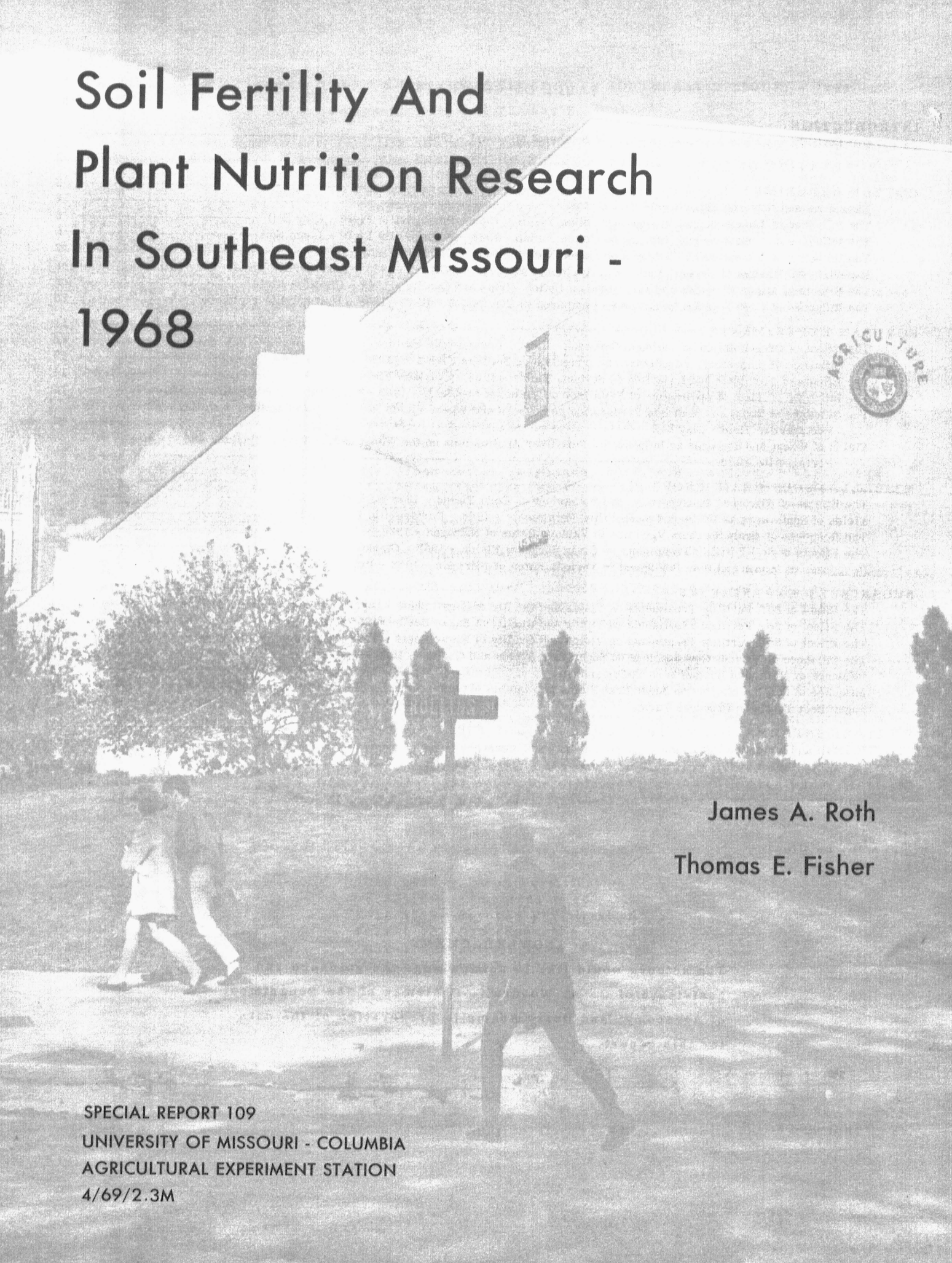
Soil Fertility And Plant Nutrition Research In Southeast Missouri - 1968



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SOIL FERTILITY AND PLANT NUTRITION RESEARCH IN SOUTHEAST MISSOURI - 1968

James A. Roth and Thomas E. Fisher[1/]

The 1968 studies in soil fertility and plant nutrition included experiments on three prominent soil types of southeast Missouri. The Portageville Field has two soils one of which is a Tiptonville silt loam or clay loam with a sandy loam overwash phase and is referred to in this report as the "Loam" soil. The other soil on the Portageville Field is a Sharkey clay and is referred to as the "Clay" soil in this report. The Clarkton Field consists of a Beulah fine sandy loam formerly classified as of the Dexter series. The Qulin Field on which experiments are in progress is located on a Waverly-Calhoun silt loam soil.

The growing season in some areas of Southeast Missouri was deficient in rainfall to the extent that yields of cotton and soybeans were reduced considerably. Other areas received ample rainfall and yields were average or above. The area as a whole experienced yields of cotton and soybeans below the ten year average.

Soil tests are included for the soil area occupied by each of the soil fertility experiments. The topsoil test is obtained from a sample taken from 0 to 7 inches deep whereas the subsoil sample from 7 to 14 inches deep. Soil tests represent an inventory of the available nutrients of the soil and an indication of the soils acidity (pH). The soils of the Portageville and Clarkton Fields generally test high in available phosphorous and potassium to the extent that little or no response to these nutrients has been obtained.

Field experiments included the crops cotton, soybeans, corn, grain sorghum, wheat, sunflowers, alfalfa and sugar beets. This was the first year that grain sorghum and sunflowers have been included in fertility trials. Sugar beet research was expanded in 1968 which completes eight years of investigations of this crop under southeast Missouri conditions.

During the year experiments were initiated at the Qulin Field which is located approximately three miles west of Qulin, Missouri. This field has very low testing soil and will provide excellent conditions for correlating crop yields with soil test values as influenced by soil treatments. Experiments will include rates of limestone, phosphorous and potassium on cotton, corn, soybeans, and wheat. Irrigation will be available at the field so as to eliminate soil moisture as controlling crop yields.

Greenhouse experiments were in progress to determine effect of limestone sources and rates on seven soils of southeast Missouri. Soil samples obtained annually determine the change in soil test value as time progresses. Other experiments in the greenhouse include experiments with limestone and trace elements to determine the nutrient requirements of the soil from the Qulin Field.

The 1968 data in this report must be used with caution as one year's data may not be as conclusive to a practice under different seasonal conditions. In some of the following experiments average yields over a period of years are shown but statistical analysis has not been completed on these data.

This report is a contribution of the Department of Agronomy's research projects as follows:

7033-2670--Cotton Fertilization
7033-4860--Limestone Needs
7033-3570--Soybean Fertilization
7033-1170--Crop Sequence
7033-1780--Soils & Plant Nutrition
7033-4920--Sugar Beets

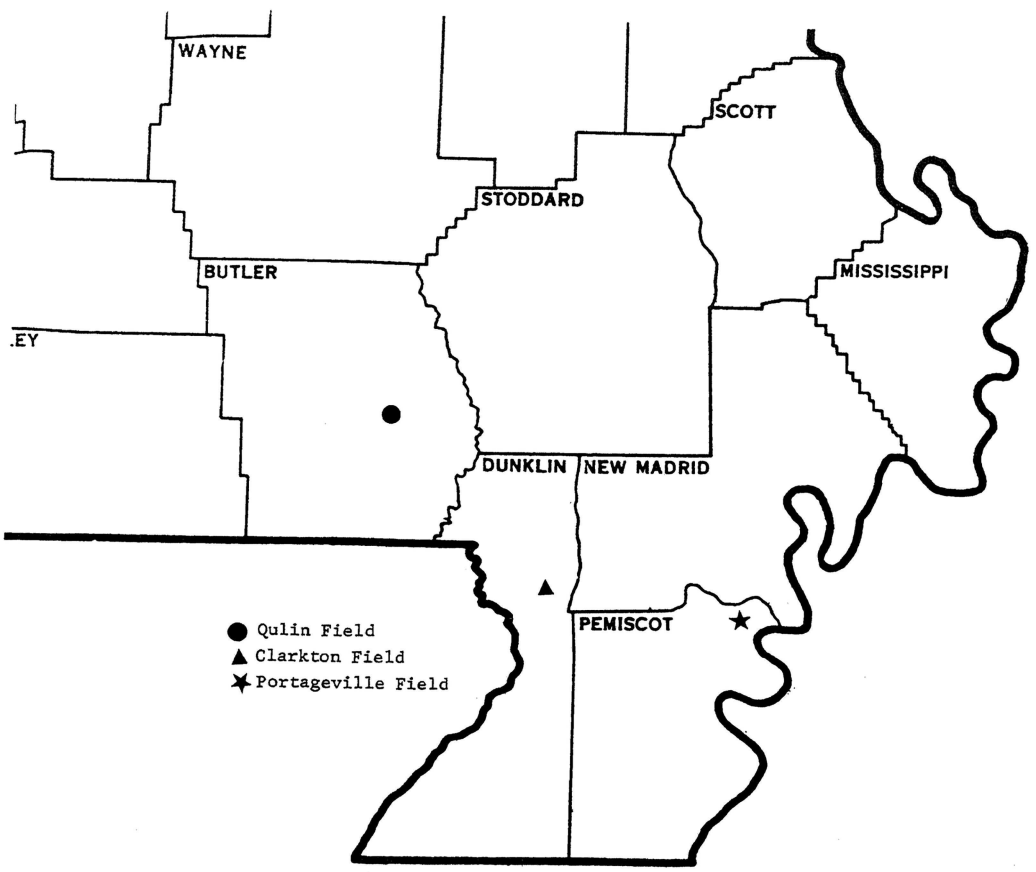
1/ James A. Roth, Assistant Professor of Agronomy (Soil Fertility) and Thomas E. Fisher, Technician, located at the Delta Center, Portageville, Missouri.

INTERPRETATION OF DATA

Statistical analyses has been computed for most of the data in this report as an attempt to determine if the differences among yields were due to the treatment applied or due to factors which cannot be controlled. Duncan's New Multiple Range Test was used and is shown by the small letters after the data.

Do not be confused by these letters as they are meant to be used as an aid in evaluating the data. For example: in a column of yields (or other results) which lists the treatments, one may readily see that any two treatments are different providing the same letter is not after both treatments. If the two treatment yields being compared are followed by the same letter then both of the treatments are considered to be equal in their capacity to improve yields. In some cases the yields following the treatments may have the same letter as the no treatment. This means the treatment applied was not different from the no treatment at a 5% level of error probability.

The analysis has been computed at the 5% level which means that 95 times out of 100 any differences among yields as indicated by the Duncan's Test are probably due to treatments and 5 times to chance alone.



COTTON EXPERIMENTS

Cotton in 1968 was grown in southeast Missouri on 190,000 acres with an estimated yield of 493 pounds of lint per acre. This compares with a five year average of 319,000 acres and an average lint of 549 pounds per acre. Reduced acreage allottments and lower price supports have resulted in cotton approaching a period of uncertainty in the years ahead unless cost of production can be reduced in southeast Missouri.

The overall objective in the Soil Fertility and Plant Nutrition research has been to reduce the per pound cost of production. In some cases excessive rates of soil treatments have been applied on farms whereas in many other instances producers have not applied ample quantities of correct nutrients. Nitrogen has probably been the most abused in its application of too high a rate on the sand and sandy loam soils and too low on the clay soils. Limestone has been the most neglected treatment on soils of high acidity or a low pH.

Research in cotton nutrition over a period of years has emphasized that a balanced program of soil fertility practices must be followed for maximum production at economical costs.

Cotton fertility research in 1968 included rates of limestone, sources of limestone, rates of nitrogen, micronutrients, methods of application and continuous cotton in a rotation. Tests were included on three of the fields of the Delta Center. Additional experiments have been initiated at the Qulin Field which has a soil highly acid with low phosphorous, potassium and magnesium tests.

The following tables report the results from the experiments in progress during 1968. Also included are the average total yields of seed cotton since the beginning of the experiment. Percent lint, staple length, and micronaire were obtained from cotton samples taken at harvest but soil treatments appear to have little or no effect on these properties of cotton.

Clarkton Field - No limestone on left (pH 4.0) as compared to four tons on the right (pH 5.5).

LIMESTONE AND NITROGEN EXPERIMENTS WITH COTTON

OBJECTIVE: To determine limestone and nitrogen requirements of cotton on three soils of southeast Missouri.

To determine the effect of nitrogen on the acidity of the soil over a period of years as measured by change in pH.

To determine duration of limestone treatments at the various rates of application, source and size of particles.

PROCEDURE: Experiments were initiated on the clay soil in 1961 at the Portageville Field, on the sandy soil on the Clarkton Field in 1962, and on the loam soil of the Portageville Field in 1963. Cotton has been planted continuously since the beginning of the experiment and soil tests were obtained annually. The 1966-67 report (Special Report 98, January 1969) included the soil test results for 1967 and additional soil test results by treatment will be included in future reports.

The limestone was broadcast disc in and then turned under at each location at the beginning of the experiment. Fertilizer (13+50+50) was banded by the row at time of planting annually and additional nitrogen was sidedressed before first bloom. Except for the plot receiving 500 pounds of fine lime annually, neither of the others have had additional limestone since the experiments were initiated.

Irrigation was available at all locations and used as required.

Cotton was harvested by a machine picker so as to simulate farm conditions. Cotton samples were obtained at harvest from each plot, ginned and classed by U.S.D.A. Classing Office at Hayti, Missouri.

RESULTS & DISCUSSION: The results of the experiment on the clay soil at Portageville (Table 1) indicate that 100 pounds of nitrogen produced the highest yield in 1968, on the plot on which eight tons of limestone was applied in 1961. This same plot also has the highest average yield of 1662 pounds of seed cotton over the seven years that this experiment has been in progress. By 1967 the pH on this plot had been raised to 6.8 as compared to the no treatment plot which had a pH of 5.7. This soil has been very difficult to handle in the production of cotton because of the high clay content which delays planting in the spring. When compared to the loam soil on the Portageville Field, the clay soil has averaged approximately 1000 pounds less in seed cotton yields.

Limestone did not influence the percent lint, staple length, or micronaire significantly in 1968. The 100 pound rate of nitrogen reduced percent of lint significantly and increased micronaire reading. Nitrogen had no affect on staple length this past season.

The loam soil on the Portageville Field (Table 2) produced the highest yields of seed cotton of the three locations. Even though the soil test indicated a need for three tons of limestone, one ton produced the highest yield but this increase was not statistically significant. The higher rates of lime increased yields of seed cotton over the check but below the one or two ton applications.

Yields in 1968 indicate maximum seed cotton with 100 pounds of nitrogen but 25 to 50 pounds of nitrogen was ample over the six year period. Excess nitrogen has been very detrimental on this soil especially during seasons of excessive rainfall.

These data (Table 3) from the experiment located at the Clarkton Field indicate that limestone was very essential in cotton production. In 1968 the highest rate, 12 tons of dolomitic limestone, produced the higher yield of 2187 pounds of seed cotton. This was an increase of over 100% as compared to the no treatment which yielded an average of 1045 pounds of seed cotton.

Even though the soil test indicated a deficiency of magnesium (40 pounds) the calcium carbonate limestone was just as effective as the dolomitic limestone in increasing yields of seed cotton on this soil. Over the seven years that the experiment has been in progress the two ton applications of limestone has been satisfactory but was below the average in 1968. This may indicate that the lower rates should be renewed.

Cotton requires nitrogen on this soil but excessive amounts reduce the yields. In 1968 the application of 25 pounds of nitrogen sidedressed in addition to the 13 pounds in the starter appeared to be sufficient. The 100 pound nitrogen application produced excessive vegetative growth with this cotton variety.

Irrigation water was applied at all locations. Yields were increased usually at all locations except on the clay soil when rain followed the irrigation immediately. The continued saturation of the soil over a period in a few instances reduced the yield of seed cotton materially.

