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Limestone and Nitrogen Application Influence on Cotton Yields and Soil Tests in Beulah Fine Sandy Loam Soil in Southeast Missouri

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SUMMARY

Seed cotton yields were increased significantly by the application of limestone on a Beulah fine sandy loam soil with an initial pHs of 3.9 to 4.0. Twelve tons of Dolomitic limestone produced highest yields of seed cotton over the eight year period but was not statistically different from the 8 ton application of calcium carbonate fine lime. The results indicate that over the eight year period 500 pounds of ($CaCO_3$) fine lime applied annually increased the soil pHs to a higher level than a higher rate applied initially.

Dolomitic limestone increased the exchangeable magnesium in the soil from 58 pounds per acre initially to 271 pounds three years after application of twelve tons. Even though soil tests indicated low levels of exchangeable magnesium, visual deficiency symptoms were not observed. On the average, pounds of exchangeable potassium per acre were reduced 110 pounds the first year after application of limestone, even though 42 pounds had been applied to the soil.

The 138 pound application of nitrogen produced the highest yield of seed cotton over the eight years, which was significantly higher than either the 38 or 63 pound rates of nitrogen application. Nitrogen significantly increased the acidity of the soil in summary of all treatments as measured by a reduction in soil pHs.

ACKNOWLEDGEMENT

The study reported in this publication was begun under the direction of Dr. G. E. Smith, Chairman, Department of Soils, and completed under the guidance of Dr. Roger Mitchell, (formerly Chairman, Department of Agronomy, Presently Dean of Extension). This research was one of the experiments of Project Number 7033-2670, "Soil Fertility and Cotton Production," University of Missouri Agricultural Experiment Station.

Limestone and Nitrogen Application Influence on Cotton Yields and Soil Tests in Beulah Fine Sandy Loam Soil in Southeast Missouri

JAMES A. ROTH AND THOMAS E. FISHER*

The application of limestone and nitrogen to the production of cotton has been a major concern of Southeast Missouri cotton producers. The amount of calcium carbonate required to neutralize the acidity produced per pound of nitrogen applied as ammonium nitrate will vary from 1.8 (2)** to 3.57 (4) pounds. The calcium content of the soil influences the availability of other plant nutrients as the pH or the acidity of the soil varies. In practically all soils in Southeast Missouri there is an ample supply of calcium to provide the nutritional requirements of the cotton plant but many acres are acid and require limestone for neutralization so as to provide a more favorable environment for increasing availability of other plant nutrients.

According to Neal and Lovett, as reported in "Hunger Signs in Crops" (7), a low pH causes "crinkle leaf" (manganese toxicity) which results in an excess of water soluble manganese in the soil solution. Increasing the pH by the addition of limestone eliminates the cause of "crinkle leaf" in cotton by reducing exchangeable manganese. The objectives of this study were to determine the optimum range of soil pH and to determine the effect of dolomitic agricultural limestone as compared to fine limestone of less than 100 mesh. Also included in the objectives was to determine optimum rate of nitrogen and what effect if any that nitrogen had on the soil pH over a period of years. This study provided an opportunity to observe other changes in soil test values over a period of years. These changes are reported in following tables (Tables 1 through 9).

This report completes the study of three soils on which similar experiments were conducted. The other two soils include Tiptonville silt loam (6) and Portageville clay soil (5).

EXPERIMENTAL PROCEDURE

A field experiment was established on an outlying experiment field located three miles south of Clarkton. The soil type was a Beulah fine sandy loam which was derived from medium or moderately coarse textured alluvium laid down by

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**Numbers in parentheses are keyed to references at end of bulletin.

the Mississippi River. Beulah soils occur on the natural levees bordering former river channels and are usually excessively drained internally with rapid permeability (1). The soil texture consisted of approximately 84 percent sand, 10 percent silt, and 6 percent clay. Soil simples (0-6 inches) were obtained from each plot prior to the application of any soil treatment. These initial tests are reported in Table 1.

A split plot design was used; the nine main blocks consisted of the no treatment, four rates of dolomitic limestone† from Piedmont, Mo., and four rates of calcium carbonate fine limestone†† from Ste. Genevieve. The four-row sub-plots, 70 feet long, of each limestone treatment and check, included three rates (38; 63; and 113 pounds per acre) of nitrogen sidedressed annually before flowering. A recommended wilt (Fusarium) resistant variety was planted in 38 inch rows as near May 1 as soil conditions permitted.

Limestone was all broadcast, disced in, and turned under prior to planting the first crop of cotton, except the 500 pounds annual treatment. The annual treatment of 500 pounds of fine lime†† from Ste. Genevieve was sidedressed as soon after planting as practical each season for the duration of the experiment.

The cotton was irrigated by sprinklers as often as needed throughout the experiment, ranging from one to four times, depending on the seasonal rainfall. Due to the inability of the soil to retain moisture, irrigations were frequent but usually terminated by August 15 to prevent excessive plant growth. Herbicides were used as recommended to control weeds and insecticides were applied as needed to control insects.

The mechanical spindle picker adapted to harvesting plots was used in obtaining seed cotton yields. Samples of seed cotton were obtained at picking from which percent lint, staple, and size of bolls were determined. Fiber data are not included in this publication as differences between treatments were not statistically significant.

Following each harvest, soil samples were obtained and analyzed from each plot according to methods used in soil testing laboratories of Missouri (3). Annual results of soil tests and yields are reported in Tables 1 through 9. Duration of the experiment included eight years of harvest and the summary of yields over the eight year period is in Table 9.

The data was evaluated statistically by Duncan's New Multiple Range Test (5% level of significance) as a split-plot design.

†Dolomitic limestone, agricultural grade, 53.5% $CaCo_3$, 43.5% $MgCO_3$, with 60-65% passing through a 40 mesh sieve.

††Calcium carbonate fine limestone 98.5% $CaCO_3$ with 100% passing through a 100 mesh sieve and 80% through a 200 mesh sieve.

