	156
25+25+25	100+0+0	124
L. S. D.	.05	39
	.20	24

Single Cross Corn planted and starter fertilizer applied April 16.

Sidedressed May 20

Irrigated June 6, 16, 22, July 1, and July 10

Stalk Count 18,000 plants per acre.

METHODS OF APPLYING FERTILIZER TO CORN

Objective of this experiment was to determine the most desirable method of fertilizing corn.

The data indicate the most efficient use of fertilizer on these clay and sandy loam soils was the banding of the starter at planting and sidedressing additional nitrogen. There appears to be no advantage to including phosphate with the nitrogen in sidedressing.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville and Sikeston Fields

Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Portageville:	1.9	160	550	940	5600	4.6	5.5	24.0	Sharkey Clay
Sikeston:	0.8	163	260	120	1300	4.9	2.0	6.0	Sandy Loam

Soil Treatment			Bushels of Corn Per Acre			
Preplant	Band At Planting	Sidedress				
$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	$N+P_2O_5+K_2O$	Portageville-Clay		Sikeston	
			1964	2 yr. Average	1964	2 year Average
No treatment			19	45	46	49
50+50+50 Broadcast and bed			33	67	72	81
100+100+100 Broadcast and bed			58	91	115	109
50+50+50 Band under bed			32	64	87	88
100+100+100 Band under bed			74	99	112	104
	50+50+50		52	80	103	104
	100+100+100		83	105	122	117
	13+50+50		25	53	43	51
	13+50+50	37+0+0	64	92	97	96
	26+100+100	74+0+0	101	117	127	117
	13+50+50	75+0+0	92	113	127	117
	13+50+50	100+0+0	104	119	131	127
	13+50+50	100+33+0	99	120	132	122
L. S. D. .05			7	--	23	--
.20			5	--	15	--

Corn planted — 523W - April 25 — Pioneer 3304 - April 15

Corn irrigated four times at Portageville and three times at Sikeston.

LIME REQUIREMENT OF SOYBEANS

This experiment was designed to determine the need for limestone by soybeans on the two soil types at the Portageville field.

The data show that on the sandy loam, fertilizer was better than no lime, one or two tons of limestone were better than fertilizer alone, and four tons of limestone plus 20+50+50 were better than two tons of limestone.

Irrigation appears to give a more favorable response than soil treatment in this experiment. The soil test values are within the range that yield increases due to additional fertilizer would not be expected. Fertilizer applications that will produce profitable yield increases of soybeans are still unknown except where fertility levels are fairly low.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field

Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C.E.C.
Sandy Loam:	1.7	224+	440	260	2500	4.8	3.0	11.0
Clay:	1.9	224+	310	940	6000	5.6	2.0	21.5

Soil Treatment		Bushels of Soybeans Per Acre		
Tons Limestone	Annual Fertilizer	Sandy Loam		Clay
Plowed down 1963	$N+P_2O_5+K_2O$	Non-Irrigated	Irrigated	
None	None	38	47	34
None	20+50+50	41	48	34
1	None	43	48	36
1	20+50+50	41	48	36
2	None	43	49	36
2	20+50+50	43	48	37
4	None	45	49	35
4	20+50+50	47	51	34
Average		43	49	35
L.S.D.	.05	2.6	N.S.	N.S.
	.20	1.6	N.S.	N.S.
ANALYSIS OF VARIANCE FOR LIMESTONE				
None		--	47	33
1		--	48	36
2		--	48	37
4		--	50	34
L.S.D.	.05		N.S.	N.S.
	.20		1.2	N.S.
ANALYSIS OF VARIANCE FOR FERTILIZER				
	None	--	48	35
	20+50+50	--	49	35
L.S.D.	.05		N.S.	N.S.
	.20		N.S.	N.S.
Hill Soybeans planted		May 6	May 6	May 6
Irrigated		None	July 7 August 5	None

Fertilizer banded at planting.

PHOSPHORUS AND POTASH FOR SOYBEANS

Soybeans have not responded to phosphate and potash applications, as indicated in the table above. The soil test indicated a high level of both nutrients present in the soil, which may account for lack of response.

Irrigation increased yield 2 bushels whereas a 7 bushel increase was obtained in 1963.