TABLE 1: THE INFLUENCE OF LIMESTONE AND NITROGEN ON COTTON YIELDS - 1968
PORTAGEVILLE FIELD - CLAY SOIL

Initial Soil Test (1961)	O.M.	P_2O_5	K	Mg.	Ca.	pH	H	C.E.C.	Soil Series
Topsoil	2.1	365	443	1020	5630	5.7	2.0	20.8	Sharkey
Subsoil	2.2	190	382	877	6497	5.6	3.0	23.3	

Soil Treatment: Limestone[1] (Tons Per Acre)	Soil Treatment: Nitrogen Sidedressed (Lbs Per A.)	Pounds Seed Cotton Per Acre Total	Percent Lint	Staple Length 1/32 Inches	Micronaire	Seven Year Means[4] Total Pounds Seed Cotton
LIMESTONE X NITROGEN MEANS						
None	25	1092 def[5]	38.8 a[5]	34.7 abc[5]	4.63 a-f[5]	1291
None	50	1095 def	38.6 a	34.3 bc	4.60 a-g	1450
None	100	1224 c-f	38.1 abc	34.7 abc	4.67 a-e	1552
2 Agricultural	25	1130 def	38.5 a	35.3 a	4.63 a-f	1260
2 Agricultural	50	1170 c-f	38.1 abc	35.0 ab	4.77 ab	1482
2 Agricultural	100	1383 a-e	37.3 bc	35.0 ab	4.40 d-g	1565
4 Agricultural	25	987 f	38.1 abc	34.7 abc	4.40 d-g	1374
4 Agricultural	50	1256 b-f	38.2 ab	34.7 abc	4.67 a-e	1649
4 Agricultural	100	1337 a-f	38.1 abc	34.3 bc	4.73 abc	1651
8 Agricultural	25	1345 a-f	38.5 a	34.3 bc	4.43 c-g	1523
8 Agricultural	50	1364 a-e	38.3 ab	34.3 bc	4.50 a-g	1712
8 Agricultural	100	1639 a	38.0 abc	34.3 bc	4.67 a-e	1751
12 Agricultural	25	1060 ef	38.4 a	34.3 bc	4.30 g	1374
12 Agricultural	50	1070 def	38.5 a	34.7 abc	4.43 c-g	1575
12 Agricultural	100	1329 a-f	37.2 c	34.3 bc	4.37 efg	1702
24 Agricultural	25	1421 a-d	38.5 a	34.0 c	4.33 fg	1530
24 Agricultural	50	1507 abc	38.4 a	34.3 bc	4.47 b-g	1649
24 Agricultural	100	1583 ab	37.9 abc	35.0 ab	4.43 c-g	1637
1/4 Fine Lime[2]	25	1100 def	38.4 a	35.3 a	4.50 a-g	1331
1/4 Fine Lime[2]	50	1216 c-f	38.4 a	34.7 abc	4.80 a	1479
1/4 Fine Lime[2]	100	1510 abc	38.2 ab	34.7 abc	4.70 a-d	1669
Minimum Least Significant Range(L.S.D.)(.05)		304	0.89	0.7	0.27	
Maximum Least Significant Range		364	1.06	0.9	0.32	
Coefficient of Variance		14.2%	1.4%	1.3%	3.6%	
LIMESTONE MEANS						
None		1137 a	38.5 a	34.5 a	4.6 a	1431
2 Ton Agricultural Limestone		1228 a	38.0 a	35.1 a	4.6 a	1436
4 Ton Agricultural Limestone		1193 a	38.1 a	34.6 a	4.6 a	1558
8 Ton Agricultural Limestone		1450 a	38.2 a	34.3 a	4.5 a	1662
12 Ton Agricultural Limestone		1153 a	38.0 a	34.4 a	4.4 a	1550
24 Ton Agricultural Limestone		1503 a	38.3 a	34.4 a	4.4 a	1605
1/4 Ton Fine Limestone[2]		1275 a	38.3 a	34.9 a	4.7 a	1493
Minimum Least Significant Range(L.S.D.)(.05)		390	0.7	0.8	0.30	
Maximum Least Significant Range		433	0.8	0.9	0.34	
Coefficient of Variance		29.7%	1.7%	2.3%	6.5%	
NITROGEN MEANS[3]						
25		1162 b	38.4 a	34.7 a	4.46 b	1383
50		1240 b	38.4 a	34.6 a	4.60 a	1571
100		1429 a	37.8 b	34.6 a	4.57 a	1647
Minimum Least Significant Range(L.S.D.)(.05)		115	0.3.	0.28	0.10	
Maximum Least Significant Range		120	0.4	0.29	0.11	
Coefficient of Variance		14.2%	1.4%	1.3%	3.6%	

Auburn M cotton planted May 4 and replanted May 22.
Row irrigated: August 9
Machine harvested: October 24 with one picking completing harvest.

1/ Agricultural (calcium carbonate) limestone from Jonesboro, Illinois with 50% passing through 40 mesh sieve applied in March 1961.
2/ Fine Lime (200 mesh-calcium carbonate limestone) banded by the row annually.
3/ Nitrogen sidedressed June 29. 13+50+50 ($N+P_2O_5+K_2O$) banded on all plots at time of planting cotton.

4/ 1961 through 1968 except 1966 when the cotton was not harvested due to an early freeze.
5/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05)

TABLE 2: THE INFLUENCE OF LIMESTONE AND NITROGEN ON COTTON YIELDS - 1968
PORTAGEVILLE FIELD - LOAM SOIL

Initial Soil Test (1963)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.6	212	300	280	2500	4.9	3.0	11.0	Tiptonville
Subsoil	1.5	157	210	360	2600	4.8	3.0	11.5	

Soil Treatment: Limestone[1] (Tons per acre)	Soil Treatment: Nitrogen[3] Sidedressed (Lbs Per A)	Pounds Seed Cotton Per Acre: First Pick	Pounds Seed Cotton Per Acre: Total	Percent Lint	Staple Length 1/32 Inches	Micronaire	Six Year Means[4] Total Seed Cotton
LIMESTONE X NITROGEN MEANS							
None	25	2033 i[5]	2413 k[5]	36.6 a[5]	34.7 ab[5]	4.13 b-e[5]	2412
None	50	2186 e-i	2660 h-k	36.3 a	34.0 b	4.10 cde	2426
None	100	2181 e-i	2762 e-j	35.4 a	34.0 b	4.07 de	2502
1 Fine Lime	25	2298 b-i	2742 f-j	37.0 a	34.7 ab	4.23 a-e	2490
1 Fine Lime	50	2561 abc	3119 a-d	36.1 a	34.3 ab	4.17 a-e	2536
1 Fine Lime	100	2691 a	3371 a	37.0 a	34.7 ab	4.33 a-e	2677
2 Fine Lime	25	2461 a-f	2854 d-j	36.5 a	35.0 a	4.30 a-e	2479
2 Fine Lime	50	2579 ab	3129 a-d	36.2 a	34.3 ab	4.17 a-e	2485
2 Fine Lime	100	2693 a	3221 ab	36.0 a	35.0 a	4.33 a-e	2465
2 Agricultural	25	2254 d-i	2739 f-j	36.7 a	35.0 a	4.50 a	2529
2 Agricultural	50	2474 a-e	2956 b-h	36.8 a	35.0 a	4.40 a-d	2587
2 Agricultural	100	2395 a-g	2996 b-f	36.7 a	35.0 a	4.23 a-e	2588
4 Fine Lime	25	2100 ghi	2561 jk	37.0 a	34.7 ab	4.27 a-e	2292
4 Fine Lime	50	2173 e-i	2709 g-k	36.8 a	34.7 ab	4.40 a-d	2374
4 Fine Lime	100	2163 f-i	2650 ijk	35.7 a	34.3 ab	4.10 cde	2307
4 Agricultural	25	2064 hi	2627 jk	36.9 a	34.3 ab	4.33 a-e	2442
4 Agricultural	50	2176 e-i	2808 e-j	36.8 a	34.3 ab	4.33 a-e	2439
4 Agricultural	100	2260 c-i	2928 c-i	36.9 a	34.7 ab	4.43 abc	2476
8 Agricultural	25	2171 e-i	2749 f-j	37.2 a	34.0 b	4.47 ab	2401
8 Agricultural	50	2339 b-i	2956 b-h	36.4 a	34.3 ab	4.07 de	2467
8 Agricultural	100	2316 b-i	2943 b-i	36.8 a	34.7 ab	4.43 abc	2362
12 Agricultural	25	2171 e-i	2777 e-j	35.7 a	35.0 a	4.13 b-e	2471
12 Agricultural	50	2105 g-i	2813 e-j	37.2 a	34.7 ab	4.50 a	2531
12 Agricultural	100	2359 b-h	3017 b-f	35.9 a	35.0 a	4.47 ab	2529
1/4 Fine Lime[2]	25	2222 d-i	2647 ijk	36.7 a	34.3 ab	4.27 a-e	2431
1/4 Fine Lime[2]	50	2512 a-d	3047 b-e	36.7 a	34.3 ab	4.00 e	2650
1/4 Fine Lime[2]	100	2461 a-f	3147 abc	36.5 a	35.0 a	4.27 a-e	2672
Minimum Least Significant Range(L.S.D.)(.05)		260	251	1.6	0.75	0.29	
Maximum Least Significant Range		311	300	1.9	0.89	0.35	
Coefficient of Variance		6.7%	5.2%	2.6%	1.3%	4.1%	
LIMESTONE MEANS							
None		2133 a	2612 a	36.0 a	34.2 d	4.1 a	2447
1 Fine Lime		2517 a	3077 a	36.7 a	34.6 a-d	4.2 a	2568
2 Fine Lime		2578 a	3068 a	36.3 a	34.8 abc	4.3 a	2476
2 Agricultural		2375 a	2897 a	36.7 a	35.0 a	4.4 a	2568
4 Fine Lime		2145 a	2640 a	36.5 a	34.6 a-d	4.3 a	2324
4 Agricultural		2167 a	2788 a	36.9 a	34.4 bcd	4.4 a	2452
8 Agricultural		2275 a	2883 a	36.8 a	34.3 cd	4.3 a	2410
12 Agricultural		2212 a	2869 a	36.3 a	34.9 ab	4.4 a	2510
1/4 Fine Lime[2]		2399 a	2947 a	36.6 a	34.6 a-d	4.2 a	2584
Minimum Least Significant Range(L.S.D.)(.05)		490	508	1.1	0.46	0.30	
Maximum Least Significant Range		558	577	1.2	0.52	0.33	
Coefficient of Variance		21.2%	17.7%	3.0%	1.3%	6.9%	
NITROGEN MEANS[3]							
	25	2197 b	2679 c	36.7 a	34.6 a	4.3 a	2439
	50	2345 a	2911 b	36.6 a	34.4 a	4.2 a	2499
	100	2391 a	3004 a	36.3 a	34.7 a	4.3 a	2509
Minimum Least Significant Range(L.S.D.)(.05)		87	84	0.53	0.25	.09	
Maximum Least Significant Range		91	88	0.56	0.26	0.10	
Coefficient of Variance		6.7%	5.2%	2.6%	1.3%	4.1%	

MO-DEL cotton planted May 4 but due to poor stand Auburn M cotton was replanted May 23.
Row irrigated: July 30.
Machine harvested: First picking October 15 and second picking November 19.

1/ Agricultural (calcium carbonate) limestone with 50% passing through a 40 mesh sieve. Obtained from Jonesboro, Illinois and broadcast, disc in the soil, and plowed under April, 1963.

2/ Fine lime (calcium carbonate-200 mesh) banded by the row annually.

3/ Nitrogen sidedressed July 8. 13+50+50 ($N+P_2O_5+K_2O$) banded on all plots at time of planting cotton.

4/ Years 1963 through 1968.

5/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

TABLE 3: THE INFLUENCE OF LIMESTONE AND NITROGEN ON COTTON YIELDS - 1968
CLARKTON FIELD

Initial Soil Test (1962)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.0	131	350	40	600	4.0	2.5	4.5	Beulah
Subsoil	1.0	52	310	40	600	4.0	2.5	4.5	

Soil Treatment								
Limestone[1] (Tons per acre)	Nitrogen[3] Sidedressed (Lbs Per A)	Pounds Seed Cotton Per Acre First Pick	Total	Percent Lint	Staple Length 1/32 Inches	Micronaire	Seven Year Means[4] Total Seed Cotton
LIMESTONE X NITROGEN MEANS							
None	25	911 g	1307 h	35.7 ab	35.0 ab	4.5 abc	1458
None	50	570 h	940 i	35.3 a-d	35.0 ab	4.8 a	1191
None	100	547 h	888 i	35.3 a-d	35.3 a	4.7 ab	1176
2 Dolomitic	25	1212 f	1575 gh	35.7 a	34.7 ab	4.4 abc	1814
2 Dolomitic	50	1435 def	1844 b-g	35.2 a-d	34.7 ab	4.3 abc	1953
2 Dolomitic	100	1353 ef	1769 d-g	34.8 a-d	34.7 ab	4.3 abc	1948
2 Calcium Carbonate	25	1395 def	1746 d-g	35.8 a	34.3 b	4.5 abc	1849
2 Calcium Carbonate	50	1238 f	1644 fg	34.8 a-d	34.7 ab	4.4 abc	1851
2 Calcium Carbonate	100	1310 ef	1759 d-g	35.5 abc	34.3 b	4.4 abc	2039
4 Dolomitic	25	1428 def	1723 efg	35.2 a-d	34.3 b	4.2 bc	1836
4 Dolomitic	50	1458 c-f	1795 c-g	35.2 a-d	34.3 b	4.2 bc	1990
4 Dolomitic	100	1503 a-f	1864 b-g	34.8 a-d	34.3 b	4.3 abc	2042
4 Calcium Carbonate	25	1497 a-f	1877 b-g	35.7 a	35.3 a	4.3 abc	1882
4 Calcium Carbonate	50	1349 e-f	1762 d-g	35.6 abc	34.7 ab	4.5 abc	1877
4 Calcium Carbonate	100	1421 def	1831 c-g	35.1 a-d	35.0 ab	4.2 bc	1959
8 Dolomitic	25	1507 a-f	1854 b-g	34.9 a-d	34.3 b	4.2 bc	1862
8 Dolomitic	50	1474 b-f	1867 b-g	34.8 a-d	34.7 ab	4.2 bc	1946
8 Dolomitic	100	1572 a-e	1965 a-f	34.9 a-d	34.7 ab	4.4 abc	1952
8 Calcium Carbonate	25	1785 ab	2103 a-d	35.2 a-d	34.7 ab	4.4 abc	1995
8 Calcium Carbonate	50	1628 a-e	2031 a-e	34.2 d	34.7 ab	4.3 abc	2033
8 Calcium Carbonate	100	1779 abc	2188 ab	34.5 bcd	35.3 a	4.1 c	2099
12 Dolomitic	25	1818 a	2231 a	34.8 a-d	34.3 b	4.2 bc	2031
12 Dolomitic	50	1706 a-d	2142 abc	34.4 cd	34.7 ab	4.3 abc	2172
12 Dolomitic	100	1710 a-d	2188 ab	34.2 d	35.0 ab	4.1 c	2199
1/4 Calcium Carbonate[2]	25	1209 f	1523 gh	35.8 a	35.0 ab	4.3 abc	1423
1/4 Calcium Carbonate[2]	50	1353 ef	1706 efg	35.2 a-d	34.7 ab	4.3 abc	1611
1/4 Calcium Carbonate[2]	100	1382 ef	1716 efg	35.4 a-d	34.3 b	4.5 abc	1605
Minimum Least Significant Range(L.S.D.)(.05)		276	303	1.0	0.7	0.4	
Maximum Least Significant Range		329	362	1.22	0.8	0.5	
Coefficient of Variance		11.8%	10.2%	1.7%	1.2%	5.7%	
LIMESTONE MEANS							
None		676 c	1045 d	35.4 a	35.1 a	4.6 a	1275
2 Dolomitic		1333 b	1729 c	35.2 ab	34.7 ab	4.3 b	1905
2 Calcium Carbonate		1315 b	1716 c	35.4 a	34.4 ab	4.4 ab	1913
4 Dolomitic		1463 ab	1794 c	35.0 ab	34.3 b	4.2 b	1956
4 Calcium Carbonate		1423 ab	1823 c	35.5 a	35.0 ab	4.3 b	1906
8 Dolomitic		1518 ab	1895 bc	34.9 ab	34.6 ab	4.3 b	1920
8 Calcium Carbonate		1731 a	2107 ab	34.6 ab	34.9 ab	4.3 b	2042
12 Dolomitic		1745 a	2187 a	34.5 b	34.7 ab	4.2 b	2134
1/4 Calcium Carbonate		1315 b	1649 c	35.5 a	34.7 ab	4.3 b	1546
Minimum Least Significant Range(L.S.D.)(.05)		304	260	0.8	0.6	0.2	
Maximum Least Significant Range		346	295	0.9	0.7	0.3	
Coefficient of Variance		21.9%	14.7%	2.2%	1.8%	5.3%	
NITROGEN MEANS[3]							
25		1418 a	1771 a	35.4 a	34.7 a	4.4 a	1794
50		1357 a	1748 a	34.9 b	34.7 a	4.4 a	1847
100		1397 a	1796 a	34.8 b	34.7 a	4.3 a	1891
Minimum Least Significant Range(L.S.D.)(.05)		92	101	0.3	0.24	0.14	
Maximum Least Significant Range		97	106	0.4	0.25	0.15	
Coefficient of Variance		11.8%	10.2%	1.7%	1.2%	5.7%	

MO-DEL (Mo 470) cotton planted May 6.
Sprinkler irrigated: June 15, 22, and August 5.
Machine harvested: First picking October 8 and second picking November 18.