Table 1

Soil Test Results[5] and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1962

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						[6] Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	.47fg	154a-d	300de	40a	667ab	2.8 ab	3.9 a	5.2 a	878g	1363g-j
None (2)	.40g	132cd	320cde	60a	533ab	2.8 ab	4.0 a	4.8 a	894fg	1343hij
None (3)	.53d-g	129d	313cde	113a	833ab	2.8 ab	4.0 a	5.8 a	881g	1294ijk
[1] 2 Tons (1)	.57c-g	169a-d	360bcd	60a	400ab	3.3 ab	4.0 a	5.0 a	1107efg	1566f-i
2 Tons (2)	.83a-e	164a-d	343cde	46a	367b	3.7 a	3.9 a	5.2 a	1235c-f	1693d-i
2 Tons (3)	.60c-g	169a-d	337cde	40a	467ab	2.8 ab	3.9 a	4.7 a	1192d-g	1638e-i
4 Tons (1)	1.03a	192ab	437a	127a	767ab	3.0 ab	4.0 a	6.2 a	1209c-g	1615e-i
4 Tons (2)	.97ab	193a	363bc	60a	533ab	3.2 ab	4.0 a	5.2 a	1389b-e	1792b-f
4 Tons (3)	.90abc	190ab	343cde	33a	500ab	3.2 ab	3.9 a	5.0 a	1376b-e	1759c-g
8 Tons (1)	.60c-g	146a-d	287e	60a	600ab	2.5 b	4.0 a	4.7 a	1684ab	2050a-d
8 Tons (2)	.47fg	169a-d	310cde	93a	700ab	2.8 ab	4.0 a	5.3 a	1549abc	2129abc
8 Tons (3)	.43fg	163a-d	303cde	67a	800ab	2.7 b	4.0 a	5.3 a	1494a-d	2011a-e
12 Tons (1)	.83a-e	175a-d	333cde	40a	766ab	3.0 ab	3.9 a	5.5 a	1608ab	2122abc
12 Tons (2)	.70a-g	142b-d	330cde	47a	533ab	2.7 b	4.0 a	4.7 a	1703ab	2224a
12 Tons (3)	.50e-g	157a-d	317cde	87a	900a	3.0 ab	3.9 a	6.2 a	1765a	2198ab
[2] 2 Tons (1)	.67b-g	159a-d	323cde	53a	337b	3.2 ab	4.0 a	4.5 a	1195d-g	1621e-i
2 Tons (2)	.83a-e	172a-d	330cde	47a	400ab	3.0 ab	4.0 a	4.7 a	1176d-g	1618e-i
2 Tons (3)	.90a-c	188ab	357bcd	53a	367b	3.2 ab	4.0 a	4.7 a	1415b-e	1998a-e
4 Tons (1)	.63b-g	155a-d	320cde	47a	733ab	2.8 ab	4.0 a	5.2 a	1212c-g	1752c-h
4 Tons (2)	.67b-g	146a-d	303cde	27a	567ab	3.0 ab	4.0 a	4.8 a	1146d-g	1726c-h
4 Tons (3)	.53d-g	166a-d	340cde	27a	633ab	2.8 ab	3.9 a	5.0 a	1189d-g	1700d-i
8 Tons (1)	.70a-g	181abc	317cde	73a	567ab	3.2 ab	4.0 a	5.2 a	1366b-e	1765c-g
8 Tons (2)	.90a-c	154a-d	333cde	60a	600ab	3.0 ab	4.0 a	5.2 a	1382b-e	1815b-f
8 Tons (3)	.60c-g	164a-d	310cde	60a	567ab	3.0 ab	3.9 a	5.2 a	1405b-e	1805b-f
[3] 500 Lbs. (1)	.87a-d	166a-d	407ab	127a	733ab	2.8 ab	4.0 a	5.8 a	442h	8751
500 Lbs. (2)	.77a-f	193a	343cde	93a	633ab	3.2 ab	4.0 a	5.5 a	508h	937kl
500 Lbs. (3)	.83a-e	190ab	333cde	40a	667ab	3.0 ab	4.0 a	5.2 a	544h	1028ijk
Min. LSR,LSD	.29	42.4	53.0	103.4	436.7	0.77	0.11	1.49	298.1	353.7
Max. LSR	.34	50.6	63.2	123.4	521.1	0.91	0.13	1.77	355.7	422.1
C.V. %	24.6	15.2	9.5	99.0	43.4	15.3	1.6	17.1	14.6	12.5

Table 1 - Cont.

Limestone	O.M.	P_2O_5	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	.47a	138a	311a	71a	678a	2.8 a	4.0 a	5.3 a	884c	1333cd
2 Tons[1/]	.67a	167a	347a	49a	411a	3.3 a	3.9 a	4.9 a	1178bc	1632bc
4 Tons	.97a	192a	381a	73a	600a	3.1 a	4.0 a	5.4 a	1324ab	1722abc
8 Tons	.50a	159a	300a	73a	700a	2.7 a	4.0 a	5.1 a	1575ab	2063ab
12 Tons	.68a	158a	327a	58a	733a	2.9 a	4.0 a	5.4 a	1692a	2181a
2 Tons[2/]	.80a	173a	337a	51a	368a	3.1 a	4.0 a	4.6 a	1262bc	1746abc
4 Tons	.61a	156a	321a	33a	644a	2.9 a	4.0 a	5.0 a	1182bc	1726abc
8 Tons	.73a	166a	320a	64a	578a	3.1 a	4.0 a	5.2 a	1384ab	1795abc
500 Lbs.[3/]	.82a	183a	361a	87a	678a	3.0 a	4.0 a	5.5 a	498d	947d
Min. LSR,LSD	.59	73.4	127.5	53.8	467.7	0.86	0.10	1.22	368.1	462.6
Max. LSR	.67	83.4	145.0	61.1	531.7	0.98	0.12	1.39	418.4	525.8
C.V. %	85.2	44.3	38.2	86.5	78.1	28.8	2.6	23.6	30.2	27.5
					NITROGEN MEANS					
38+50+50[4/]	.71a	166a	343a	70a	619a	3.0 a	4.0 a	5.2 a	1189a	1637a
63+50+50	.73a	163a	331a	59a	541a	3.0 a	4.0 a	5.0 a	1220a	1697a
113+50+50	.65a	169a	328a	58a	637a	2.9 a	3.9 a	5.2 a	1251a	1714a
Min. LSR,LSD	.010	14.1	17.7	34.5	145.6	0.26	.035	0.50	99.4	117.9
Max. LSR	.010	14.9	18.6	36.3	153.1	0.27	.037	0.52	104.5	124.0
C.V. %	24.6	15.2	9.5	99.0	43.4	15.3	1.6	17.1	14.6	12.5