TABLE 1 -- EXPERIMENTAL RESULTS

Portageville Field								
Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Sandy Loam	1.4	224+	540	160	1700	4.8	2.5	8.2
Clay	1.9	224+	310	940	6000	5.6	2.0	21.5

Soil Treatment	Bushels of Soybeans Per Acre		
$N+P_2O_5+K_2O$	Sandy Loam		Clay
	Non-Irrigated	Irrigated	
None	46	46	35
0+30+0	42	46	37
0+60+0	46	47	37
0+0+30	44	47	34
0+0+60	41	42	36
0+30+30	43	43	36
0+30+60	43	39	36
0+60+30	42	46	38
0+60+60	43	46	35
Average	43	45	36
L. S. D. .05	N. S.	N. S.	N. S.
.20	N. S.	N. S.	N. S.
Hill soybeans planted	May 6	May 6	May 6
Irrigated	None	August 8	None

Fertilizer banded at planting.

Two ton agricultural limestone applied to sandy loam soil March 1963.

SOIL FERTILITY EXPERIMENTS WITH SOYBEANS

These experiments were conducted with cooperative farmers of the area to determine the need for various plant nutrients in soybean production.

The soil treatments were applied to four rows across the farmer's field for each of the treatments. These four-row plots were divided in 100 foot lengths or "replications" and each replication was harvested separately. Soil tests were made from each of the 100 foot plots with the intention of making a comparison with the yield from each respective plot. The data in the table are the averages for each treatment.

All locations indicated a small response to 30 pounds of potash. Rainfall was below normal during the growing season and low soil moisture probably limited response to fertilizer. The application of phosphate appeared to have little effect on yields even though the soils at some locations had a low phosphorous test value. The trace elements mixture did not improve yields and may have caused a yield depression at one location. Fifty pounds of fine lime with potash increased yield on the Parrish farm but had no effect at the other locations.

SOIL FERTILITY EXPERIMENTS - SOYBEANS - 1964

PHOSPHOROUS, POTASSIUM, AND TRACE ELEMENTS

Farmer Cooperator Experiments									
Soil Tests:	OM	P_2O_5	K	Mg.	Ca.	H	pH	C. E. C.	Soil Type
Harvey Lee, Qulin	1.4	46	136	290	1700	3.1	4.7	8.5	Silt Loam
H. Parrish, Naylor	1.4	116	82	344	1900	3.0	4.5	8.0	Silt Loam
G. Wyatt, Naylor	0.9	46	59	153	1130	2.5	4.4	6.0	Silt Loam
R. Slaughter, Senath	1.8	207	93	565	2950	1.0	5.8	10.9	Sand
S. McAnally, Dudley	1.3	29	125	205	1990	2.4	4.9	8.0	Silt Loam

Soil Treatment	Bushels of Soybeans Per Acre				
$N+P_2O_5+K_2O$	Lee	Parrish	Wyatt	Slaughter	McAnally
No Treatment	19	13	26	19	16
0+0+30	22	25	29	17	20
0+0+60	21	27	29	21	18
0+0+90	18	28	27	21	17
0+30+0	18	15	28	20	18
0+60+0	19	15	27	20	17
*Trace Element Mix 1	18	14	25	21	15
*Trace Element Mix 2	16	14	26	19	16
0+0+30+50 Fine Lime	19	29	23	20	16
33+0+0	--	--	30	--	--
35+8+24	--	--	27	--	--
2+8+24	--	--	24	--	--
Variety	Hood	Hill	Hood	Lee	Ogden
Fertilizer sidedressed	June 14	June 16	June 16	June 10	June 23

FERTILIZER EXPERIMENTS WITH WHEAT

The data from these experiments can be summarized as follows:

Clarkton (Sandy soil): Phosphorous and potash can be supplied in a starter fertilizer (9+36+36) and both are needed in the starter. Nitrogen gives statistically significant yield increase up to 132 pounds providing phosphorus and potash are applied in equal ratio.

Kalkbrenner (fine sandy loam - low fertility): The best results were obtained with a starter fertilizer of 9+36+36 and 66 pounds N at either planting time or in March.

Sikeston (sandy loam - high fertility): No phosphorus and potash needs were indicated. Sixty-six pounds N at planting or in March.

Portageville (fine sandy loam - high fertility): No phosphorus and potash needs indicated. Thirty-three pounds N in March.

Portageville (clay - high fertility): 9+36+36 starter with 33 pounds N in March.