1/ Calcium carbonate fine lime from Ste. Genevieve, Missouri. Dolomitic (40% magnesium carbonate) limestone with 50% passing through a 40 mesh sieve from Piedmont, Missouri.
2/ Fine lime (200 mesh-calcium carbonate) banded by the row annually.
3/ Nitrogen sidedressed June 28. 13+50+50 ($N+P_2O_5+K_2O$) banded on all plots at time of planting cotton.
4/ 1962 through 1968.
5/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

TABLE 4: EXPERIMENTAL RESULTS OF VARIOUS METHODS OF APPLYING FERTILIZER ON COTTON - 1968

PORTAGEVILLE FIELD - CLAY SOIL

Initial Soil Test (1964):	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	2.5	208	350	980	5300	5.4	6.5	24.3	Sharkey
Subsoil	2.2	179	380	1020	7000	5.5	6.0	28.5	

Soil Treatment: Preplant $N+P_2O_5+K_2O$	Soil Treatment: Band at Planting $N+P_2O_5+K_2O$	Soil Treatment: Sidedress $N+P_2O_5+K_2O$	Pounds Seed Cotton Per Acre: First Picking	Pounds Seed Cotton Per Acre: Total	Percent Lint	Staple Length 1/32 Ins.	Micronaire	Residue[1] Pounds Seed Cotton Total	Six Year[2] Average Pounds Seed Cotton Total
No Treatment			1036 f[4]	1157 e[4]	37.5 a[4]	35.3 a[4]	4.6 a[4]	848 a[4]	1037
50+ 50+ 50 Broadcast & Bed			1840 de	1996 cd	37.8 a	34.3 b	4.6 a	749 a	1804
75+ 75+ 75 Broadcast & Bed			2150 abcd	2310 abc	38.4 a	34.7 ab	4.9 a	825 a	1748[3]
100+100+100 Broadcast & Bed			2297 a	2475 ab	37.3 a	34.3 b	4.8 a	798 a	2327
50+ 50+ 50 Band under bed			1916 cde	2019 cd	38.1 a	34.7 ab	4.7 a	843 a	2011
100+100+100 Band under bed			2253 ab	2432 ab	37.9 a	35.3 a	4.6 a	924 a	2354
	50+ 50+ 50		1813 e	1923 d	38.3 a	35.3 a	4.7 a	846 a	1987
	100+100+100		2338 a	2528 a	37.6 a	34.7 ab	4.6 a	876 a	2200
	13+ 50+ 50	37+0+0	2024 abcde	2193 abcd	37.9 a	34.7 ab	4.8 a	795 a	2076
	13+ 50+ 50	87+0+0	2173 abc	2388 ab	37.9 a	35.0 ab	4.7 a	1038 a	1814[3]
	100+ 0+ 0		2212 abc	2407 ab	37.6 a	35.0 ab	4.9 a	988 a	1934[3]
50+ 0+ 0 Broadcast & Bed			1962 bcde	2122 bcd	36.8 a	35.0 ab	4.9 a	965 a	1709[3]
100+ 0+ 0 Broadcast & Bed			2322 a	2546 a	36.8 a	35.0 ab	4.7 a	804 a	1856[3]
Minimum Least Significant Range(L.S.D.)(.05)			293	327	1.4	0.7	0.4	374	
Maximum Least Significant Range			341	380	1.6	0.9	0.5	435	
Coefficient of Variance			8.6%	8.8%	2.2%	1.3%	5.0%	25.6%	

Fertilizer applied preplant April 30, at planting May 6, and sidedress June 29.
Auburn M cotton planted May 6.
Row irrigated: August 9.
Machine harvested: first picking October 24 and second picking November 19.

1/ Yields obtained from plots on which fertilizer was applied in 1967 but none in 1968.
2/ Years 1963 through 1968.
3/ Years 1966, 1967 and 1968.
4/ Duncan's New Multiple Range Test: Yields and other results followed by same letter are not significantly different (.05).

OBJECTIVE: To determine the most effective and economical method of applying fertilizer on cotton.
To determine if it is necessary to split the application of nitrogen because of high rainfall.
To verify the soil test as to the need for phosphorous and potassium on this clay soil.
To determine "carry over" effect of fertilizer applied the previous season.

PROCEDURE: Fertilizer applications were applied according to time and method as indicated in Table 4. The area was alternated from the preceeding year and yields were measured from both areas. Cotton samples were obtained at harvest and percent lint, staple length and micronaire data were obtained. Irrigation was available and applied as needed.

RESULTS: Results indicate that applying 50+50+50 in a split application was the more effective method of application but required two applications, at planting and sidedressing. The method of application had little effect on yields where the 100+100+100 fertilizer application was used. In 1968 on this soil the results indicate that nitrogen alone was sufficient without phosphorous and potassium. Treatments that included 100 pounds of nitrogen produced maximum yields in 1968.

According to the data, carry over of fertilizer did not significantly affect the yields although there is indication that there was some carry over nitrogen on the plots on which 100 pounds of nitrogen was applied the previous year, 1967.

Soil treatments had little or no effect on percent lint, staple length, or micronaire.

TABLE 5: THE EFFECTS OF MINOR ELEMENTS AND LIMESTONE ON COTTON YIELDS AND QUALITY-1968
CLARKTON FIELD

Initial Soil Test (1964)	O.M.	P_2O_5	K	Mg	Ca	pH	H	C.E.C.	Soil Series
Topsoil	0.7	202	130	160	1300	4.9	2.0	6.0	Beulah
Subsoil	0.6	90	130	140	1700	4.2	2.0	7.0	
1968 Soil Test									
Topsoil									
(No Fine Lime)	1.0	208	200	200	900	5.4	2.0	5.5	Beulah
(4 T Fine Lime)**	0.7	208	170	20	2600	6.9	1.0	8.0	Beulah

Soil Treatment[1] (Pounds Per Acre)	Pounds Seed Cotton Per Acre				Percent Lint		Staple Length 1/32 Inches		Micronaire		Five Year[3] Average Total Pounds Seed Cotton	
	First Picking		Total									
	No[2]	4T[2]	No	4T	No	4T	No	4T	No	4T	No	4T
	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime	Fine Lime
LIMESTONE X NUTRIENT MEANS												
No Micro Nutrients	1101 a	1140 a	1706 abc	1647 abc	35.1 abc	34.1 bcd	35 a	35 a	4.7 a	4.5 ab	1789	1615
0.5 Boron Banded	1251 a	1143 a	1733 abc	1556 c	35.7 a	34.3 a-d	34 a	35 a	4.4 ab	4.4 ab	1691	1556
0.5 Boron Broadcast	1241 a	1133 a	1736 abc	1559 c	35.0 a-d	34.7 a-d	35 a	35 a	4.5 ab	4.3 b	1866	1623
1.0 Boron Banded	1169 a	1140 a	1693 abc	1625 bc	35.5 ab	33.9 cd	35 a	35 a	4.7 a	4.5 ab	1842	1650
1.0 Boron Broadcast	1153 a	1156 a	1729 abc	1661 abc	35.0 a-d	34.7 a-d	35 a	35 a	4.6 ab	4.5 ab	1791	1644
2.0 Boron Banded	1261 a	1225 a	1932 a	1756 abc	35.1 abc	33.9 cd	35 a	35 a	4.7 a	4.5 ab	1941	1738
2.0 Boron Broadcast	1166 a	1169 a	1795 abc	1625 bc	34.8 a-d	34.0 cd	35 a	35 a	4.5 ab	4.2 b	1805	1677
4.0 Boron Broadcast	1117 a	1012 a	1755 abc	1539 c	35.7 a	33.7 d	35 a	35 a	4.4 ab	4.4 ab	1830	1607
0.75 Boron Premerge Band	1254 a	1166 a	1909 ab	1657 abc	35.1 abc	33.9 cd	35 a	35 a	4.6 ab	4.4 ab	1935	1652
20 Copper Sulphate Banded	1173 a	1097 a	1752 abc	1579 c	34.8 a-d	34.3 a-d	35 a	35 a	4.6 ab	4.5 ab	1730	1556
20 Zinc Sulphate Banded	1199 a	1061 a	1752 abc	1575 c	35.7 a	35.2 abc	35 a	35 a	4.5 ab	4.5 ab	1806	1568
Minimum L.S.R.(L.S.D.)(.05)	218		242		1.2		0.9		0.3			
Maximum L.S.R.	264		293		1.4		1.1		0.4			
Coefficient of Variance	11.4%		8.6%		2.0%		1.5%		4.2%			
NUTRIENT MEANS												
No Micro Nutrients	1120 a		1677 ab		34.6 ab		35 a		4.6 ab		1702	
0.5 Boron Banded	1197 a		1644 ab		35.0 ab		35 a		4.4 ab		1624	
0.5 Boron Broadcast	1187 a		1648 ab		34.8 ab		35 a		4.4 ab		1745	
1.0 Boron Banded	1154 a		1659 ab		34.7 ab		35 a		4.6 a		1746	
1.0 Boron Broadcast	1154 a		1695 ab		34.9 ab		35 a		4.5 ab		1718	
2.0 Boron Banded	1242 a		1844 a		34.5 ab		35 a		4.6 ab		1840	
2.0 Boron Broadcast	1167 a		1710 ab		34.4 b		35 a		4.3 b		1741	
4.0 Boron Broadcast	1064 a		1647 ab		34.7 ab		35 a		4.4 ab		1719	
0.75 Boron Premerge Band	1210 a		1783 ab		34.5 ab		35 a		4.5 ab		1794	
20 Copper Sulphate Banded	1135 a		1666 ab		34.5 ab		35 a		4.5 ab		1643	
20 Zinc Sulphate Banded	1130 a		1664 b		35.5 a		35 a		4.5 ab		1687	
Minimum L.S.R.(L.S.D.)(.05)	154		171		0.8		0.6		0.2			
Maximum L.S.R.	179		199		1.0		0.7		0.3			
Coefficient of Variance	11.4%		8.6%		2.0%		1.5%		4.2%			
LIMESTONE MEANS[2]												
No Fine Lime	1189 a		1772 a		34.8 b		35 a		4.5 a		1821	
4 Tons Fine Lime	1131 a		1616 a		35.0 a		35 a		4.4 a		1626	
Minimum L.S.R.(L.S.D.)(.05	335		534		0.7		0.8		0.2			
Maximum L.S.R.	335		534		0.7		0.8		0.2			
Coefficient of Variance	27.3%		29.8%		1.9%		2.2%		5.0%			

MO-DEL (Mo. 470) cotton planted May 6.
Sprinkler irrigated: June 15, 22 and August 5.
Machine harvested: First picking October 8 and second picking November 18.

1/ Micro-nutrient broadcast applications disc in, and then bedded. Band applications applied in a band under the bed. Premerge band sprayed over row after planting but before emergence of cotton. 50+50+50 banded on all plots at time of planting with an additional 50 pounds of nitrogen sidedressed June 27.

2/ All plots 4 tons dolomitic (magnesium) limestone applied in 1963. Four tons fine lime (200 mesh calcitic limestone) applied to half of area in 1963.

3/ Years 1964 through 1968.

4/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine the need for boron by the cotton plant on acid and neutral soils. To determine rate and method of application. To verify need for zinc and copper.

PROCEDURE: Soil from the Clarkton Field was used in the greenhouse to grow cotton in 1963. These greenhouse studies indicated that cotton responded to boron, copper sulphate and zinc sulphate. Field studies were started at the Clarkton Field in 1964 of which one-half of the area was limed with 4 tons fine lime to produce a soil of pH 7.0. The neutral pH was desired so as to accentuate the need for micronutrients.

Treatments as listed in Table 5 above were applied across both the area with the 4 tons of fine lime and the area without the fine lime. The whole area was limed in 1963 with 4 tons of dolomitic limestone.

RESULTS: The additional 4 tons of fine lime reduced the magnesium in the 1968 soil test above from 200 to 20 pounds per acre. Both areas had the same amount of dolomitic limestone applied in 1963. Every treatment on the fine lime area was below the same treatment on the area on which the fine lime was not applied. There was a greater difference in the first two years of the experiment.

The 2 pound rate of boron banded near the row produced the highest yield in 1968 and the highest average yield during the five year period. Boron applied in premerge at the rate of 3/4 pound per acre also increased yield.

Copper and zinc have not responded favorably and over the five year period there is an indication of a depression in yield by these elements.

TABLE 6: THE INFLUENCE OF CROP ROTATION ON COTTON AS COMPARED TO CONTINUOUS COTTON - 1968

PORTAGEVILLE FIELD

CLAY SOIL

Initial Soil Test (1960)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	3.2	160	500	940	7000+	5.3	3.8	22.1	Sharkey
Subsoil	2.7	170	480	940	7000+	6.9	0.5	25.9	

Crop Sequences			Pounds Seed Cotton Per Acre		Staple Length		
First Year	Second Year	Third Year	First Pick	Total	Percent Lint	1/32 Inches	Micronaire
Cotton	Soybeans	Corn		1955 a[1/]	39.1 a[1/]	35.0 a[1/]	4.9 a[1/]
Cotton	Soybeans	Wheat-Sudan		1762 ab	39.5 a	34.3 ab	4.9 a
Cotton	Soybeans	Wheat-Soybeans		1762 ab	39.5 a	34.0 b	5.1 a
Cotton	Soybeans	Soybeans		1879 a	38.5 a	34.6 ab	5.2 a
Cotton	Fescue	Fescue		1836 ab	39.1 a	34.6 ab	5.0 a
Cotton	Cotton	Cotton		1549 bc	39.4 a	34.6 ab	5.0 a
Minimum Least Significant Range(L.S.D.)(.05)				262	1.1	0.7	0.4
Maximum Least Significant Range				295	1.2	0.8	0.5
Coefficient of Variance				8.8%	1.6%	1.2%	4.6%

LOAM SOIL

Initial Soil Test (1964)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.4	224+	540	160	1700	4.8	2.5	8.1	Tiptonville
Subsoil	1.1	212	520	120	1500	4.9	2.0	7.0	

Crop Sequences			Pounds Seed Cotton Per Acre		Staple Length		
First Year	Second Year	Third Year	First Pick	Total	Percent Lint	1/32 Inches	Micronaire
Cotton	Soybeans	Corn	3335 a[1/]	3644 a[1/]	36.8 a[1/]	34.0 b[1/]	4.3 a[1/]
Cotton	Soybeans	Wheat-Sudan	3013 b	3296 bc	36.9 a	34.3 ab	4.3 a
Cotton	Soybeans	Wheat-Soybeans	3009 b	3283 bc	36.8 a	34.0 b	4.3 a
Cotton	Soybeans	Soybeans	2668 c	2999 cd	36.3 a	34.0 b	4.4 a
Cotton	Fescue	Fescue	3147 ab	3376 ab	36.6 a	35.0 a	4.3 a
Cotton	Cotton	Cotton	2930 bc	3186 bcd	36.6 a	34.0 b	4.2 a
Minimum Least Significant Range(L.S.D.)(.05)			259	310	1.0	0.6	0.3
Maximum Least Significant Range			292	349	1.2	0.7	0.4
Coefficient of Variance			5.0%	5.5%	1.6%	1.1%	4.9%

Cotton Planted: Clay soil, Auburn M May 4. Loam soil, MO-DEL (Mo. 470) May 4 and replanted Auburn M May 23.