1/ Dolomitic limestone, agricultural grade, from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

5/ Soil samples obtained before limestone applications.

6/ Yields after limestone applications.

(1) 38 pounds of nitrogen per acre.

(2) 63 pounds of nitrogen per acre.

(3) 113 pounds of nitrogen per acre.

Table 2

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiment
Beulah Sandy Loam Soil - Clarkton Field - 1963

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	.63ab	177a-h	267ab	113c-g	933fg	3.5 ab	4.0 f	6.7 bcd	501ijk	963e
None (2)	.67ab	156gh	283a	80e-h	833g	3.3 abc	4.0 f	6.0 d	278k	563g
None (3)	.63ab	155gh	227abc	80e-h	867fg	3.3 abc	4.0 f	6.2 cd	334jk	691fg
[1] 2 Tons (1)	.67ab	192a-f	273a	120c-g	1067d-g	2.7 d-g	4.3 ef	6.2 cd	1006efg	1349cd
2 Tons (2)	.73ab	192a-f	177bc	113c-g	1067d-g	3.0 b-e	4.2 ef	6.3 cd	1137a-g	1494a-d
2 Tons (3)	.73ab	173a-h	210abc	127c-f	1067d-g	3.0 b-e	4.2 ef	6.3 cd	1058c-g	1435a-d
4 Tons (1)	.80a	204ab	240abc	153bcd	1133d-g	2.7 d-g	4.4 d-f	6.3 cd	1287a-d	1546a-d
4 Tons (2)	.70ab	177a-h	260ab	153bcd	1200c-g	2.5 e-h	4.5 c-f	6.3 cd	1399a	1657ab
4 Tons (3)	.67ab	207a	263ab	133cde	1000e-g	2.7 d-g	4.3 ef	6.0 d	1310abc	1602abc
8 Tons (1)	.50b	157gh	200abc	167abc	1367b-e	1.8 i	4.9 a-d	6.2 cd	1035d-g	1376bcd
8 Tons (2)	.50b	164e-h	210abc	167abc	1233c-g	2.2 ghi	4.9 a-d	6.2 cd	947g	1359cd
8 Tons (3)	.50b	170b-h	237abc	147bcd	1167c-g	2.3 f-i	4.6 a-e	6.2 cd	907gh	1300d
12 Tons (1)	.63ab	193a-e	197abc	193ab	1200c-g	2.2 ghi	4.9 a-d	6.2 cd	1228a-f	1539a-d
12 Tons (2)	.63ab	168c-h	153c	213a	1267c-f	2.0 hi	5.0 abc	6.3 cd	1317abc	1690a
12 Tons (3)	.73ab	157f-h	237abc	190ab	1133d-g	2.2 ghi	5.0 abc	6.0 d	1363ab	1706a
[2] 2 Tons (1)	.87a	183a-g	233abc	113c-g	1067d-g	3.2 a-d	4.3 ef	6.5 bcd	1133a-g	1471a-d
2 Tons (2)	.67ab	194a-e	220abc	80e-h	1133d-g	3.0 b-e	4.3 ef	6.5 bcd	973fg	1363cd
2 Tons (3)	.70ab	203abc	273a	80e-h	1167c-g	3.2 a-d	4.2 ef	6.7 bcd	1222a-f	1595abc
4 Tons (1)	.67ab	144h	223abc	100d-g	1700b	2.2 ghi	5.0 abc	7.0 bc	1006e-g	1382bcd
4 Tons (2)	.63ab	177a-h	220abc	80e-h	1433bcd	2.8 c-f	4.6 b-e	7.0 bc	1051c-g	1471a-d
4 Tons (3)	.63ab	167d-h	207abc	113c-g	1267c-f	2.3 f-i	4.6 b-e	6.2 cd	1032d-g	1395b-d
8 Tons (1)	.70ab	176a-h	240abc	67gh	2200a	2.3 f-i	5.1 a	8.3 a	1163a-g	1520a-d
8 Tons (2)	.70ab	161e-h	253ab	73f-h	1567bc	2.8 c-f	4.6 b-e	7.3 b	1277a-e	1598abc
8 Tons (3)	.70ab	167d-h	237abc	73f-h	1467bcd	2.7 d-g	5.0 ab	7.0 bc	1114b-g	1444a-d
[3] 500 Lbs. (1)	.67ab	189a-g	210abc	73f-h	900fg	3.5 ab	4.0 f	6.3 cd	580ij	917ef
500 Lbs. (2)	.87a	189a-g	243abc	80e-h	833g	3.7 a	4.1 f	6.3 cd	616i	1019e
500 Lbs. (3)	.73ab	202a-d	223abc	40h	967e-g	3.2 a-d	4.0 f	6.0 d	678hi	996e
Min. LSR,LSD	.21	29.4	77.7	48.6	345.0	0.56	0.45	0.79	234.6	247.6
Max. LSR	.25	35.1	92.7	58.0	412.0	0.67	0.54	0.94	279.9	295.4
C.V. %	18.4	9.9	20.1	25.0	17.2	12.1	6.0	7.3	14.0	10.9

Clarkton - Sand - 1963 - Cont.