TABLE 1 -- EXPERIMENTAL RESULTS

SUMMARY OF SOIL TESTS

Location:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.	Soil Type
Sikeston Field	2.4	350	475	93	1470	5.0	2.0	6.7	Sandy Loam
Clarkton Field	1.0	240	135	30	0	4.4	3.5	3.8	Sand
Kalkbrenner (Cooperator) (Five miles N.W. of Qulin)	1.7	58	90	660	3000	6.0	1.0	11.5	Fine Sandy Loam
Portageville Field	1.7	224+	590	300	2500	4.8	3.0	11.1	Fine Sandy Loam
Portageville Field	2.4	189	455	940	6500	5.5	4.0	24.7	Clay

Limestone has been applied to Clarkton and Portageville-Loam since initial soil tests were taken. Additional soil tests will be taken at completion of experiment.

Soil Treatments			Bushels of Wheat Per Acre				
Basic Plowdown	Starter $N+P_2O_5+K_2O$	Nitrogen Top Dress	Sikeston	Clarkton	Kalkbrenner	Portageville Loam*	Clay
Influence of Starter Fertilizers, Phosphate, and Nitrogen on Wheat Yields.							
No Treatment			38	12	17	34	36
	9+36+36	None	41	16	20	37	40
	None	33# March	48	27	30	42	46
	9+36+36	33# March	49	29	32	44	49
	None	66# March	51	27	35	43	50
	9+36+36	66# March	51	33	39	43	52

TABLE 1 (cont.)

Soil Treatments			Bushels of Wheat per Acre				
Basic Plowdown	Starter $N+P_2O_5+K_2O$	Nitrogen Top Dress	Sikeston	Clarkton	Kalkbrenner	Portageville Loam	Portageville Clay
Influence of Time of Nitrogen Applications on Yields of Wheat							
	9+36+36	66# Seeding	54	23	43	43	45
	9+36+36	66# January	52	24	37	47	43
	9+36+36	66# March	52	35	41	46	43
	9+36+36	66# April	52	32	39	45	45
	9+36+36	66# March	51	34	41	43	41
	100# Traces						
L. S. D.	.05		N. S.	3	2	N. S.	N. S.
Influence of Starter Fertilizers on Wheat Yields.							
	9+36+36	66# March	52	42	40	46	52
		75+36+36 March	55	41	37	48	50
	9+0+36	66# March	53	37	40	46	49
	9+36+0	66# March	52	43	38	48	50
	6+24+24	69# March	52	42	41	45	49
	12+48+12	63# March	51	42	40	48	49
L. S. D.	.05		N. S.	N. S.	2	N. S.	N. S.

* Plowdown treatment

TABLE 1 (cont.)

Soil Treatments			Bushels of Wheat Per Acre				
Basic Plowdown	Starter $N+P_2O_5+K_2O$	Nitrogen Top Dress	Sikeston	Clarkton	Kalkbrenner	Portageville Loam*	Portageville Clay
	9+36+36	100# March	49	36	41	38	51
	9+36+36	132# March	48	40	40	29	51
0+400+0	9+36+36	None	44	16	21	40	44
0+400+0	9+36+36	33# March	49	30	31	43	50
0+400+0	9+36+36	66# March	51	35	37	42	53
0+400+0	9+36+36	100# March	49	40	38	36	51
0+400+0	9+36+36	132# March	43	41	37	30	50
L. S. D. .05			3	3	3	7	7

SOIL FERTILITY EXPERIMENTS WITH SUGAR BEET

Soil fertility studies with sugar beets were made on the sandy loam and clay soil at the Delta Center near Portageville. On the sandy loam soil experiments were initiated to study favorable rates of limestone and the effect of irrigation.

The yields of sugar beets were considerably higher than in 1963. Percent sugar increased with later harvest. Three harvests were made, October 19, November 13, and December 9. The clay soil produced the highest yields of the two soil types.

The sandy loam soil was very difficult to irrigate due to poor penetration of the water which is probably the reason for the small increase in yield from irrigation. It was evident that sugar beets could deplete the soil moisture from greater depths than could cotton or corn grown at Portageville.

The application of limestone did not affect the yields of sugar beets in 1964. Since the limestone was applied just prior to planting it may not have had time to be of benefit.