Fertilizer: 25+50+50 ($N+P_2O_5+K_2O$) banded by all cotton at time of planting. Sidedressed with 75 pounds of nitrogen on the clay soil and 50 pounds of nitrogen on the loam soil June 29. All other crops in rotation fertilized at optimum rates for the specific crop. No fertilizer applied on soybeans.

Row Irrigated: Clay soil August 22. Loam soil August 2 and 23.

Machine Harvested: Clay soil, only one picking October 24. Loam soil first picking October 15 and second picking November 19.

1/ Duncan's New Multiple Range Test: Yields and other results followed by same letter are not significantly different (.05).

OBJECTIVE: To determine if cotton can be grown continuously on the same soil maintaining maximum yield. To determine which of five crop combinations most appliable in a three year rotation.

PROCEDURE: Crops as outlined in Table 6 were planted and fertilized at optimum rates for each crop except soybeans on which no fertilizer was applied. Three areas were used so that all three years crops were grown annually and rotated each year. The experiment was started in 1963 on the clay and loam soils and has completed two cycles. Irrigation was available and used on both soils.

RESULTS: After six years of cotton on the continuous cotton plots the yield of seed cotton in 1968 was lower than the yields of cotton in a rotation. On both the clay and loam soils cotton in the rotation with corn produced higher yields but these increases were not significantly different from the other rotations.

SOYBEAN EXPERIMENTS

Soybeans were the most important crop grown in southeast Missouri during 1968 from the standpoint of cash value and area occupied. Approximately 1,253,000 acres were grown in the seven county area which produced over thirty percent of the total production of the state. The reduction of cotton acreage over the past years has resulted in an increase in the soybean acreage of the area.

Soybean yields for the state as a whole were estimated at 28 bushels per acre as compared to 22 bushels in 1967. Many producers in southeast Missouri experienced a reduction in yields in 1968 as compared to 1967 because of extremely dry weather that affected portions of the area.

Soil fertility experiments in 1968 included rotations, fertilizers, limestones, micronutrients, time of application of fertilize, irrigation, and fertilizing of the previous crop. Fertilizing of the previous crop has been the most effective method of increasing yields of soybeans. Direct application of fertilizer to soybeans, except in extremely low tests of potassium or calcium, has not resulted in an increase of yields.

Soybeans (41 bu. per acre yield) the first year after a fertilized crop of cotton. Fertilizer was not applied on soybeans.

Soybeans (24 bu. per acre yield) the second year after a fertilized crop of cotton. Fertilizer was not applied on the soybeans.

Irrigation has been the most effective in the increase of soybean yields. Many of the seasons are too dry in late summer and fall for maximum soybean production. In 1968 yields were increased from 13 to 19 bushels on soybean experiments at the Delta Center by irrigation.

TABLE 7: THE EFFECT OF CROP ROTATION ON YIELDS OF SOYBEANS 1968

PORTAGEVILLE FIELD

CLAY SOIL

Initial Soil Test (1960)	O.M.	P_2O_5	K	Mg	Ca	pH	H	C.E.C.	Soil Series
Topsoil	3 2	160	500	940	7000+	5 3	3 8	22.1	Sharkey
Subsoil	2.7	170	480	940	7000+	6 9	0 5	25.9	

Crop Sequence			Yield of Soybeans (Bu Per Acre)		Percent Moisture At Harvest	
First Year	Second Year	Third Year	Second Year	Third Year	Second Year	Third Year
Cotton	Soybeans	Corn	17.4 ab[1/]		12.9 a[1/]	
Cotton	Soybeans	Wheat-Sudan	16.8 ab		13.3 a	
Cotton	Soybeans	Wheat-Soybeans	17.3 ab	17.1 ab	13.2 a	13.0 a
Cotton	Soybeans	Soybeans	25.0 a	12.8 b	13.0 a	12.6 a
Minimum Least Significant Range(L.S.D.)(.05)			8.3		0.9	
Maximum Least Significant Range			9.2		1.0	
Coefficient of Variance			25.8%		4.0%	

LOAM SOIL

Initial Soil Test (1964)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.4	224+	540	160	1700	4.8	2.5	2.5	Tiptonville
Subsoil	1.1	212	520	120	1500	4.9	2.0	7.0	

Crop Sequence			Yield of Soybeans (Bu. Per Acre)		Percent Moisture At Harvest	
First Year	Second Year	Third Year	Second Year	Third Year	Second Year	Third Year
Cotton	Soybeans	Corn	40.1 a[1/]		13.6 ab[1/]	
Cotton	Soybeans	Wheat-Sudan	39.5 a		13.5 ab	
Cotton	Soybeans	Wheat-Soybeans	39.9 a	18.9 c	13.7 ab	12.7 c
Cotton	Soybeans	Soybeans	37.8 ab	34.8 b	14.0 a	13.1 bc
Minimum Least Significant Range(L.S.D.)(.05)			4.2		0.8	
Maximum Least Significant Range			4.6		0.9	
Coefficient of Variance			6.6%		3.2%	

Soybeans Planted: Clay soil, Hill soybeans May 8. Hill soybeans after wheat June 17. Loam soil, Dyer soybeans May 8 and replanted June 3. Dyer soybeans after wheat June 17.
Fertilizer: None applied to soybeans. Other crops in rotation fertilized optimum rates.
Row Irrigated: Clay soil August 22. Loam soil August 2 and 23.
Harvested by Combine: Early planted soybeans October 3 and soybeans after wheat October 25 on clay and loam soils.
Soybeans on the clay soil affected by disease which reduced yields considerably.

1/ Duncan's New Multiple Range Test: Yields followed by same letter are not significantly different (.05).

OBJECTIVE: To determine the effects of crop rotation on the yields of soybeans and the influence of the various crop rotations on the tilth of the soil.

PROCEDURE: Various crops as listed above in three year rotations were compared with continuous cotton. All crops were fertilized optimum except soybeans and irrigated as the season required. Fertilizer was not applied on the soybeans. Each year of the rotation was grown annually on three different areas and then rotated the following year. The experiment was included on the clay and loam soils at the Portageville Field.

RESULTS: Results on the clay soil in 1968 were erratic because of a disease (southern blight) of the soybeans which killed full grown plants. The soybeans following the fertilized cotton produced 25 bushels as compared to the second year of 12.8 bushels per acre. Even though this soil, according to soil test, is very fertile, the physical properties apparently do not permit maximum yields. The clay content of this Sharkey soil was measured as 51 percent.

The soybeans on the loam soil produced a higher yield the first year after fertilized cotton as compared to the second year in 1968. In 1967 this difference was 17 bushels between the first and second year after cotton. The soybeans included in the cotton-soybeans-corn rotation were the high yielding beans but the increase was not significant at the 5% level.

This experiment was terminated at the completion of the 1968 harvest.

TABLE 8: THE INFLUENCE OF LIMESTONE, FERTILIZER, AND IRRIGATION ON SOYBEAN YIELDS - 1968
PORTAGEVILLE - LOAM

Initial Soil Test	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.7	224+	440	260	2500	4.8	3.0	11.0	Tiptonville
Subsoil	1.6	224+	400	300	2800	5.0	2.0	10.8	

Soil Treatment		Bushels of Soybeans Per Acre				
Tons Limestone Applied 1963	Annual Fertilizer $N+P_2O_5+K_2O$	Non-irrigated	Irrigated	Limestone and Fertilizer Mean	Six Year Means[1/] Non-irrigated	Six Year Means[1/] Irrigated
LIMESTONE X FERTILIZER X IRRIGATION MEANS						
None	None	26.2 def[2/]	38.1 c[2/]	32.1 cd[2/]	31.1	38.2
None	20+50+50	25.1 f	38.1 c	31.6 d	31.1	39.0
1	None	28.1 de	39.4 bc	33.8 abc	33.0	40.0
1	20+50+50	28.5 de	42.0 ab	35.2 ab	32.4	40.0
2	None	28.3 de	42.7 a	35.5 a	33.3	41.0
2	20+50+50	25.9 ef	40.7 abc	33.3 bcd	32.4	40.0
4	None	28.9 d	40.9 abc	34.9 ab	34.1	40.0
4	20+50+50	27.2 def	41.7 ab	34.4 ab	34.0	39.2
Minimum Least Significant Range(L.S.D.)(.05)		2.6		1.9		
Maximum Least Significant Range		3.0		2.1		
Coefficient of Variance		4.5%		4.5%		
LIMESTONE MEANS						
None		25.6 b	38.1 a	31.9 a	31.1	38.6
1 Ton		28.3 b	40.7 a	34.5 a	32.7	40.0
2 Ton		27.1 b	41.7 a	34.4 a	32.9	40.5
4 Ton		28.0 b	41.3 a	34.7 a	34.1	39.6
Minimum Least Significant Range(L.S.D.)(.05)		4.2		3.0		
Maximum Least Significant Range		4.7		3.2		
Coefficient of Variance		9.8%		9.8%		
FERTILIZER MEANS						
None		27.9 b	40.3 a	34.1 a	32.9	39.8
20+50+50		26.7 b	40.6 a	33.6 a	32.5	39.6
Minimum Least Significant Range(L.S.D.)(.05)		1.3		0.9		
Maximum Least Significant Range		1.4		0.9		
Coefficient of Variance		4.5%		4.5%		
IRRIGATION MEANS						
Non-Irrigated		27.3 b			32.7	
Irrigated		40.4 a			39.7	
Minimum Least Significant Range(L.S.D.)(.05)		4.4				
Maximum Least Significant Range		4.4				
Coefficient of Variance		10.6%				

Soybeans planted: Dyer May 8 and replanted June 3.
Fertilizer banded at planting.
Row irrigated: July 30, August 24, and September 13.

1/ Years 1963 to 1968 inclusive.
2/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine limestone requirements of soybeans on the loam soil, changes in the soil test values, fertilizer requirements of soybeans and to what extent irrigation affects yields.

PROCEDURE: Varying rates of limestone were applied in 1963 with each rate split with a fertilized and a no treatment plot. Fertilizer was applied annually but limestone was applied only as the experiment was started. Three replications were irrigated three times during 1968 and three replications were not irrigated. Soil samples were obtained in 1968 from each plot and in the process of analysis.

RESULTS: Limestone increased yields on both the irrigated and non-irrigated areas but the increase was not significant. Fertilizer application of 20+50+50 ($N+P_2O_5+K_2O$) annually did not affect yields in 1968 or over the past six years. Irrigation increased yields in 1968, 13 bushels with an average yield increase of seven bushels over the past six years. Results of the soil tests after five years were reported in the 1966-67 report (Special Report 98 published January 1969).

TABLE 9: THE EFFECTS OF FERTILIZER AND IRRIGATION ON SOYBEAN YIELDS - 1968
CLARKTON FIELD

Initial Soil Test (1966)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.0	190	160	220	1100	5.5	2.2	6.2	Beulah
Subsoil	0.6	90	130	140	1700	4.2	2.0	7.0	

Soil Treatment[1] N+P_2O_5+K_2O	Bushels of Soybeans Per Acre				
			Fertilizer	Three Year Means[3]	
	Non-irrigated	Irrigated	Means	Non-irrigated	Irrigated
FERTILIZER X IRRIGATION MEANS					
None	5.2 c[4]	21.9 b[4]	13.6 b[4]	23.0	34.0
None(Seed not inoculated)[2]	6.2 c	24.1 ab	15.2 ab	22.4	34.0
0 + 0+30	6.2 c	27.5 a	16.8 ab	23.0	36.1
0 + 0+60	6.8 c	25.6 ab	16.2 ab	22.0	35.0
0 +30+60	6.2 c	25.7 ab	15.9 ab	25.0	39.0
7.5+33+25.5+Traces	6.2 c	28.0 a	17.1 a	23.3	38.0
7.5+33+25.5	5.5 c	27.6 a	16.6 ab	24.3	39.0
6 +18+30 +3 Manganese	6.3 c	27.6 a	17.0 a	23.5	39.0
6 +22+22 +3 Zinc	6.6 c	26.1 ab	16.4 ab	23.4	36.0
4 Boron	7.9 c	26.3 ab	17.1 a	25.0	36.0
2 Boron	6.9 c	23.7 ab	15.3 ab	22.0	36.0
100 Trace Element Mixture	7.7 c	21.8 b	14.8 ab	23.1	35.0
100 Sulphur	5.5 c	25.2 ab	15.3 ab	22.0	35.0
50 + 0+ 0 Sidedressed July 11	6.1 c	26.6 a	16.4 ab	22.0	36.1
100 + 0+ 0 Sidedressed July 11	6.8 c	26.8 a	16.8 ab	21.3	35.1
Minimum Least Significant Range(L.S.D.)(.05)	4.0		2.8		
Maximum Least Significant Range	4.8		3.3		
Coefficient of Variance	14.9%		14.9%		
IRRIGATION MEANS					
Non-irrigated	6.4 b			23.0	
Irrigated	25.6 a			36.2	
Minimum Least Significant Range(L.S.D.)(.05)	3.2				
Maximum Least Significant Range	3.2				
Coefficient of Variance	21.7%				

Soybeans planted: Hill May 26.
Sprinkler irrigated: June 22, 31, August 5, 20 and September 4.
Harvested: October 5.

1/ All fertilizer banded at planting except sidedressed nitrogen which was banded near the row July 11.
2/ All seed of other plots inoculated.
3/ 1966, 1967 and 1968.
4/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine the influence of nitrogen, phosphorous, potassium, and minor nutrients on soybean yields on a sandy soil and to explore the effects of irrigation.

PROCEDURE: Four tons of dolomitic limestone were applied on a sandy loam soil in 1964 which changed the pH from 4.0 to 5.5 by the time the experiment was started in 1966. Fertilizer treatments were applied by banding near the row after planting. Three replications were irrigated and a similar area on which no water was applied. Water was applied five times during the 1968 season with special emphasis on the period beginning at first bloom through seed formation.

RESULTS: The 1968 results indicate that without irrigation the soil treatments applied did not affect yields significantly. With irrigation yields were increased three to four times or from 6.4 to 25.6 bushels. Yields in 1966 averaged 44.7 bushels on the irrigated plots as compared to 38.6 bushels on the non-irrigated area. The hot winds during the 1968 season probably prevented proper seed set of the soybean seed. Soybean yields are usually higher in seasons when late summer and fall weather is cool and higher rainfall than this past season.

The above three years data indicates a response to phosphate and potassium on the irrigated plots whereas on the non-irrigated plots there was no response.

One important conclusion from this experiment that soybeans yields have declined approximately 10 bushels per year for each year the experiment has been in progress. Whether this is due to nutrient depletion or the increase of soybean diseases, the true fact is not known at this time.

This experiment was terminated after the harvest of the 1968 crop and a new experiment will be designed for future study of soybean problems on this sandy soil.