Table 2 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.64a	162a	259a	91de	878d	3.39ab	4.01d	6.28a	371c	739b
2 Tons[1/]	0.71a	185a	220a	120cd	1067cd	2.89a-d	4.24c	6.28a	1067ab	1426a
4 Tons	0.72a	196a	254a	147bc	1111cd	2.61bcd	4.42c	6.22a	1332a	1602a
8 Tons	0.50a	164a	216a	160b	1256bc	2.11d	4.80ab	6.17a	963ab	1345a
12 Tons	0.67a	173a	196a	199a	1200c	2.11d	4.96a	6.17a	1302a	1645a
2 Tons[2/]	0.74a	194a	242a	91de	1122cd	3.11abc	4.26c	6.56a	1109ab	1476a
4 Tons	0.64a	163a	217a	98de	1467b	2.44cd	4.73b	6.72a	1030ab	1416a
8 Tons	0.70a	168a	243a	71e	1744a	2.61bcd	4.92ab	7.56a	1185a	1521a
500 Lbs.[3/]	0.76a	193a	226a	64e	900d	3.44a	4.02d	6.22a	624bc	977b
Min. LSR,LSD	0.23	72.3	73.9	34.8	249.7	0.73	0.20	0.66	481.5	331.6
Max. LSR	0.26	82.2	84.0	39.5	283.8	0.83	0.23	0.75	547.3	377.0
C.V. %	34.1	40.7	32.1	30.1	20.9	26.7	4.5	10.2	48.2	24.6
					NITROGEN MEANS					
38+50+50[4/]	0.68a	179a	231a	122a	1285a	2.7 a	4.6 a	6.6 a	993a	1340a
63+50+50	0.68a	175a	224a	116a	1174ab	2.8 a	4.5 a	6.5 ab	999a	1357a
113+50+50	0.67a	178a	235a	109a	1122b	2.8 a	4.4 a	6.3 b	1002a	1352a
Min. LSR,LSD	0.070	9.8	25.9	16.2	115.1	0.19	0.15	0.26	78.2	82.5
Max. LSR	0.073	10.3	27.2	17.0	121.0	0.20	0.16	0.28	82.2	86.8
C.V. %	18.4	9.9	20.1	25.0	17.2	12.1	6.0	7.3	14.0	10.9

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

Table 3

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1964

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	0.90b-e	259a-f	197a-d	47fgh	633ef	2.50abc	4.20i-k	4.50bc	1487f	1939g
None (2)	0.80ef	232def	190a-d	20h	500f	2.83ab	4.17jk	4.33c	943hi	1556hi
None (3)	0.93a-e	274a-e	217a	20h	533ef	3.00a	4.13k	4.67bc	822i	1480i
[1] 2 Tons (1)	1.00a-d	300a-d	203ab	93efg	833c-f	2.33a-d	4.57f-k	4.83abc	2057a-e	2430b-f
2 Tons (2)	1.10a	293a-e	197a-d	100ef	700d-f	2.83ab	4.43g-k	5.33abc	2132a-e	2584a-f
2 Tons (3)	1.07ab	304a-d	197a-d	133c-e	800c-f	2.67ab	4.60e-j	5.50abc	2149a-e	2735ab
4 Tons (1)	1.03abc	304a-d	190a-d	173bcd	1000b-f	2.00b-e	4.77c-g	5.33abc	1988cde	2299f
4 Tons (2)	0.93a-e	289a-e	183a-e	187abc	767c-f	2.00b-e	5.00b-f	5.00abc	2224a-d	2614a-e
4 Tons (3)	1.00a-d	333ab	177b-e	127de	767c-f	2.67ab	4.70d-h	5.33abc	2194a-d	2715abc
8 Tons (1)	0.83def	220ef	150e	127de	833c-f	2.33a-d	4.97b-f	5.00abc	2116a-e	2427b-f
8 Tons (2)	0.70f	256b-f	160de	173bcd	867c-f	1.50def	5.10bcd	4.50bc	2276abc	2578a-f
8 Tons (3)	0.80ef	269a-f	167b-e	147b-e	967c-f	1.67c-f	5.03b-e	5.00abc	2204a-d	2607a-f
12 Tons (1)	0.87c-f	259a-f	190a-d	180a-d	967c-f	1.50def	5.20bc	5.00abc	2299ab	2588a-f
12 Tons (2)	0.87c-f	277a-e	190a-d	233a	1067b-e	1.00f	5.70a	4.83abc	2335a	2728abc
12 Tons (3)	0.87c-f	195f	173b-e	200ab	967c-f	1.50def	5.37ab	5.00abc	2158a-e	2640a-d
[2] 2 Tons (1)	0.90b-e	285a-e	200abc	47fgh	933c-f	2.33a-d	4.73d-h	5.17abc	1982cde	2339def
2 Tons (2)	0.93a-e	296a-e	180a-e	20h	800c-f	2.67ab	4.30h-k	5.00abc	1864e	2355def
2 Tons (3)	1.03abc	260a-f	170b-e	33gh	800c-f	2.33a-d	4.37g-k	4.67bc	1942de	2597a-f
4 Tons (1)	0.83def	265a-f	160de	20h	1067b-e	2.33a-d	4.60e-j	5.33abc	2021b-e	2319ef
4 Tons (2)	0.93a-e	270a-f	167b-e	33gh	1067b-e	2.33a-d	4.63e-i	5.33abc	2060a-e	2420c-f
4 Tons (3)	0.93a-e	242c-f	163c-e	20h	967c-f	2.00b-e	4.80c-g	4.67bc	2162a-e	2601a-f
8 Tons (1)	0.90b-e	241c-f	183a-e	40gh	1633a	1.67c-f	5.33ab	6.17a	2276abc	2565a-f
8 Tons (2)	0.93a-e	263a-f	197a-d	33gh	1500ab	1.33ef	5.37ab	5.50abc	2341a	2673abc
8 Tons (3)	0.87c-f	230def	177b-e	33gh	1300abc	1.50def	5.37ab	5.17abc	2345a	2741a
[3] 500 Lbs. (1)	0.90b-e	305a-d	193a-d	40gh	1233a-d	2.33a-d	4.67d-h	5.83ab	1195gh	1677hi
500 Lbs. (2)	0.90b-e	335a	187a-e	33gh	733def	3.00a	4.17jk	5.17abc	1307fg	1837g
500 Lbs. (3)	0.90b-e	311abc	190a-d	33gh	667ef	2.67ab	4.20ijk	4.67bc	1127gh	1811gh
Min. LSR,LSD	0.16	65.5	33.2	52.2	450.4	0.76	0.38	1.19	254.9	261.4
Max. LSR	0.20	78.2	39.6	62.3	537.5	0.91	0.46	1.42	304.1	311.9
C.V. %	10.7	14.3	10.8	35.8	29.1	20.8	4.8	14.0	7.9	6.6