Spraying of copper sulphate was done on a 14 day schedule during the growing season to prevent leaf diseases. There was little indication that leaf diseases would have been a problem in 1964 with the variety grown, until the wet period in September.

Nitrogen appears to be the most critical nutrient with sugar beets at the Portageville field. Nitrogen sidedressed on July 27 produced the higher yields on the clay soil but with a slight depression in sugar content. The data indicates a need for 150 to 200 pounds of total nitrogen applied in split applications.

The March 1st planting was killed after emergence by a late freeze with temperatures below 20° F. It was necessary to plant three times on the sandy loam soil and two times on the clay soil before satisfactory stands were obtained. Early planting, preferably in February, seem to be essential in sugar beet production because of weeds and diseases that affect the later plantings.

Additional research is needed if sugar beets are to be grown in Southeast Missouri anytime in the future. The data and observations indicate that this crop can be grown successfully but there are numerous problems that need to be solved before culture of sugar beets can be relatively free of hazards.

The highest yield of beets was on the clay soil plots receiving 100+100+100 banded at planting and 50 pounds N sidedressed June 3 and July 27. The percentage of sugar in these beets was 14.7. This yield was not significantly greater,

however, than that produced by 100+50+50 and 50 pounds N sidedressed on June 3 and July 27. Treatments that did not include the July 27 application of nitrogen produced yields that were lower than those receiving it.

The treatment producing the highest percentage of sugar, 15.3, was 150+100+100 banded at planting with no extra nitrogen. The yield from this treatment was 29.5 tons. The difference in percentage sugar between 150+100+100 and 100+100+100 pounds N sidedressed in two applications was not statistically different.

The largest yield on the loam soil was 25.6 tons produced with a fertilizer treatment of 100+100+100 banded at planting time. More than 100 pounds of N applied in any manner did not increase yields on this soil. 50+50+50 produced a yield of 23.3 tons per acre which was significantly greater than no treatment. The yield difference between 50+50+50 and 100+100+100 was statistically significant. The percentage of sugar was also statistically different between these two treatments, but in favor of the 50+50+50. This same reverse relationship existed for the percentage of purity for the two treatments.

Date of harvest had a statistically significant effect on percentage of sugar on both soil types, the November 13 harvest producing the greatest amount of sugar. In the case of total yield the highest tonnage was produced at the October 19 harvest date. The yields on the loam soil were not significantly greater at other harvests but were significantly greater on the clay soil.

The experiment studying the effect of limestone on yield of sugar beets on the sandy loam soil did not give significant yield increase in 1964.

The irrigation experiment gave statistically significant yield increase of 3.7 tons in the sandy loam soil.

TABLE 1 -- EXPERIMENTAL RESULTS WITH FERTILIZER

Portageville Field

Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C. E. C.
Sandy Loam	2.5	208	300	320	4200	5.0	2.0	14.0
Clay	2.7	346	360	940	7000	5.9	2.0	24.0

* Soil Treatment			*** Summary of Three Harvests					
			Sandy Loam Soil			Clay Soil		
Band at Planting	Nitrogen Sidedress		Percent	Juice Purity	Yield Tons Per	Percent	Juice Purity	Yield Tons Per
$N+P_2O_5+K_2O$	June 3	July 27	Sugar	Percent	Acre	Sugar	Percent	Acre
No Treatment			15.6	94.5	22.0	15.3	94.9	17.5
0+50+50			16.1	95.0	22.2	15.5	95.0	17.7
25+50+50			15.0	94.4	23.1	15.2	95.2	22.0
50+50+50			15.5	94.6	23.3	14.8	94.4	23.9
50+0+50	50#		14.6	92.7	25.0	15.0	94.3	28.2
50+50+0	50#		14.8	93.7	22.2	14.5	94.6	30.5
50+0+0			14.7	94.0	23.5	14.6	94.9	23.8
50+0+0	50#		14.7	93.2	22.7	14.8	94.0	29.7
100+50+50			15.2	93.7	22.8	15.1	94.4	28.4
100+50+50	50#		14.2	92.3	24.0	14.4	93.4	30.2
100+50+50	50#	50#	14.1	92.0	24.8	14.9	93.6	34.5
100+50+50	100#		13.8	91.2	23.1	14.3	93.2	33.0
100+50+50	100#	50#	13.3	91.8	23.4	14.2	93.2	34.7

TABLE 1 (cont.)