TABLE 10: THE INFLUENCE OF TIME OF APPLICATION OF FERTILIZER ON YIELDS OF SOYBEANS - 1968
CLARKTON AND PORTAGEVILLE FIELDS

Initial Topsoil Test:	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Clarkton	1.0	185	170	170	1600	5.1	3.8	8.2	Beulah
Portageville-Loam	2.6	308	350	320	5000	5.8	5.0	19.4	Tiptonville
Portageville-Clay	2.3	169	440	1020	6700	5.6	6.5	28.0	Sharkey

Time of Application	Soil Treatment[1] $N+P_2O_5+K_2O$	Bushels of Soybeans Per Acre: Clarkton	Portageville: Loam	Portageville: Clay
TIME OF APPLICATION X FERTILIZER MEANS				
Fall (Broadcast)	0+50+50	31.0 a[3]	21.8 a[3]	30.5 a[3]
Fall (Broadcast)	50+50+50	29.0 a	18.8 a	28.0 ab
Winter (Broadcast)	0+50+50	28.9 a	19.8 a	28.5 ab
Winter (Broadcast)	50+50+50	29.3 a	18.7 a	29.7 ab
Spring (Broadcast)	0+50+50	29.4 a	15.2 a	27.7 ab
Spring (Broadcast)	50+50+50	29.9 a	21.0 a	30.2 ab
Planting Date (Broadcast)	0+50+50	24.1 b	22.1 a	26.9 ab
Planting Date (Broadcast)	50+50+50	29.3 a	20.0 a	27.4 ab
Planting Date (Banded)	0+50+50	28.6 a	17.8 a	27.0 ab
Planting Date (Banded)	50+50+50	27.9 ab	18.7 a	26.0 b
	No Treatment	30.1[2]	22.3[2]	28.1[2]
Minimum Least Significant Range(L.S.D.)(.05)		3.9	7.4	3.9
Maximum Least Significant Range		4.4	8.2	4.2
Coefficient of Variance		9.0%	21.1%	7.5%
TIME OF APPLICATION MEANS				
Fall		30.0 a	20.3 a	29.3 a
Winter		29.1 a	19.3 a	29.1 a
Spring		29.6 a	18.1 a	29.0 a
Planting Date (Broadcast)		26.7 a	21.0 a	27.2 a
Planting Date (Banded)		28.3 a	18.2 a	26.5 a
Minimum Least Significant Range(L.S.D.)(.05)		5.9	12.4	3.7
Maximum Least Significant Range		6.5	13.4	4.0
Coefficient of Variance		19.0%	4.8%	9.8%
FERTILIZER TREATMENT MEANS				
	None	30.1[2]	22.3[2]	28.1[2]
	0+50+50	28.4 a	19.3 a	28.1 a
	50+50+50	29.1 a	19.4 a	28.3 a
Minimum Least Significant Range(L.S.D.)(.05)		1.7	3.3	1.7
Maximum Least Significant Range		1.7	3.3	1.7
Coefficient of Variance		9.0%	21.1%	7.5%
Soybean variety		Hill	Dyer	Hill
Date of Planting		May 7	May 8	May 8
Irrigated		June 22 & 31 August 5 & 20 September 4	August 2 & 23	August 23
Fertilizer applied:				
Fall application		Oct. 19, '67	Nov. 9, '67	Nov. 8, '67
Winter application		Dec. 8, '67	Jan. 5	Jan. 5
Spring application		April 8	April 30	April 30
At planting date		May 7	May 8	May 8
Fertilizer banded at planting		May 7	May 8	May 8
Soybeans Harvested		October 5	October 28	October 3

1/ Fertilizer broadcast and disc in the soil
2/ No treatment was not included in statistical analysis.
3/ Duncan s New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine if time of fertilizer application had any effect on soybean yields, if nitrogen was necessary in fertilizing soybeans, and if banding the fertilizer was preferable to broadcasting.

PROCEDURE: Beginning after harvest fertilizers, with and without nitrogen, were applied broadcast and disc into the soil at intervals during the winter and extending up to date of planting. Broadcast and banded applications were made at planting. This experiment was included on the clay and loam soils of the Portageville Field and the sandy loam soil of the Clarkton Field. Irrigation water was applied at all locations as needed.

RESULTS: The 1968 results indicate there has been no advantage to applying fertilizer on soybeans at either of the three locations at any time. These plots were located on areas that were previously fertilized for cotton and in time the soybeans may respond to soil treatment.

TABLE 11: THE INFLUENCE OF STRAW AND SEED BED PREPARATION ON SOYBEAN AND WHEAT YIELDS IN A WHEAT AND SOYBEAN ROTATION - 1968
PORTAGEVILLE FIELD-CLAY SOIL

Initial Soil Test (1965)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	2.0	188	500	1040	4000	4.6	7.0	21.9	Sharkey
Subsoil	1.7	150	500	1140	3800	4.2	14.0	29.0	

Method of Seedbed Preparation For Soybeans After Wheat	Bushels Per Acre 1968 Wheat	1968 Soybeans	Four Year Means 1/ Wheat	Four Year Means 1/ Soybeans
Straw burned - disc and plant soybeans	23.9 ab 2/	24.8 ab 2/	32.0	25.0
Straw scattered - disc and plant soybeans	20.0 bc	22.4 b	29.3	23.4
Straw scattered - break, disc and plant soybeans	18.1 c	21.7 b	28.6	23.1
Straw scattered with 33 pounds nitrogen - break, disc and plant soybeans	21.9 abc	26.1 ab	30.0	26.0
Straw scattered - disc and plant soybeans 12+48+48 banded on soybeans	23.2 ab	24.5 ab	32.0	24.0
Straw burned - disc and plant soybeans 12+48+48 banded on soybeans	25.6 a	23.3 b	33.4	25.0
Full season soybeans		29.2 a		33.0
Full season cotton (pounds seed cotton)	2007			
Minimum Least Significant Range(L.S.D.)(.05)	3.7	4.6		
Maximum Least Significant Range	4.1	5.2		
Coefficient of Variance	11.1%	12.7%		

Monon wheat planted October 30, 1967 with 9+36+36 ($N+P_2O_5+K_2O$) starter. Wheat topdressed with 66 pounds nitrogen per acre March 8.

Wheat harvested June 13.
Hill soybeans planted June 17, Sidedressed fertilizer (12+48+48) July 8.
Row irrigated August 6 and 24.
Soybeans harvested October 25.

1/ Years 1965 through 1968.
2/ Duncan's New Multiple Range Test: Yields followed by same letters are not significantly different (.05).

OBJECTIVE: To determine the effects of the various methods of handling the straw after harvesting wheat, if nitrogen was required to decompose the straw, if fertilizer would increase the yield of soybeans, and how the one year rotation compared with full season crops of soybeans and cotton.

PROCEDURE: Wheat was grown on the plots and after harvest the straw was burned or retained. Seedbed was prepared and fertilizer applied as listed above. Soybeans were planted as soon as practical and, if need be, irrigated to germinate the seed. Full season soybeans and cotton were also included for crop value comparisons. After harvest of the soybeans the soil was disced, wheat replanted, and fertilized with 12+48+48 followed by a spring top-dressing of 66 pounds of nitrogen.

RESULTS: Removing the straw by burning has been as satisfactory as any of the other methods in seedbed preparation. This may not be as true in the future as the organic matter of the soil is depleted. In 1968 the maximum yield was obtained from the treatment on which the straw was turned under with 33 pounds of nitrogen. Breaking the straw under has been a very difficult method of seedbed preparation on this clay soil. Irrigation has been required in a few seasons when rainfall was deficient after breaking in order to obtain a stand of soybeans.

A complete fertilizer banded by the row has not increased yields of soybeans on this soil which tests high in phosphorous and potassium.

Full season soybeans have continually out yielded the soybeans after wheat. The increase over four years has been approximately 8 bushels but is doubtful if this 8 bushels would offset the value of the 29 to 33 bushels of wheat. Of course this would depend on the value of the individual crops and ability to double crop.

TABLE 12: YIELDS OF WHEAT AND SOYBEANS AS INFLUENCED BY FERTILIZER APPLICATIONS ON THE WHEAT ONLY-1968 CLARKTON AND PORTAGEVILLE FIELDS

Initial Soil Test (1968)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil-Clarkton	1.1	220	190	230	1500	5.8	1.0	6.2	Beulah
Topsoil-Portageville-Loam	2.5	300	560	270	4000	5.7	2.0	13.8	Tiptonville
Topsoil-Portageville-Clay	3.3	396	650	1060	5900	5.7	4.0	24.1	Sharkey

Soil Treatment[1] (Applied on Wheat) $N+P_2O_5+K_2O$	Bushels Per Acre					
	Clarkton		Portageville-Loam		Portageville-Clay	
	Wheat	Soybeans	Wheat	Soybeans	Wheat	Soybeans
No Treatment	19.6 ab[3]	25.9 a[3]	40.0 a[3]	18.9 a[3]	[2]	25.1 a[3]
75+ 0+ 0	18.8 ab	27.6 a	39.3 a	19.9 a		24.3 a
75+ 0+ 50	19.9 ab	26.3 a	39.2 a	18.1 a		25.9 a
75+ 0+100	18.5 b	28.5 a	39.9 a	21.7 a		25.7 a
75+ 50+ 0	18.9 ab	24.9 a	41.4 a	19.9 a		25.1 a
75+ 50+ 50	21.6 a	27.4 a	41.4 a	20.7 a		25.3 a
75+ 50+100	20.1 ab	27.9 a	40.9 a	21.3 a		26.6 a
75+100+ 0	20.1 ab	27.6 a	41.9 a	20.5 a		24.5 a
75+100+ 50	20.9 ab	25.4 a	39.6 a	21.7 a		24.9 a
75+100+100	21.3 ab	28.0 a	41.3 a	21.8 a		23.9 a
75+100+100+100 Lbs Traces	21.0 ab	28.7 a	39.6 a	20.2 a		26.0 a
Minimum Least Significant Range(L.S.D.)(.05)	2.5	3.8	2.9	4.3		2.7
Maximum Least Significant Range	3.0	4.5	3.3	5.0		3.1
Coefficient of Variance	8.8%	9.8%	4.9%	14.5%		7.4%
Date of planting	Oct. 19, '67	June 18	Oct. 24, '67	June 17	Nov. 11, '67	June 17
Variety planted	Monon	Hill	Monon	Dyer	Monon	Hill
Date of harvest	June 11	Oct. 21	June 12	Oct. 28	-	Oct. 28

1/ Nitrogen split with 10 pounds per acre at planting and balance topdressed March 18. All other fertilizer applied at time of planting.
2/ Wheat was not harvested because of poor stand.
3/ Duncan s New Multiple Range Test: Yields followed by same letters are not significantly different (.05).

OBJECTIVE: To determine if the fertilizer applied to the wheat crop would carry over to the following soybean crop and if so what analysis of fertilizer would be most effective.

PROCEDURE: At the time of planting the wheat fertilizer, as listed above, was applied banded near the seed. The nitrogen was split with 10 pounds applied at planting and the balance top-dressed in the following spring. This experiment was located on the sandy loam soil at the Clarkton Field, the clay and loam soils of the Portageville Field. As soon as wheat was harvested the straw was turned under, soil tilled and planted in soybeans without fertilizer.

RESULTS: The results in Table 12 indicate that neither of the crops responded significantly in 1968 to fertilizer on soils testing high in plant nutrients at any of the three locations. The fertilizing of the previous crops was probably responsible for the lack of response especially in the wheat crop. The stand of soybeans on the loam soil was irregular which may account for the lower yield on this soil.

MISCELLANEOUS GRAIN CROPS

Corn and wheat are important crops of southeast Missouri. Corn acreage fluctuates considerably from year to year but an estimated 175,000 acres were grown in the area during 1968. The acreage of wheat harvested in 1968 was approximately 323,700 acres.

The acreage of wheat has declined during past seasons but the wheat grown is usually followed with a crop of soybeans. With irrigation many farmers have obtained yields of soybeans planted in June that compared with the early planted soybeans.

The interest in grain sorghum has increased in the area and in 1968 a number of farmers grew a considerable acreage. If plans materialize additional acreage will be planted in 1969. Grain sorghum can be planted later than corn and yields of 100 bushels per acre were obtained from sorghum planted after wheat. The introduction of high yielding bird resistant varieties has been responsible for the increased interest by farmers of this crop. Previously the birds would not permit grain sorghum to mature as they would eat the seed from the heads.

Sunflowers have also experienced renewed interest since the introduction of the low growing Russian varieties. These varieties have a high oil content and can be processed by local cottonseed oil mills. The yields in the soil fertility experiment indicated that sunflowers are responsive to nitrogen. The yields of the sunflower experiments in 1968 did not compare with soybean crops in yield or value.

Soil fertility experiment which indicates the response of sunflowers to a complete fertilizer application.

Two bird resistant grain sorghums in soil fertility experiment.

TABLE 13: THE EFFECTS OF NITROGEN, PHOSPHOROUS, AND POTASSIUM ON CORN YIELDS - 1968
CLARKTON FIELD

Initial Soil Test (1969)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	0.8	210	163	220	733	5.2	2.7	5.7	Beulah
Subsoil	0.6	92	157	93	567	4.2	4.7	6.7	

Soil Treatment $N+P_2O_5+K_2O$	Corn	
	Bushels Per Acre	Percent Moisture at Harvest
No Treatment	9.8 c[1/]	14.1 ab[1/]
0+100+100	12.8 c	14.3 ab
50+100+100	43.6 b	13.8 b
100+100+100	92.4 a	14.7 ab
150+100+100	90.3 a	14.9 a
200+100+100	101.8 a	14.6 ab
150+ 0+100	89.7 a	15.0 a
150+ 50+100	98.9 a	14.9 a
150+100+100	90.3 a	14.9 a
150+100+ 0	80.5 a	14.4 ab
150+100+ 50	104.1 a	14.6 ab
150+100+100	90.3 a	14.9 a
Minimum Least Significant Range(L.S.D.)(.05)	29.8	0.78
Maximum Least Significant Range	34.2	0.91
Coefficient of Variance	24.0%	3.2%

Pioneer 3304 planted April 6.
Fertilizer banded near the row April 9.
Irrigated: June 7, 14, July 1, 10, 18.
Harvested: September 29.

1/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine the most optimum rate of nitrogen, phosphorous and potassium for corn on a sandy loam soil.

PROCEDURE: Corn was planted and fertilizer treatments, as outlined above, were banded near the row. Irrigation water was applied when needed by large sprinklers. Yields were measured and moisture determined at time of harvest.

RESULTS: These data indicate that 100 pounds of nitrogen were required to produce maximum yields on this soil. There was no significant increase by the application of phosphorous and potassium. The soil test indicates a low pH even though four tons of dolomitic limestone have been applied.

TABLE 14: YIELDS OF SUNFLOWERS AS INFLUENCED BY FERTILITY TREATMENTS - 1968
PORTAGEVILLE FIELD-CLAY SOIL

Soil Test:	O.M.	P_2O_5	K	Mg	Ca	pH	H	C.E.C.	Soil Series
Topsoil:	3.1	396	720	1060	6300	5.6	5.0	25.7	Sharkey
Subsoil:	2.2	154	480	1020	7000+	5.1	7.5	29.9	

Soil Treatment[1/] $N+P_2O_5+K_2O$	Pounds Sunflower Seed Per Acre
No Treatment	529 c[2/]
25+ 50+ 50	747 b
50+ 50+ 50	1094 a
75+ 50+ 50	1185 a
100+ 50+ 50	1272 a
125+ 50+ 50	1240 a
125+ 0+ 50	1126 a
125+ 50+ 0	1327 a
125+100+100	1221 a
Minimum Least Significant Range(L.S.D.)(.05)	214
Maximum Least Significant Range	220
Coefficient of Variance	11.2%

Peredovik sunflowers planted June 6 but did not germinate until June 25.
Row irrigated: August 24.
Harvested: October 29.

1/ Fertilizer applied sidedress July 15.
2/ Duncan's New Multiple Range Test: Yields followed by same letters are not significantly different (.05).

OBJECTIVE: To determine soil fertility requirements of sunflowers on a clay soil.

PROCEDURE: Peredovik sunflowers were planted after time of harvest of wheat. Soil fertility treatments as listed above were applied sidedress in a band near the row. Plants were thinned to eight inches. Irrigation water was applied once during the season. A combine was used in harvesting.

RESULTS: The results indicate that nitrogen was required for maximum yields. Response to phosphorous and potassium was questionable on this soil which tests high for both of these nutrients. The yields in this experiment were too low to offer any competition to soybeans at present prices. Additional experimental work will be required to determine the merits of this crop for production in southeast Missouri.