Clarkton - Sand - 1964 - Cont.

Table 3 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.88a	255a	201a	29d	556c	2.78a	4.17e	4.50a	1084c	1658b
2 Tons[1/]	1.06a	299a	199a	109c	778bc	2.61ab	4.53cde	5.22a	2113ab	2583
4 Tons	0.99a	309a	183a	162b	844bc	2.22abc	4.82bc	5.22a	2136ab	2543a
8 Tons	0.78a	248a	159a	149b	889b	1.83bcd	5.03ab	4.83a	2199ab	2537a
12 Tons	0.87a	244a	184a	204a	1000b	1.33d	5.42a	4.94a	2264ab	2652a
2 Tons[2/]	0.96a	280a	183a	33d	844bc	2.44ab	4.47cde	4.94a	1929b	2430a
4 Tons	0.90a	259a	163a	24d	1033b	2.22abc	4.68bcd	5.11a	2081ab	2447a
8 Tons	0.90a	245a	186a	36d	1478a	1.50cd	5.36a	5.61a	2321a	2660a
500 Lbs.[3/]	0.90a	317a	190a	36d	878b	2.67a	4.34de	5.22a	1210c	1775b
Min. LSR,LSD	0.30	171.2	44.0	35.9	286.4	0.73	0.39	1.00	335.7	415.5
Max. LSR	0.34	194.6	50.0	40.8	325.6	0.84	0.44	1.14	381.6	472.3
C.V. %	32.4	62.7	24.0	41.3	31.1	33.7	8.2	19.7	17.4	17.6
					NITROGEN MEANS					
38+50+50[4/]	0.91a	271a	185a	85a	1015a	2.15a	4.78a	5.24a	1936a	2287b
63+50+50	0.90a	279a	183a	93a	889a	2.17a	4.76a	5.00a	1943a	2372ab
113+50+50	0.93a	269a	181a	83a	863a	2.22a	4.73a	4.96a	1900a	2436a
Min. LSR,LSD	0.055	21.8	11.1	17.4	150.1	0.25	0.13	0.40	85.0	87.1
Max. LSR	0.057	23.0	11.6	18.3	157.9	0.27	0.13	0.42	89.3	91.6
C.V. %	10.7	14.3	10.8	35.8	29.1	20.8	4.8	14.0	7.9	6.6

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

Table 4

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiment
Beulah Sandy Loam Soil - Clarkton Field - 1965

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None(1)	0.73abc	190g	177a-d	110gh	525jk1	2.73b-e	4.37k1m	4.67bc	1346f-i	1592g-i
None(2)	0.80abc	238a-g	168bcd	48hi	352k1	3.27ab	4.001m	4.67bc	1251hi	1533hi
None(3)	0.80abc	200fg	153bcd	57hi	283 1	3.53a	3.90m	4.67bc	1212i	1454i
1/ 2 Tons(1)	0.83abc	256a-f	195a-d	180def	830g-j	2.07fg	4.87f-k	5.17abc	1670b-e	1900b-f
2 Tons(2)	0.93a	240a-g	187a-d	153fg	603i-1	2.47c-f	4.77g-k	4.83abc	1733b-e	2018bcd
2 Tons(3)	0.87abc	249a-g	217ab	212c-f	797g-j	2.17d-g	4.90f-k	5.33abc	1746bcd	2067bc
4 Tons(1)	0.70bc	281a-d	205abc	157fg	833g-j	1.93fgh	5.23d-h	4.83abc	1507c-g	1720e-h
4 Tons(2)	0.90ab	277a-e	200a-d	218b-e	917d-j	1.77g-j	5.40c-f	5.33abc	1700b-e	1923b-f
4 Tons(3)	0.83abc	249a-g	203abc	170ef	728h-k	2.20c-g	4.97f-j	5.00abc	1739bcd	2021bcd
8 Tons(1)	0.67c	220d-g	158bcd	253abc	1023c-h	1.17jk1	5.70bcd	4.83abc	1510c-g	1716f-h
8 Tons(2)	0.70bc	208fg	137d	233a-d	920d-j	0.97k1	5.80abc	4.33c	1494d-g	1752d-h
8 Tons(3)	0.70bc	223c-g	147cd	253abc	973c-i	1.20i-1	5.60b-e	5.00abc	1592b-f	1877b-f
12 Tons(1)	0.70bc	215efg	202a-d	283a	1340bc	0.67i	6.33a	5.50abc	1700b-e	1942b-f
12 Tons(2)	0.67c	211fg	193a-d	278ab	1317cd	0.60 1	6.33a	5.00abc	1798ab	2083b
12 Tons(3)	0.83abc	196fg	197a-d	250abc	1292cde	0.73 1	6.10ab	5.17abc	2005a	2342a
2/ 2 Tons(1)	0.73abc	235a-g	200a-d	73hi	920d-j	2.20c-g	5.00f-j	5.00abc	1556b-f	1769c-h
2 Tons(2)	0.83abc	224b-g	190a-d	70hi	898e-j	2.80bcd	4.53jk	5.33abc	1562b-f	1854b-g
2 Tons(3)	0.83abc	246a-g	207abc	68hi	860f-j	2.10efg	4.83f-k	4.83abc	1706b-e	1995b-e
4 Tons(1)	0.80abc	203fg	168bcd	88hi	1153c-g	1.70g-j	5.33c-g	5.00abc	1572b-f	1795c-h
4 Tons(2)	0.67c	287ab	237a	63hi	1252c-f	2.10efg	5.13e-i	5.67ab	1608b-e	1857b-g
4 Tons(3)	0.80abc	227b-g	187a-d	92hi	1000c-i	1.83f-i	5.13e-i	4.83abc	1644b-e	1972b-f
8 Tons(1)	0.80abc	221d-g	182a-d	70hi	1683ab	1.40hjk	6.00ab	6.00a	1684b-e	1919b-f
8 Tons(2)	0.87abc	224b-g	195a-d	67hi	1700ab	1.40h-k	5.83abc	6.00a	1746bcd	2024bcd
8 Tons(3)	0.83abc	205fg	200a-d	67hi	1755a	1.17jk1	6.03ab	5.17abc	1762bc	2077b
3/ 500 Lbs.(1)	0.77abc	296a	210abc	47hi	637h-1	2.73b-e	4.70h-k	4.83abc	1300ghi	1553hi
500 Lbs.(2)	0.80abc	258a-f	185a-d	33i	833g-j	2.83bc	4.60ijk	5.33abc	1480e-h	1733e-h
500 Lbs.(3)	0.80abc	285abc	192a-d	60hi	897e-j	2.77bcd	4.47jk1	5.50abc	1480e-h	1847b-g
Min. LSR,LSD	0.17	53.8	54.8	55.7	347.8	0.57	0.49	1.01	214.8	235.0
Max. LSR	0.20	64.2	65.4	66.4	415.0	0.68	0.59	1.21	256.3	280.4
C.V. %	13.0	13.6	17.3	24.5	21.3	17.5	5.7	11.8	8.0	7.5