100+100+100	50#	50#	14.5	93.0	24.5	14.7	94.0	36.3
100+100+100	50#		14.3	92.7	25.4	14.9	93.9	31.9
100+100+100			14.5	93.0	25.6	15.2	94.3	29.1
150+100+100			14.8	93.8	23.9	15.3	94.2	29.5
100+25+25			14.8	92.7	24.0	14.7	94.4	30.1
**100+100+100	50#	50#	13.1	91.7	24.8	14.9	93.6	31.7
100+100+100+Boron			14.6	93.2	23.9	14.8	94.2	29.2
L.S.D. .05			0.8	0.9	2.2	0.7	0.8	2.5
.20			0.6	0.6	1.5	0.5	0.5	1.7

ANALYSIS OF VARIANCE FOR HARVEST

Date of Harvest							
October 19	13.7	92.8	24.3	14.7	94.1	31.1
November 13	15.7	93.2	23.1	15.7	94.3	28.3
December 9	14.5	93.5	23.8	14.3	94.3	26.5
L.S.D. .05	0.3	N.S.	N.S.	0.3	N.S.	1.0
.20	0.2	N.S.	N.S.	0.2	0.2	0.6

* All plots, except limestone experiment, had 4 ton agricultural limestone broadcast and plowed down prior to planting.

Irrigation water applied Loam: June 4, 15, 22, 29, July 9, Aug. 3, and Sept. 11.
Clay: June 4, 16, 30, Aug. 10, and Aug. 14.

** Fertilizer (100+100+100) broadcast on bed instead of banding.

*** Three harvests were made: October 19, November 13, and December 9. The above data are means of all three harvests.

Sugar beets were all sprayed with copper sulphate every 14 days beginning June 13 and ending September 2 with one additional spraying October 17.

TABLE 2 -- EXPERIMENTS WITH LIMESTONE

Limestone	Fertilizer			
None	150+100+100	13.6	91.2	24.8
500# Fine Lime Banded	150+100+100	14.4	91.9	25.3
4 Ton Ag. Lime Plowed Down	150+100+100	14.3	92.2	25.2
500# Hydrated Lime Banded	150+100+100	14.4	91.6	25.6
L.S.D. .05		N.S.	N.S.	N.S.
.20		0.5	N.S.	N.S.

ANALYSIS OF VARIANCE FOR HARVEST

Date of Harvest				
October 19		13.1	91.2	26.3
November 13		15.7	91.7	24.6
December 9		13.8	92.4	24.8
L.S.D.	.05	0.7	0.9	N.S.
	.20	0.5	0.6	1.1

IRRIGATION EXPERIMENT

		Sandy Loam Soil			Clay Soil		
		Percent Sugar	Juice Purity	Yield Tons Per Acre			
Non-Irrigated	150+100+100	12.5	92.0	20.7	--	--	--
Irrigated	150+100+100	13.7	91.9	24.4	--	--	--
L.S.D.	.05			3.6			
	.20			2.2			
Date of Planting		April 18			March 30		
Beets Thinned		May 4			May 4		

SOIL FERTILITY EXPERIMENTS WITH ALFALFA

This experiment was designed to study lime and fertilizer needs and longevity of stand in Sharky clay soil. All plots still have a good stand on them and no great yield differences due to treatment are yet apparent.

SOIL FERTILITY EXPERIMENTS - ALFALFA - 1964

PHOSPHOROUS, POTASSIUM, AND LIMESTONE

Portageville Field - Clay Soil

Soil Test:	OM	P_2O_5	K	Mg.	Ca.	pH	H	C.E.C.
Topsoil:	2.9	156	360	840	6000	5.7	2.0	21.0
Subsoil:	1.9	203	400	965	6400	6.4	1.0	21.5

Plowdown Soil Treatment

Limestone Tons Per Acre	Fertilizer $N+P_2O_5+K_2O$	Tons of Hay Per Acre
None	None	5.9
None	0+400+0	6.7
None	0+400+200	6.9
None	0+0+200	7.2
3	None	6.4
3	0+400+0	5.8
3	0+400+200	6.3
3	0+0+200	6.6
6	None	7.2
6	0+400+0	7.5
6	0+400+200	7.1
6	0+0+200	7.4

Fertilizer and limestone plowed down in fall 1961.

First and second seedings lost with above seeding in fall 1962.

* Means of three replications