TABLE 15: THE RESPONSE OF GRAIN SORGHUM VARIETIES TO VARIOUS RATES OF NITROGEN - 1968
PORTAGEVILLE FIELD-LOAM SOIL

Soil Test:	O.M.	P_2O_5	K	Mg	Ca	pH	H	C.E.C.	Soil Series
Topsoil	2.1	358	540	440	3400	6.0	1.0		Tiptonville

Variety	Soil Treatment[1] (Pounds Nitrogen)	Pounds Per Acre Yield	Percent Moisture at Harvest
VARIETY X NITROGEN MEANS			
AKS-614	50	4119 efg[2]	14.9 ef[2]
(Arkansas)	75	4111 efg	14.8 ef
	100	3931 fg	14.7 f
	125	3993 efg	14.9 ef
BR 64	50	5955 a	15.9 abc
(DeKalb)	75	5181 bc	15.7 abcde
	100	5564 ab	15.3 bcdef
	125	5603 ab	15.8 abcd
BR 62	50	5283 abc	15.5 bcdef
(DeKalb)	75	5017 bcd	15.0 cde
	100	5064 bcd	15.0 cde
	125	4986 bcd	15.7 abcde
A 25	50	4314 defg	16.2 ab
(DeKalb)	75	3712 fg	16.5 a
	100	3822 fg	16.4 a
	125	3603 g	16.6 a
Savana	50	4227 efg	15.2 cdef
(Northrup King)	75	4384 def	15.3 bcdef
	100	4712 cde	14.8 ef
	125	4400 def	15.0 cde
Minimum Least Significant Range(L.S.D.)(.05)		662	0.8
Maximum Least Significant Range		800	1.0
Coefficient of Variance		10.0%	3.6%
VARIETY MEANS			
AKS 614		4039 d	14.8 d
BR 64		5576 a	15.7 b
BR 62		5088 b	15.3 bc
A 25		3863 d	16.4 a
Savana		4431 d	15.1 cd
Minimum Least Significant Range(L.S.D.)(.05)		331	0.40
Maximum Least Significant Range		367	0.45
Coefficient of Variance		10.0%	3.6%
NITROGEN MEANS (Pounds Per Acre)			
	50	4780 a	15.5 a
	75	4481 a	15.5 a
	100	4619 a	15.2 a
	125	4517 a	15.6 a
Minimum Least Significant Range(L.S.D.)(.05)		664	0.46
Maximum Least Significant Range		708	0.49
Coefficient of Variance		20.2%	4.1%

Planted: June 12.
Nitrogen sidedressed July 1.
Irrigated: August 10.
Desicated with sodium chlorate ten to fourteen days before harvest.
Harvested: A 25 September 11. Other varieties October 3.

1/ Banded 50 pounds per acre of phosphate and potash (0+50+50) to all plots.
2/ Duncan's New Multiple Range Test: Results followed by the same letters are not significantly different (.05).

OBJECTIVE: To determine if varieties of grain sorghum differ in their response to varying rates of nitrogen.

PROCEDURE: Five bird resistant varieties of grain sorghum were selected to plant with varying rates of nitrogen. Rates of nitrogen, as listed in table 15, were applied in a band near the row two weeks after planting. Fifty pounds each of phosphate and potash were applied uniformly to all plots. Irrigation water was applied once during the season. Two weeks before harvesting with a combine the plants were desicated with sodium chlorate spray.

RESULTS: The data above indicates that there was considerable difference between varieties. The A25 variety was early maturing and was harvested three weeks before the others. BR64 with only 50 pounds of nitrogen produced the highest yield in the test. According to the nitrogen means in the table above 50 pounds of nitrogen produced the maximum yield. Previous soil treatments may have been responsible for this low nitrogen requirement.

TABLE 16: THE EFFECTS OF SOIL FERTILITY TREATMENTS ON GRAIN SORGHUM YIELDS - 1968
CLARKTON FIELD

Initial Soil Test	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	0.9	224	170	250	900	5.3	3.0	6.5	Beulah
Subsoil	0.7	80	290	210	400	4.1	5.0	7.3	

Soil Treatment[1] $N+P_2O_5+K_2O$	Pounds Per Acre Yield	Percent Moisture at Harvest
0+ 50+ 50	2143 b[2]	16.9 a[2]
33+ 50+ 50	3216 a	16.1 b
67+ 50+ 50	3525 a	15.7 bc
100+ 50+ 50	3739 a	15.6 bc
133+ 50+ 50	3760 a	15.5 bc
167+ 50+ 50	3372 a	15.6 bc
200+ 50+ 50	3720 a	15.5 bc
167+ 0+ 0	3470 a	15.3 c
167+ 0+ 0	2843 ab	15.7 bc
167+ 50+ 50	3372 a	15.6 bc
167+100+ 50	3892 a	15.7 bc
167+100+100	3577 a	15.8 bc
167+ 50+ 0	3561 a	15.7 bc
167+ 50+ 50	3372 a	15.6 bc
167+ 50+100	3347 a	16.0 bc
167+100+100	3577 a	15.8 bc
Minimum Least Significant Range(L.S.D.)(.05)	973	0.7
Maximum Least Significant Range	1147	0.8
Coefficient of Variance	16.7%	2.5%

AKS 614 (Arkansas) planted June 18.
Irrigated: June 18, 22, August 26, and September 4.
Harvested: October 5. Desicated with Sodium Chlorate 14 days before harvest.

1/ Fertilizer sidedressed June 28.
2/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine soil fertility requirements of grain sorghum on a sandy soil.

PROCEDURE: A bird resistant variety of grain sorghum (AKS 614) was planted after wheat and the fertilizer treatments as listed above were banded near the row. Irrigation water was applied by large sprinklers four times during the growing season. Sorghum was desicated with sodium chlorate fourteen days before harvest. Harvesting was accomplished with a combine and yield and percent moisture determined.

RESULTS: The results indicate that nitrogen increased yields. On this soil the application of phosphorous and potassium increased yields at the 50 pound rate but increases were not significant. Due to the variations in the experiment yields were erratic.

TABLE 17: RESPONSES OF MONON AND BLUE BOY WHEAT TO VARIOUS RATES OF NITROGEN - 1968
PORTAGEVILLE FIELD-LOAM SOIL

Variety	Nitrogen[1] Topdressed	Yield Bu. per A.	Test Weight	Percent[2] Severity of Stem Rust	Glume[3] Blotch	Height (Inches)	Percent Lodging	Straw Color[4]
VARIETY X NITROGEN MEANS								
Monon	50	32.6 bc	58	Trace	2	37	4	1
	100	28.1 c	57	Trace	2	37	10	2
	150	19.9 d	55	Trace	4	36	15	3
Blue Boy	50	42.2 a	53	27	2	35	1	1
	100	41.4 a	54	15	2	35	2	2
	150	37.9 ab	50	33	3	35	3	3
Minimum Least Significant Range(L. S. D.)(.05)		5.3						
Maximum Least Significant Range		5.7						
Coefficient of Variance		6.9%						
NITROGEN MEANS								
	50	37.4 a	56					
	100	34.7 a	55					
	150	28.9 b	53					
Minimum Least Significant Range(L. S. D.)(.05)		4.7						
Maximum Least Significant Range		4.8						
Coefficient of Variance		8.8%						
VARIETY MEANS								
Monon		26.9 b	57					
Blue Boy		40.5 a	52					
Minimum Least Significant Range(L. S. D.)(.05)		2.7						
Maximum Least Significant Range		2.7						
Coefficient of Variance		6.9%						

Wheat planted November 13, 1967 with 13-1/2+54+54 ($N+P_2O_5+K_2O$) starter.
Harvested: June 24.

1/ Nitrogen topdressed March 7.
2/ Blue Boy wheat 100% infected whereas Monon a trace of stem rust infestation.
3/ Glume Blotch: 1 = low to 5 = severe infestation.
4/ Straw Color: 1 = light color, 2 = medium color, and 3 = dark color.

OBJECTIVE: To determine if Blue Boy wheat would respond to high rates of nitrogen without lodging and to compare Blue Boy wheat with Monon wheat.

PROCEDURE: Blue Boy and Monon wheat were planted in the fall of 1967 on the loam soil at the Portageville Field. The starter included 13.5 pounds of nitrogen on all plots and the balance was topdressed in the spring bringing the totals up to the amounts listed in table 17. The wheat was combined at harvest and yields, moistures and test weights determined.

RESULTS: The Blue Boy wheat produced higher yields than the Monon wheat by 13.6 bushels. The two varieties responded unfavorably to higher than the 50 pounds nitrogen rate of application. The Monon wheat should have been harvested at an earlier date but was delayed until the Blue Boy was ready to harvest. The actual date of maturity was not observed so the date of harvest does reflect maturity correctly. The test weight was lower for the Blue Boy wheat but the Monon wheat lodged five times as much at the 150 pound rate of nitrogen as compared to the 50 pound rate of application.

This experiment was conducted in cooperation with Leo Duclos, Research Geneticist, Assistant Professor of Agronomy at the Delta Center.

SUGAR BEET EXPERIMENTS

Soil fertility research involving sugar beets was expanded in 1968 to include the sandy loam soil on the Clarkton Field and the loam and clay soils of the Portageville Field. It is anticipated that a sugar mill will be established in the area some time in the future but definite plans have not been made. Other phases of sugar beet research were in progress at the Delta Center so as to have solutions to some of the problems that may be encountered if and when the crop becomes a reality in southeast Missouri.

The soil on the Clarkton Field is sandy and heavily infested with root knot nematode. This nematode is present on a large portion of the sandy soils of the area and will require fumigation if sugar beets are to be grown. The production of beets on this soil will enable continued harvesting in the fall during periods of rainfall when the loam and clay soils would be too wet. The production of sugar beets on this sandy soil in 1968 was unsatisfactory thus additional research is needed to determine how to improve production and quality on this soil.

The loam soil at the Portageville Field has produced satisfactory yields and quality of sugar beets since research was initiated in 1961. One difficult problem encountered in this soil has been the slow penetration of irrigation water applied by flooding the middles. The method of planting, two rows on one bed, has contributed to this problem. Experiments have indicated that an expanded mica material incorporated into the soil has aided considerably by increasing water penetration and has been reflected by a yield increase. Other materials incorporated into the soil did not increase yields.

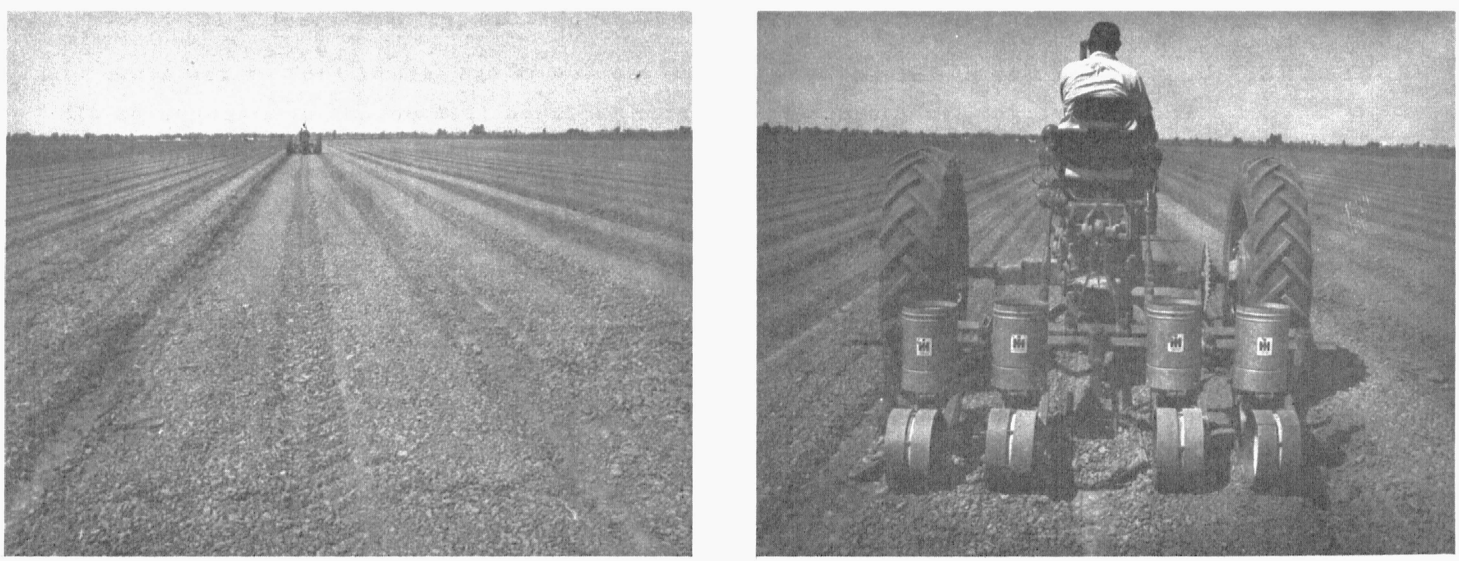
The clay soil at the Portageville Field has resulted in the highest yields of sugar beets of all soils used in the experimental trials in 1968 and previous years. Leaf spot on this soil has not been a serious problem as compared to the loam soil or sandy soil. Irrigation has been required on this soil but not as frequent as either the loam or sandy soils. Harvesting on the clay soil would be extremely difficult in wet seasons so early harvest has been essential.

Nitrogen applications have been very essential in increasing yields of sugar but an excessive amount has been detrimental to the quality of the crop. Quality of sugar beets was measured by the percent sugar and purity percentage of the juice. One hundred fifty (150) pounds of nitrogen has produced maximum yields without reducing quality materially. On the sandy soil best results have been obtained by a split application of nitrogen as compared to one preplant application.

The various row spacings of the sugar beets affected the yield and quality of the crop in 1968. Increasing the distance between rows has resulted in a decline in yields and a reduction in quality by reducing percent sugar and juice purity. Results have indicated that 22 inch rows are most favorable for the beet crop but it is somewhat difficult to perform tillage operations with tractors of the area which have large tires.

Experiments at the Delta Center other than those in soil fertility have included variety testing, fungicide sprays, chemical weed control, and selection for resistance to root knot nematode and cercospora leaf spot. These studies were included in the 1968 Report of Sugar Beet Research in Southeast Missouri.

The Great Western Sugar Company of Denver, Colorado has provided valuable assistance and materials in conducting the research program in sugar beets at the Delta Center.



Preparing seed bed and planting sugar beets on a clay soil in southeast Missouri in 1968

TABLE 18: THE EFFECT OF SOIL FERTILITY TREATMENTS ON YIELDS AND QUALITY OF SUGAR BEETS - 1968
PORTAGEVILLE FIELD-CLAY SOIL

Soil Test (1968)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	2.7	448+	500	920	5600	5.5	5.0	23.5	Sharkey
Subsoil	2.3	221	430	960	5700	5.9	3.5	22.5	

Soil Treatment[1]		Beets Harvested Per 100 Feet			Percent Sugar		
Pounds of Nitrogen							
Sidedress April 25	Sidedress	Oct. 24	Nov. 21	Mean	Oct. 24	Nov. 21	Mean
0		155 a	132 b	144 ab	15.5 ab	15.9 a	15.7 a
75		138 ab	141 ab	139 ab	15.5 ab	15.7 ab	15.6 a
150		144 ab	141 ab	143 ab	15.3 ab	15.5 ab	15.4 ab
75	75 (June 21)	135 b	138 ab	137 ab	15.0 ab	15.4 ab	15.2 ab
225		133 b	131 b	132 b	14.8 ab	15.5 ab	15.1 ab
75	75 (June 21) / 75 (July 30)	135 b	131 b	133 ab	14.7 b	15.0 ab	14.8 b
150[2]		134 b	138 ab	136 ab	15.4 ab	15.4 ab	15.4 ab
75 / 8 Ton Fine Lime	75 (June 21)	149 ab	142 ab	145 a	15.1 ab	15.3 ab	15.2 ab
Mean		140	137	139	15.2	15.4	15.3
Minimum Least Significant Range(L.S.D.)(.05)		16.9		11.9	0.9		0.7
Maximum Least Significant Range		20.2		13.7	1.1		0.8
Coefficient of Variance		8.5%			4.2%		

		Juice Purity Percent			Yield Tons Per Acre		
		Oct. 24	Nov. 21	Mean	Oct. 24	Nov. 21	Mean
0		97.1a	96.8ab	96.9 a	11.5 gh	9.7 h	10.5 e
75		96.3a-d	96.4a-d	96.3 ab	14.1 fg	12.1 gh	13.1 e
150		96.5abc	96.1a-d	96.3 ab	19.1 de	17.7 ef	18.4 cd
75	75 (June 21)	95.8bcd	95.5cd	95.7 bc	21.8 a-d	19.4 cde	20.6 bc
225		96.1 a-d	95.8 bcd	95.9 bc	23.1 a-d	23.3 abc	23.2 ab
75	75 (June 21) / 75 (July 30)	95.6 cd	95.3 d	95.5 c	24.5 a	23.6 ab	24.0 a
150[2]		95.8 bcd	95.9 bcd	95.9 bc	20.2 b-e	19.9 b-e	20.0 c
75 / 8 Ton Fine Lime	75 (June 21)	96.6 abc	96.2 a-d	96.4 ab	16.3 ef	16.1 ef	16.2 d
Mean		96.2	96.0	96.1	18.8	17.7	18.3
Minimum Least Significant Range(L.S.D.)(.05)		1.0		0.7	3.6		2.5
Maximum Least Significant Range		1.2		0.8	4.3		2.9
Coefficient of Variance		0.7%			13.8%		

Planted: A 402-64R March 29.
Row irrigated: June 22, July 22, August 21 and September 11.
Sprayed with fungicide (TBZ) for leaf spot control July 9, August 9 and September 3.
Herbicide: One pound trifluralin and cultivated into soil May 24.
Harvest: First harvest October 24 and second harvest November 21.