Clarkton - Sand - 1965 - Cont.

Table 4 - Cont.

Limestone	O.M.	P_2O_5	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.78ab	209a	166a	72c	387e	3.18a	4.09e	4.67b	1270c	1526c
2 Tons[1/]	0.88a	248a	199a	182b	743d	2.23bc	4.84cd	5.11ab	1716ab	1995ab
4 Tons	0.81ab	269a	203a	182b	826cd	1.97cd	5.20c	5.06ab	1649ab	1888ab
8 Tons	0.69b	217a	147a	247a	972cd	1.11e	5.70b	4.72ab	1532abc	1782abc
12 Tons	0.73ab	207a	197a	271a	1316b	0.67e	6.26a	5.22ab	1834a	2122a
2 Tons[2/]	0.80ab	235a	199a	71c	893cd	2.37bc	4.79d	5.06ab	1608ab	1872abc
4 Tons	0.76ab	239a	197a	81c	1135bc	1.88cd	5.20c	5.17ab	1608ab	1875abc
8 Tons	0.83ab	217a	192a	68c	1713a	1.32de	5.96ab	5.72a	1730ab	2007ab
500 Lbs.[3/]	0.79ab	280a	196a	47c	789d	2.78ab	4.59d	5.22ab	1420bc	1711bc
Min. LSR,LSD	0.16	110.0	51.1	50.5	292.2	0.63	0.36	0.92	293.6	322.9
Max. LSR	0.19	125.1	58.1	57.5	332.2	0.71	0.41	1.04	333.7	367.0
C.V. %	20.8	46.7	27.1	37.3	30.0	32.2	0.69	17.9	18.4	17.3
					NITROGEN MEANS					
38+50+50[4/]	0.75b	235a	189a	140a	994a	1.84a	5.28a	5.09a	1538b	1767c
63+50+50	0.80ab	241a	188a	129a	977a	2.02a	5.16ab	5.17a	1597ab	1864b
113+50+50	0.81a	231a	189a	136a	954a	1.97a	5.10b	5.06a	1654a	1961a
Min. LSR,LSD	.057	17.9	18.3	18.6	115.9	0.19	0.16	0.34	71.6	78.3
Max. LSR	.060	18.9	19.2	19.5	121.9	0.20	0.17	0.36	75.3	82.4
C.V. %	13.0	13.6	17.3	24.5	21.3	17.5	5.7	11.8	8.0	7.5

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.

(2) 63 pounds of nitrogen per acre.

(3) 113 pounds of nitrogen per acre.