1/ Fertilizer applied preplant 0+100+100+2B ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into bed with rotor-tiller and bed shaper.

2/ Sodium nitrate used as nitrogen source. Ammonium nitrate used as source of nitrogen on all other plots.

3/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVES: To determine rate of nitrogen required for high yields of high quality sugar beets. To determine if all nitrogen can be applied in one operation, either preplant or at time of planting or is it desirable to apply part of the nitrogen later in the season.

PROCEDURE: Limestone, phosphate, potash and boron were applied broadcast and disc into the soil. Land was shaped into beds by use of rotor-tiller equipped with bed shaper. Beds were permitted to settle approximately thirty days after which beets were planted on top of the beds. Beets were fertilized after emergence according to treatments as listed above. At thinning trifluralin was applied and incorporated into the soil with the cultivator. Leaf spot was controlled by periodic spraying of a fungicide. Irrigation water was applied as needed by the row method of application. Sugar beets were harvested, yields determined, samples obtained from which sugar and purity analysis were made. A later harvest was made to determine change in yield and quality of the beets due to a delayed or an early harvest.

RESULTS: Yields in excess of 20 tons per acre were obtained on this clay soil in 1968. One entry in the variety test yielded 36 tons per acre which was the highest yield obtained at any time at the Delta Center.

As the rate of nitrogen was increased the quality of the sugar beets declined. Just the opposite occurred in regard to yields which increased as the nitrogen was increased. On this clay soil the split applications of nitrogen outyielded the same total nitrogen applied in one application.

The eight ton application of fine lime reduced the yield of sugar beets even though the soil pH was 5.5. The rate of application was probably too high or was not mixed as thoroughly in the soil as it should have been.

TABLE 19: THE EFFECT OF SOIL FERTILITY TREATMENTS ON YIELDS AND QUALITY OF SUGAR BEETS - 1968
PORTAGEVILLE FIELD-LOAM SOIL

Soil Test (1968)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	2.3	320	410	260	3400	5.5	2.5	12.5	Tiptonville
Subsoil	2.1	160	220	340	4000	5.3	4.0	15.5	

Soil Treatment[1] Pounds of Nitrogen		Beets Harvested Per 100 Feet			Percent Sugar		
Sidedress April 25	Sidedress	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean
0		141 abc[3]	118 c[3]	130 ab[3]	14.6 cde[3]	15.4 bc[3]	14.9 a[3]
75		128 abc	133 abc	130 ab	14.6 cde	15.6 b	15.1 a
150		131 abc	145 ab	138 ab	14.1 e	16.6 a	15.3 a
75	75 (June 21)	136 abc	136 abc	136 ab	13.9 e	16.2 a	15.1 a
225		126 bc	124 bc	125 b	13.0 f	14.5 de	13.7 b
75	75 (June 21) // 75 (July 30)	136 abc	144 ab	140 ab	13.1 f	15.1 bcd	14.1 b
150[2]		149 a	134 abc	142 ab	14.2 de	16.3 a	15.2 a
75 // 8 Ton Fine Lime	75 (June 21)	138 abc	138 abc	138 ab	14.5 de	15.4 bc	15.0 a
Mean		135	134	135	14.0	15.6	14.8
Minimum Least Significant Range (L.S.D.)(.05)		19.1		13.5	0.8		0.6
Maximum Least Significant Range		23.0		15.6	1.0		0.7
Coefficient of Variance		9.9%			3.8%		

		Juice Purity Percent			Yield Tons Per Acre		
		Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean
0		96.3 abc[3]	97.0 a[3]	96.6 a[3]	11.6 ef[3]	9.7 f[3]	10.6 c[3]
75		96.1 abc	95.4 abc	95.7 abc	14.3 cde	17.0 abc	15.6 ab
150		94.5 bcd	96.1 abc	95.3 a-d	12.8 def	13.8 cde	13.3 b
75	75 (June 21)	95.7 abc	96.4 ab	96.0 ab	13.7 cde	14.6 cde	14.2 b
225		94.2 cd	94.9 a-d	94.5 cd	13.9 cde	17.2 abc	15.6 ab
75	75 (June 21) // 75 (July 30)	94.5 bcd	93.3 d	93.9 d	15.0 b-e	15.9 a-d	15.4 ab
150[2]		94.7 bcd	95.5 abc	95.1 bcd	17.2 abc	18.2 ab	17.7 a
75 // 8 Ton Fine Lime	75 (June 21)	96.5 ab	96.3 abc	96.4 ab	16.5 abc	19.0 a	17.7 a
Mean		95.3	95.6		14.4	15.7	15.0
Minimum Least Significant Range (L.S.D.)(.05)		1.8		1.3	3.1		2.2
Maximum Least Significant Range		2.2		1.5	3.7		2.5
Coefficient of Variance		1.4%			14.2%		

Planted: A 402-64R March 29.
Row irrigated: June 10, 22, July 10, 16, 23, 31, August 21, and September 11.
Sprayed with fungicide (TBZ) for leaf spot control July 9, August 9, and September 3.
Herbicide: One pound trifluralin per acre sprayed and cultivated into soil May 21.
Harvested: First harvest October 28 and second harvest November 26.

1/ Fertilizer applied preplant 0+100+100+2 Boron ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into bed with rotor-tiller and bed shaper.

2/ Sodium nitrate used as nitrogen source. Ammonium nitrate used as source on all other treatments.

3/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05)

OBJECTIVES: To determine rate of nitrogen required for high yields of high quality sugar beets. To determine if all nitrogen can be applied in one operation, either preplant or at time of planting or is it desirable to apply part of the nitrogen later in the season.

PROCEDURE: Limestone, phosphate, potash and boron were applied broadcast and disc into the soil. Land was shaped into beds by use of rotor-tiller equipped with bed shaper. Beds were permitted to settle approximately thirty days after which beets were planted on top of the beds. Beets were fertilized after emergence according to treatments as listed above. At thinning trifluralin was applied and incorporated into the soil with the cultivator. Leaf spot was controlled by periodic spraying of a fungicide. Irrigation water was applied as needed by the row method of application. Sugar beets were harvested, yields determined, samples obtained from which sugar and purity analysis were made. A later harvest was made to determine change in yield and quality of the beets due to a delayed or an early harvest.

RESULTS: As the rate of nitrogen was increased, yields increased but the percent sugar and juice purity declined. The season was extremely hot and dry during July and August which necessitated weekly applications of irrigation water. Poor penetration of water prevented restoration of the soil moisture to the full capacity of the soil. The results indicate that 150 pounds of nitrogen was adequate if applied in the form of sodium nitrate. A split application of 150 pounds of nitrogen (ammonium nitrate) plus eight tons of fine limestone produced a yield equal to the sodium nitrate treatment. Due to the high soil test of phosphorous and potassium this soil in past experiments has not responded to the addition of these nutrients.

TABLE 20: THE EFFECT OF SOIL FERTILITY TREATMENTS ON YIELDS AND QUALITY OF SUGAR BEETS - 1968
CLARKTON FIELD

Soil Test (1968)	O.M.	P_2O_5	K	Mg.	Ca	pH	H	C.E.C.	Soil Series
Topsoil	1.3	326	220	220	1300	5.7	2.0	6.5	Beulah
Subsoil	0.8	80	160	280	700	4.8	3.0	6.0	

Soil Treatment[1/] Pounds of Nitrogen		Beets Harvested Per 100 Feet			Percent Sugar		
Sidedress April 25	Sidedress	Nov. 4	Nov. 25	Mean	Nov. 4	Nov. 25	Mean
0		136 bcd	133 bcd	135 abc	14.9 bcd	16.1 a	15.5 a
75		128 cde	134 bcd	131 abc	14.7 b-e	15.9 ab	15.3 a
150		129 cde	124 de	126 bc	14.0 def	14.6 c-f	14.3 bc
75	75 (June 28)	135 bcd	111 ef	123 bc	13.4 f	14.9 bcd	14.1 bc
225		133 bcd	104 f	119 c	12.3 g	14.2 def	13.2 c
75	75 (June 28) / 75 (August 1)	139 a-d	137 bcd	138 ab	14.1 def	13.5 ef	13.8 c
150[2/]		146 abc	146 abc	146 a	14.7 b-e	15.7 abc	15.2 a
75 / 8 Ton Fine Lime /	75 (June 28)	158 a	153 a	156 a	14.2 def	15.2 a-d	14.7 ab
Mean		138	130	134	14.0	15.0	14.5
Minimum Least Significant Range(L.S.D.)(.05)		16.7		16.7	1.1		0.8
Maximum Least Significant Range		20.1		19.3	1.3		0.9
Coefficient of Variance		12.4%			5.3%		

		Juice Purity Percent			Yield Tons Per Acre		
		Nov. 4	Nov. 25	Mean	Nov. 4	Nov. 25	Mean
0		96.5 abc	96.9 ab	96.7 ab	9.4 abc	8.5 bc	8.9 bc
75		97.1 a	97.2 a	97.2 a	7.6 c	7.4 c	7.5 c
150		96.8 ab	95.4 cde	96.1 a	10.0 abc	9.8 abc	9.9 abc
75	75 (June 28)	96.1 abc	95.7 b-e	95.9 bc	11.2 abc	10.9 abc	11.0 ab
225		94.7 de	95.4 cde	95.0 c	11.4 abc	10.9 abc	11.2 ab
75	75 (June 28) / 75 (August 1)	95.7 b-e	94.5 e	95.1 c	11.4 abc	11.0 abc	11.2 ab
150[2/]		96.2 abc	96.0 a-d	96.1 a	12.4 abc	10.8 abc	11.6 ab
75 / 8 Ton Fine Lime /	75 (June 28)	96.3 abc	96.1 abc	96.2 a	13.3 a	11.0 abc	12.2 a
Mean		96.2	95.9	96.1	10.8	10.0	10.4
Minimum Least Significant Range(L.S.D.)(.05)		1.2		0.9	3.7		2.6
Maximum Least Significant Range		1.5		1.0	4.5		3.0
Coefficient of Variance		0.9%			24.9%		

Fumigated: 25 gallons of Shell D-D soil fumigant per acre placed 9 inches deep under each row, February 23.
Planted: A 402-64R planted March 18 but replanted April 1, and April 10.
Sprinkler irrigated: June 7, 14, July 1, 10, 15, 22, 31, August 6, 23, and September 4.
Sprayed with fungicide (TBZ) for leaf spot control.
Herbicide: 2-1/2 pounds dalapon sprayed over beets May 3 and 1 pound trifluralin May 20 and cultivated into soil.
Harvest: First November 4 and second harvest November 25.

1/ Fertilizer applied preplant 0+100+100+2 B ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into bed with rotor-tiller and bed shaper.

2/ Sodium nitrate used as nitrogen source. Ammonium nitrate used as source of nitrogen on all other plots.

3/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVES: To determine rate of nitrogen required for high yields of high quality sugar beets. To determine if all nitrogen can be applied in one operation, either preplant or at time of planting or is it desirable to apply part of the nitrogen later in the season.

PROCEDURE: Limestone, phosphate, potash and boron were applied broadcast and disc into the soil. Land was shaped into beds by use of rotor-tiller equipped with bed shaper. Beds were permitted to settle approximately thirty days after which beets were planted on top of the beds. Beets were fertilized after emergence according to treatments as listed above. At thinning trifluralin was applied and incorporated into the soil with the cultivator. Leaf spot was controlled by periodic spraying of a fungicide. Irrigation water was applied as needed by the sprinkler method of application. Sugar beets were harvested, yield determined, samples obtained from which sugar and purity analysis were made. A later harvest was made to determine change in yield and quality of the beets due to a delayed or an early harvest.

RESULTS: Sugar beet yields on this sandy soil were below what would be acceptable in commercial production. Root-knot nematode and poor water holding capacity of this soil have contributed to the low yields. The split application totaling 150 pounds of nitrogen with additional limestone produced the maximum yield in 1968. The higher rate of nitrogen (225 pounds) reduced percent sugar and juice purity without improvement in yield.

Future study will aim toward the determination of production methods required to produce satisfactory sugar beet crops on this soil. In the operation of a sugar mill beets may be harvested on this soil at times when wet soil conditions would prevent harvest on the loam or clay soils. Thus it will be desirable that some beets be grown on the sandy soils.

TABLE 21: THE INFLUENCE OF VARIOUS ROW SPACINGS ON SUGAR BEET YIELDS AND QUALITY - 1968

PORTAGEVILLE FIELD-CLAY SOIL

Row Spacing	Beets Harvested Per 100 Feet			Percent Sugar			Juice Purity Percent			Yield Tons Per Acre		
	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean
	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
28" and 16" 1/	142 a	143 a	142 b	15.6 a	15.6 a	15.6 a	96.8 a	95.6 b	96.2 a	19.1 c	11.1 bc	10.6 c
22"	157 a	155 a	156 ab	15.8 a	15.3 a	15.6 a	96.0 ab	95.1 b	95.6 a	13.4 a	13.0 ab	13.2 a
26"	143 a	148 a	145 ab	15.0 a	16.8 a	15.9 a	95.8 ab	95.6 b	95.7 a	13.2 ab	12.1 abc	12.7 ab
30"	162 a	156 a	159 a	15.8 a	15.6 a	15.7 a	95.6 b	95.3 b	95.4 a	12.0 abc	11.1 bc	11.6 bc
Min. L.S.R. (L.S.D.)(.05)	20.5		14.5	1.8		1.3	1.1		0.8	1.9		1.3
Max. L.S.R.	23.5		15.6	2.1		1.4	1.2		0.8	2.2		1.4
Coefficient of Variance	10.5%			8.9%			0.9%			12.0%		

PORTAGEVILLE FIELD-LOAM SOIL

28" and 16" 1/	136 ab	143 ab	139 a	14.5 b	16.6 a	15.5 a	95.2 ab	96.1 a	95.7 a	13.0 b	15.0 ab	14.0 b
22"	133 ab	138 ab	135 a	14.3 b	15.0 b	14.7 b	94.7 b	95.0 ab	94.9 ab	16.8 a	16.8 a	16.8 a
26"	137 ab	155 a	146 a	14.5 b	15.3 b	14.9 ab	95.1 ab	95.4 ab	95.3 ab	13.0 b	15.0 ab	14.0 b
30"	140 ab	125 b	133 a	14.4 b	15.0 b	14.7 b	94.7 b	94.4 b	94.6 b	13.1 b	13.0 b	13.0 b
Min. L.S.R. (L.S.D.)(.05)	22.2		15.7	0.96		0.68	1.09		0.77	3.0		2.1
Max. L.S.R.	24.8		17.0	1.07		0.73	1.22		0.84	3.4		2.3
Coefficient of Variance	9.0%			3.6%			0.7%			11.8%		

Planted: A402-64R April 16.
Fertilizer applied preplant 100+100+100+2 Boron ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into soil.
Row irrigated: Clay soil-June 22, July 22, August 21 and September 11. Loam soil-June 10, 22, July 10, 16, 23, 31, August 6, 20, September 4 and 11.
Sprayed with fungicide (TBZ) July 9, August 9, and September 3.
Herbicides used were dalapon to control grass postemergence and trifluralin incorporated into soil with cultivator after thinning.
Harvested: First harvest October 28 and second harvest November 26.

1/ Two rows on bed 16 inches apart with 28 inch middles between the double rows.
2/ Duncan's New Multiple Range Test: Results followed by the same letters are not significantly different (.05)

OBJECTIVE: To determine the most desirable sugar beet row spacing for maximum yield and highest quality. However it was desired in this experiment to keep the row spacing within practibility of present day equipment.

PROCEDURE: Preplant fertilizer was broadcast and disc into the soil. Sugar beets were planted on the flat in row spacings as listed in table 21. The herbicide trifluralin was applied and incorporated into the soil at time of thinning. Irrigation water was applied as needed. Fungicide (TBZ) was applied three times during the season to prevent leaf spot. The beets were harvested, yields determined, and samples obtained for sugar percentage and purity analysis.

RESULTS: Narrow rows were not practical with the size tires of tractors used in modern agriculture. These data obtained from the two soils above indicate that the 22 inch rows produced the higher yields of the various row widths tested. The 30 inch rows would be the more ideal spacing as far as machinery was concerned but the quality and yield of the beets were reduced on the clay and loam soils. The method of planting two rows of sugar beets on one bed was very difficult to irrigate, cultivate and harvest.

The beets in these two tests were planted late which was the reason for the low yields. Had the sugar beets been planted in March instead of April 16 higher yields would have resulted. Sugar beets in the 1969 experiments will be planted in rows spaced 26 inches apart.

TABLE 22: INFLUENCE OF METHOD OF IRRIGATION ON YIELDS AND QUALITY OF SUGAR BEETS - 1968
PORTAGEVILLE-LOAM

	Beets Per 100 Feet Harvest			Percent Sugar Harvest			Juice Purity Percent Harvest			Yield Tons Per Acre Harvest		
	Oct. 28	Nov. 21	Mean	Oct. 28	Nov. 21	Mean	Oct. 28	Nov. 21	Mean	Oct. 28	Nov. 21	Mean
IRRIGATION X HARVEST MEANS	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/
Row Irrigation	126 a	111 a	118 a	15.3 a	14.9 a	15.1 a	94.6 a	94.6 a	94.6 a	16.6 b	21.0 a	18.8 b
Sprinkler Irrigation	111 a	119 a	115 a	12.8 b	14.2 a	13.5 b	92.3 a	92.9 a	92.6 b	20.5 a	23.5 a	22.0 a
Minimum L.S.R.(L.S.D.)(.05)	29		21	1.2		0.9	2.8		2.0	3.5		2.5
Maximum L.S.R.	31		21	1.3		0.9	3.0		2.0	3.7		2.5
Coefficient of Variance		14.5%			5.0%			1.8%			9.9%	
HARVEST MEANS												
October 28			118 a			14.0 a			93.5 a			18.6 b
November 21			115 a			14.6 a			93.8 a			22.3 a
Minimum L.S.R.(L.S.D.)(.05)			15			1.4			1.4			5.7
Maximum L.S.R.			15			1.4			1.4			5.7
Coefficient of Variance			8.2%			6.1%			0.9%			17.6%

Planted: A 402-64R April 15, Thinned: May 9.
Fertilizer all plots: 100+100+100+2B ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into bed with rotor-tiller. 50 pounds nitrogen sidedress May 28 and 100 pounds nitrogen sidedressed July 22.
Herbicide: One pound trifluralin incorporated into soil with rotary hoe May 22 after thinning.
Irrigated: June 10, 22, July 10, 16, 23, 31, August 6, 20, September 4 and 11.
Harvested: First harvest October 28 and second harvest November 21.
Fungicide: All plots sprayed with TBZ to control cercospora leaf spot July 8, August 9, 29 and September 21.
1/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine the influence of the method of applying irrigation water on sugar beet quality and yield.

PROCEDURE: Preplant fertilizer was broadcast and incorporated into the bed. Sugar beets were planted on top of the bed and after thinning trifluralin was incorporated into the soil with a rotary hoe. Irrigation water was applied during the growing season as needed. On portions of the area the row method of irrigation was used while on a similar area the sprinkler system was used. The fungicide TBZ was applied on the beets of both areas. At harvest yields were obtained and samples obtained for sugar and purity analysis. Two harvest were made to measure the differences in yield and quality of the beets between harvests.

RESULTS: Because of poor penetration row irrigation has not been a very effective method of irrigating sugar beets on the loam soil at Portageville Field.

The sprinkler method improved penetration of the water into the soil but also caused the spread and intensity of cercospora leaf spot. Leaf spot causes the leaves to desicate which necessitates replacement by new leaves. This process of renewing the leaves causes a reduction in the sugar content as indicated by the data in table 22. Fungicide sprays were applied but did not completely control the disease. The row irrigated sugar beets had very little leaf spot on the plant leaves.

The yield of the sugar beets irrigated by sprinkler averaged 3.2 tons more than those row irrigated. Additional studies in the use of fungicides and the development of more resistant varieties may change this unfavorable result of sprinkler irrigation.

TABLE 23: INFLUENCE OF SOIL TREATMENTS ON SUGAR BEET YIELDS AND QUALITY - 1968
PORTAGEVILLE FIELD-LOAM SOIL

Soil Treatment[1/]	Beets Per 100 Feet Harvest			Percent Sugar Harvest			Juice Purity Percent Harvest			Yield Tons Per Acre Harvest		
	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean	Oct. 28	Nov. 26	Mean
LIMESTONE X HARVEST MEANS	2/	2/	2/	2/	2/	2/	2/	2/	2/			
None	123 a	138 a	130 a	13.3 bc	14.5 ab	13.9 a	94.7 ab	93.9 ab	94.3 abc	12.6 b	13.7 b	13.2 a
Deep Tillage 24"	116 a	128 a	122 a	13.7 abc	14.9 a	14.3 a	95.7 a	94.9 ab	95.3 ab	10.9 b	15.9 ab	13.4 a
5 Ton Zonolite	109 a	131 a	120 a	12.9 c	14.9 a	13.9 a	94.5 ab	94.4 ab	94.4 abc	14.1 b	21.6 a	17.9 a
10 Ton Zonolite	118 a	120 a	119 a	13.2 bc	14.9 a	14.0 a	95.5 ab	95.5 ab	95.5 a	15.1 ab	16.9 ab	16.0 a
20 Ton Silage	121 a	124 a	123 a	13.6 abc	14.0 abc	3.8 a	93.8 b	93.8 b	93.8 c	13.2 b	15.1 ab	14.2 a
250 Ton Clay Soil	121 a	125 a	123 a	12.9 c	14.2 abc	13.5 a	94.1 ab	94.4 ab	94.2 bc	13.1 b	14.2 b	13.6 a
Minimum L.S.R.(L.S.D.)(.05)	26		19	1.3		0.9	1.6		1.2	6.5		4.6
Maximum L.S.R.	29		20	1.5		1.0	1.8		1.3	7.2		5.1
Coefficient of Variance	9.6%			4.3%			0.8%			20.0%		
HARVEST MEANS	118 a	128 a		13.3 a	14.5 a		94.7 a	94.5 a		13.2 a	16.2 a	

Planted: A 402-64R April 12.
Fertilized all plots with 100+100+100+2B ($N+P_2O_5+K_2O$+Boron) broadcast and incorporated into bed with rotor-tiller.
Irrigated: June 10, 22, July 10, 16, 23, 31, August 6, 20, September 4 and 11.
Harvested: First harvest October 28 and second harvest November 21.
Fungicide: All plots sprayed with TBZ to control cercospora leaf spot; July 8, August 9, 29, and September 12.

1/ Materials were incorporated into top 8 inches of soil.
2/ Duncan's New Multiple Range Test: Results followed by same letters are not significantly different (.05).

OBJECTIVE: To determine a soil treatment method that would increase the rate of penetration of irrigation water into the loam soil.

PROCEDURE: Various materials as listed in table 23 were incorporated into the soil eight inches deep with a rotor-tiller. In addition one treatment consisted of removing and mixing the soil 24 inches deep. The plots were then shaped into beds and sugar beets planted on top of the beds. Row irrigation was used in applying the water. Trifluralin was incorporated into the soil after thinning to control weeds. Two harvests were made so as to determine effects of date of harvest on yields and quality of the beets.

RESULTS: Expanded mica (Zonolite) resulted in the highest yields of this experiment. Observations during the growing season indicated maximum top growth on the plot containing the mixture of clay soil. The yield of beets was not increased by the clay treatment. A practical method of improving the rate of penetration is definitely needed and future work will include experiments on this problem.

TABLE 24: SUGAR BEET TRIALS ON PRODUCER FARMS

Name of Producer - Location	Acres	Beets Per 100 Feet	Percent Sugar	Juice Purity Percent	Yield Tons Per Acre
Sam Hunter Farms - New Madrid[1/]	5	146	15.0	95.9	19.6
Bolton & Dortch - Bragg City[2/]	5	159	14.3	95.4	16.1
Winston Harris - Senath[3/]	3	156	15.8	95.2	22.1

Planted: A 402-64R 1/ April 11; 2/ May 1; 3/ March 27
Fertilizer: According to soil test recommendation all each location.
Herbicide: One pound treflan incorporated into soil after thinning. Pyramin and TCA used at Harris location to kill weeds post emergence.
Row irrigated at all locations.
Fungicide spray (TBZ) applied all locations four times during July, August and September.
Harvested: Yields obtained November 5.

The members of the sugar beet association selected three producers of the area to grow a small acreage of sugar beets. Members of the staff at the Delta Center assisted the producers in this project.

The results above indicate very satisfactory yields. The Bolton and Dortch farms' yield was lowest due to the late planting (May 1). The delay was due to wet soils. Even though the planting was late a reasonable yield was obtained under the conditions that prevailed.

With the interest of The Great Western Sugar Company plans were made to produce 300 acres in 1969 on ten farms of the area.

Thinning sugar beets with a mechanical thinner.

Comparison of single and split application of nitrogen fertilizer on sugar beets.

WEATHER INFORMATION OF THE PORTAGEVILLE FIELD

The 1968 growing season (June, July and August) was extremely dry at the Portageville Field and several irrigations were required to maintain crops. Even with irrigation the hot temperature and winds resulted in below maximum yields of the soybean and sugar beet crops.

AVERAGE TEMPERATURE AT THE DELTA CENTER, PORTAGEVILLE, MISSOURI, 1968

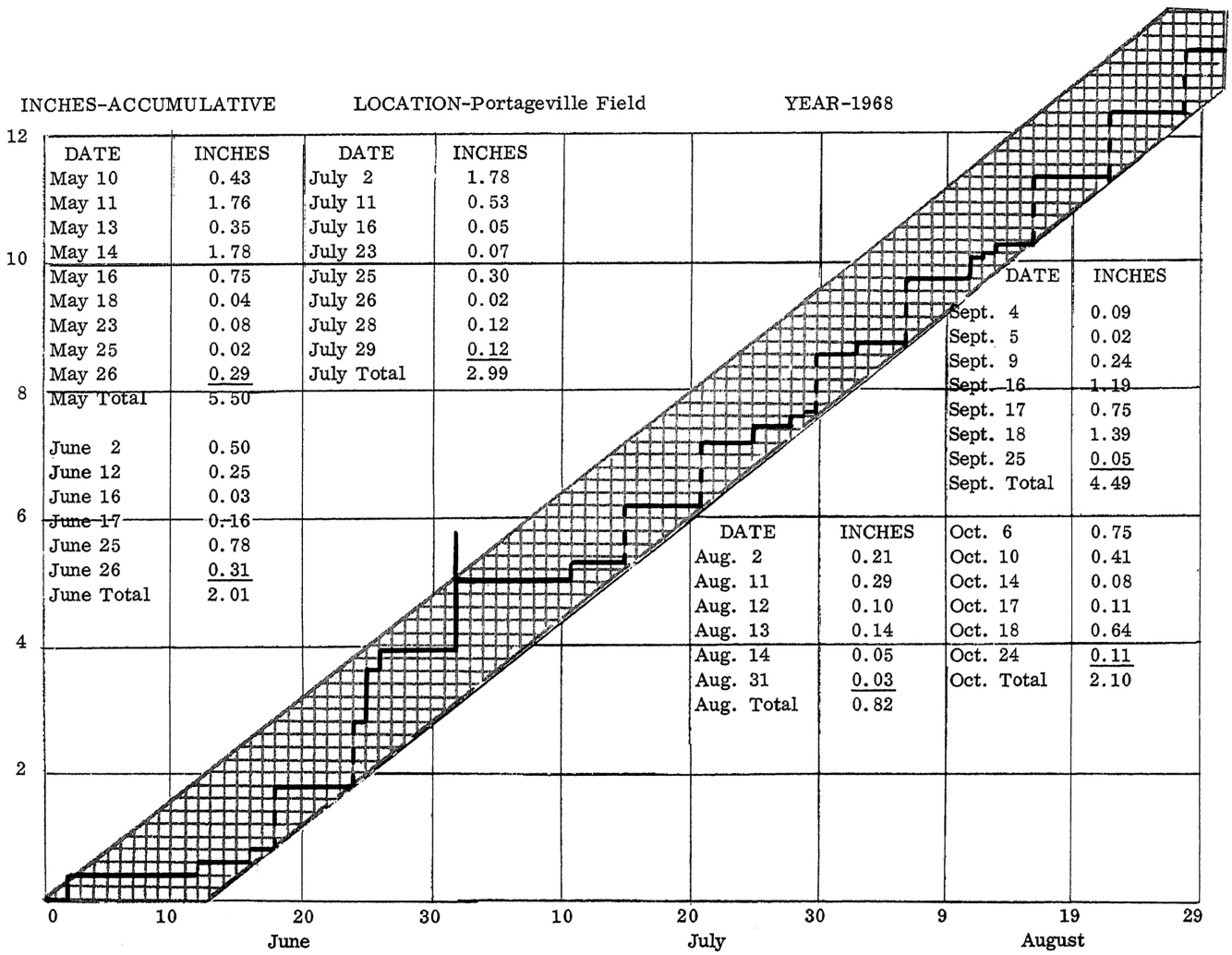
	May	June	July	August	September	October
Average Maximum Temperature	76.7	89.3	89.5	89.6	81.3	71.6
Average Minimum Temperature	57.2	67.3	68.8	68.7	56.7	48.4
Mean	67.0	78.3	79.2	79.2	69.0	60.0

The accumulative water chart, Figure 1, reports the rainfall as recorded by the Weather Bureau at the Portageville Field on the loam soil. The chart is based on a daily requirement of 0.16 inches for the day from June 1 to August 31. This requirement of 0.16 was considered for corn but other crops may vary from this assumption.

The rainfall has been recorded and plotted, Figure 1, and is shown by the solid vertical lines on the chart. The broken vertical line indicates that irrigation water should have been applied to maintain a sufficient supply of water for the plants. Irrigation on the chart is indicated as an application of one inch which in case of a rain following irrigation permits absorption of an additional inch by the soil. Only once (July 2) during the June 1 to August 31 period did the rainfall raise above the top line which would indicate runoff. If the irrigation on June 24 had been delayed one day the soil would have held the rainfall of July 2 without any runoff.

The method of charting precipitation as shown in Figure 1 is offered as a guide to irrigation, especially for those who may be undertaking irrigation for the first time. Experience will show necessary variations in this method for the adaption to crop and local conditions.

For additional information see Science and Technology Guide "Irrigating Corn on Claypan Soils in Missouri" by C. M. Woodruff, page 4137.



DATE	INCHES
May 10	0.43
May 11	1.76
May 13	0.35
May 14	1.78
May 16	0.75
May 18	0.04
May 23	0.08
May 25	0.02
May 26	0.29
May Total	5.50
June 2	0.50
June 12	0.25
June 16	0.03
June 17	0.16
June 25	0.78
June 26	0.31
June Total	2.01

DATE	INCHES
July 2	1.78
July 11	0.53
July 16	0.05
July 23	0.07
July 25	0.30
July 26	0.02
July 28	0.12
July 29	0.12
July Total	2.99

DATE	INCHES
Aug. 2	0.21
Aug. 11	0.29
Aug. 12	0.10
Aug. 13	0.14
Aug. 14	0.05
Aug. 31	0.03
Aug. Total	0.82

DATE	INCHES
Sept. 4	0.09
Sept. 5	0.02
Sept. 9	0.24
Sept. 16	1.19
Sept. 17	0.75
Sept. 18	1.39
Sept. 25	0.05
Sept. Total	4.49

DATE	INCHES
Oct. 6	0.75
Oct. 10	0.41
Oct. 14	0.08
Oct. 17	0.11
Oct. 18	0.64
Oct. 24	0.11
Oct. Total	2.10

Figure 1: Rainfall and irrigation requirements during the growing season.