Table 5

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1966

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)		227a-f	170g-j	93e	567k	3.00bcd	4.37jk	5.17a-d	1323efg	1841cd
None (2)		216c-f	160ij	67efg	567k	3.33abc	4.30k	5.17a-d	1130gh	1634de
None (3)		212c-g	157j	80ef	500k	3.83a	4.13k	5.50abc	875h	1428e
1/ 2 Tons (1)		241a-f	213a	153d	767j	2.50def	5.07e-h	5.33a-d	1834ab	2280ab
2 Tons (2)		233a-f	197a-f	147d	733j	3.00bcd	4.90ghi	5.67ab	1742a-d	2276ab
2 Tons (3)		245a-e	193a-g	160cd	867g-j	2.67de	5.03e-i	5.67ab	1602a-f	2332a
4 Tons (1)		255abc	200a-e	173cd	900f-j	2.00fg	5.37cde	5.17a-d	1818ab	2224ab
4 Tons (2)		268a	197a-f	193bc	1000e-h	1.67ghi	5.63bc	5.17a-d	1883a	2384a
4 Tons (3)		249a-d	210ab	167cd	833hij	2.00fg	5.23d-g	5.00bcd	1700a-d	2358a
8 Tons (1)		196fg	167hij	213ab	1033efg	1.17ij	6.07a	5.00bcd	1526b-f	2054abc
8 Tons (2)		206d-g	193a-g	233a	1033efg	1.33hij	5.87ab	5.00bcd	1471c-f	2086abc
8 Tons (3)		171g	173f-j	227ab	1033efg	1.33hij	5.87ab	5.00bcd	1297fg	2099abc
12 Tons (1)		203efg	183c-i	247a	1267cd	1.00j	6.20a	5.50abc	1490b-f	2145abc
12 Tons (2)		207d-g	190a-h	233a	1367c	0.83j	6.23a	5.33a-d	1539a-f	2316ab
12 Tons (3)		204efg	200a-e	233a	1167de	1.00j	6.10a	5.17a-d	1412d-g	2289ab
2/ 2 Tons (1)		244a-e	190a-h	73ef	1000e-h	2.83cd	4.93f-i	5.83a	1834ab	2312ab
2 Tons (2)		220b-f	200a-e	60efg	767j	3.00bcd	4.80hi	5.33a-d	1674a-d	2270ab
2 Tons (3)		236a-f	197a-f	60efg	767j	2.67de	4.83hi	5.00bcd	1654a-e	2322a
4 Tons (1)		238a-f	177e-j	67efg	1000e-h	1.83gh	5.43cd	4.83cd	1877a	2335a
4 Tons (2)		218b-f	173f-j	60efg	1067ef	2.17efg	5.47cd	5.17a-d	1572a-f	2175abc
4 Tons (3)		198fg	173f-j	80ef	967f-i	1.83gh	5.27def	4.67d	1680a-d	2339a
8 Tons (1)		218b-f	180d-j	87ef	1400bc	0.83j	6.20a	4.83cd	1628a-f	2204ab
8 Tons (2)		230a-f	207abc	80ef	1633a	1.00j	6.10a	5.67ab	1458c-g	2185abc
8 Tons (3)		234a-f	203a-d	87ef	1533ab	1.00j	6.10a	5.50abc	1556a-f	2371a
3/ 500 Lbs. (1)		260ab	180d-j	33g	767j	3.33abc	4.73hi	5.50abc	1546a-f	1949bcd
500 Lbs. (2)		261ab	183c-i	53fg	833hij	3.33abc	4.70hij	5.83a	1785abc	2283ab
500 Lbs. (3)		239a-f	187b-h	53fg	800ij	3.50ab	4.67ij	5.83a	1441c-g	2047abc
Min. LSR,LSD		37.7	22.1	33.6	149.8	0.54	0.32	0.68	292.0	312.6
Max. LSR		45.0	26.4	40.1	178.8	0.64	0.39	0.81	348.4	373.0
C.V. %		9.9	7.0	15.8	9.2	15.0	3.6	7.6	11.1	8.6

Table 5 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None		218a	162a	80cd	544d	3.39a	4.27f	5.28a	1109b	1634b
2 Tons[1/]		240a	201a	153b	789c	2.72abc	5.00d	5.56a	1726a	2296a
4 Tons		257a	202a	178b	911c	1.89cd	5.41c	5.11a	1800a	2322a
8 Tons		191a	178a	224a	1033c	1.28de	5.93b	5.00a	1431ab	2080a
12 Tons		204a	191a	238a	1267b	0.94e	6.18a	5.33a	1480ab	2250a
2 Tons[2/]		233a	196a	64cd	844c	2.83ab	4.86de	5.39a	1721a	2301a
4 Tons		218a	174a	69cd	1011c	1.94bcd	5.39c	4.89a	1710a	2283a
8 Tons		228a	197a	84c	1522a	0.94e	6.13ab	5.33a	1547a	2253a
500 Lbs.[3/]		254a	183a	47d	800c	3.39a	4.70e	5.72a	1591a	2093a
Min. LSR,LSD		108.4	36.7	31.1	229.3	0.87	0.22	1.16	387.5	367.4
Max. LSR		123.3	41.7	35.3	260.6	0.98	0.25	1.31	440.5	417.7
C.V. %		47.8	19.6	24.6	23.7	40.3	4.1	21.8	24.7	17.0
					NITROGEN MEANS					
38+50+50[4/]		231a	184a	127a	967ab	2.06a	5.37a	5.24a	1653a	2149a
63+50+50		229a	189a	125a	1000a	2.19a	5.33ab	5.37a	1584a	2179a
113+50+50		221a	188a	127a	941b	2.20a	5.25b	5.26a	1468b	2176a
Min. LSR,LSD		12.6	7.4	11.2	49.9	0.18	0.11	0.23	97.3	104.2
Max. LSR		13.2	7.8	11.8	52.5	0.19	0.11	0.24	102.3	109.6
C.V. %		9.9	7.0	15.8	9.2	15.0	3.6	7.6	11.1	8.6

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

Table 6

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1967

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None(1)	0.43f	263b-e	200b-f	100ghi	633hi	2.83b-e	4.80klm	5.00bcd	816e	1114f
None(2)	0.50ef	253b-e	183f	47jkl	500i	3.33ab	4.47mn	4.83cd	603e	868f
None(3)	0.60c-f	258b-e	207a-f	60i-l	500i	3.83a	4.40n	5.50bcd	596e	858f
[1] 2 Tons(1)	0.63b-f	292a-e	230ab	133efg	767e-i	2.50c-g	5.10h-l	5.33bcd	1268cd	1598c-e
2 Tons(2)	0.83ab	269a-e	230ab	133efg	800e-i	2.83b-e	5.00i-l	5.67abc	1369a-d	1765a-e
2 Tons(3)	0.77a-d	289a-e	220a-d	113fgh	633hi	3.33ab	4.80klm	5.67abc	1258cd	1664b-e
4 Tons(1)	0.73a-d	302a-d	227abc	160cde	667hi	2.33d-g	5.27g-j	5.00bcd	1369a-d	1723a-e
4 Tons(2)	0.77a-d	300a-e	230ab	173cd	733f-i	2.00f-i	5.57efg	4.83cd	1290bcd	1775a-e
4 Tons(3)	0.77a-d	322ab	230ab	147def	667hi	2.50c-g	5.03i-l	5.17bcd	1543abc	1975abc
8 Tons(1)	0.57def	222de	187ef	220ab	1100b-h	1.00k	6.13abc	4.83cd	1297bcd	1549d-e
8 Tons(2)	0.63b-f	223cde	193def	220ab	1033b-h	1.17jk	6.17abc	5.00bcd	1533abc	1854a-e
8 Tons(3)	0.60c-f	224cde	207a-f	187bc	933c-i	1.50h-k	5.83cde	4.83cd	1454a-d	1801a-e
12 Tons(1)	0.73a-d	262b-e	197c-f	233a	1200a-e	1.00k	6.20abc	5.33bcd	1471abc	1851a-e
12 Tons(2)	0.67b-e	248b-e	213a-f	227a	1400abc	0.83k	6.50a	5.50bcd	1608ab	2021ab
12 Tons(3)	0.73a-d	218e	203a-f	220ab	1167a-f	1.00k	6.20abc	5.17bcd	1503abc	2034ab
[2] 2 Tons(1)	0.93a	279a-e	233a	80h-k	900d-i	2.50c-g	5.23g-j	5.33bcd	1428a-d	1687a-e
2 Tons(2)	0.73a-d	245b-e	197c-f	53jkl	500i	3.00bcd	4.73lmn	4.50d	1536abc	1864a-d
2 Tons(3)	0.80abc	282a-e	217a-e	40kl	700ghi	3.17abc	4.73lmn	5.33bcd	1634a	2001ab
4 Tons(1)	0.60c-f	263b-e	203af	87hij	1167a-g	1.83g-j	5.73def	5.33bcd	1431a-d	1706a-e
4 Tons(2)	0.67b-e	305abc	203a-f	67i-l	1100b-h	2.17e-h	5.37f-i	5.50bcd	1389a-d	1729a-e
4 Tons(3)	0.63b-f	274a-e	220a-d	73i-l	1333a-d	2.00f-i	5.47e-h	6.00ab	1516abc	1877a-d
8 Tons(1)	0.63b-f	348a	203af	67i-l	1400abc	0.83k	6.30ab	4.83cd	1523abc	1890a-d
8 Tons(2)	0.63b-f	271a-e	233a	67i-l	1400abc	0.83k	6.23ab	4.83cd	1549abc	1916a-d
8 Tons(3)	0.77a-d	258b-e	227abc	53jkl	1600a	1.33ijk	6.00bcd	5.83abc	1608ab	2070a
[3] 500 Lbs.(1)	0.70b-e	294a-e	210a-f	33 1	1500ab	2.50c-g	5.20g-k	6.67a	1146d	1471e
500 Lbs.(2)	0.67b-e	310ab	200b-f	33 1	1100b-h	2.67b-f	5.20g-k	5.83abc	1379a-d	1762a-e
500 Lbs.(3)	0.73a-d	311ab	203a-f	33 1	833e-i	3.17abc	4.87jkl	5.50bcd	1372a-d	1788a-e
Min. LSR,LSD	0.18	69.7	26.6	36.1	398.6	0.67	0.35	0.93	272.6	108.4
Max. LSR	0.21	83.2	31.8	43.1	475.6	0.79	0.42	1.11	325.3	114.0
C.V. %	15.4	15.2	7.5	19.0	24.4	18.5	3.8	10.5	12.0	11.3

Clarkton - Sand - 1967 - Cont.

Table 6 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.51a	258a	197a	69d	544c	3.33a	4.56e	5.11b	671b	947b
2 Tons[1/]	0.74a	283a	227a	127c	733c	2.89ab	4.97cd	5.56ab	1298a	1676a
4 Tons	0.76a	308a	229a	160b	689c	2.28bc	5.29bc	5.00b	1401a	1824a
8 Tons	0.60a	223a	196a	209a	1022b	1.22d	6.04a	4.89b	1428a	1735a
12 Tons	0.71a	243a	204a	227a	1256ab	0.94d	6.30a	5.33ab	1527a	1968a
2 Tons[2/]	0.82a	269a	216a	58de	700c	2.89ab	4.90d	5.06b	1533a	1851a
4 Tons	0.63a	281a	209a	76d	1200b	2.00c	5.52b	5.61ab	1446a	1771a
8 Tons	0.68a	292a	221a	62d	1467a	1.00d	6.18a	5.17b	1560a	1959a
500 Lbs.[3/]	0.70a	305a	204a	33e	1144b	2.78abc	5.09cd	6.00a	1299a	1674a
Min. LSR,LSD	0.33	114.9	52.6	25.1	241.4	0.74	0.33	0.65	497.7	568.6
Max. LSR	0.37	130.6	59.8	28.6	274.4	0.85	0.37	0.74	565.7	646.4
C.V. %	48.0	42.0	24.9	22.2	24.8	34.7	6.1	12.3	36.8	33.2
					NITROGEN MEANS					
38+50+50[4/]	0.66a	281a	210a	124a	1037a	1.93b	5.55a	5.30a	1305a	1621b
63+50+50	0.68a	269a	209a	113ab	952a	2.09b	5.47a	5.17a	1362a	1728ab
113+50+50	0.71a	271a	215a	103b	930a	2.43a	5.26b	5.44a	1387a	1785a
Min. LSR,LSD	.059	23.2	8.9	12.0	132.9	0.22	0.12	0.31	90.9	108.4
Max. LSR	.062	24.4	9.3	12.7	139.7	0.23	0.12	0.33	95.6	114.0
C.V. %	15.4	15.2	7.5	19.0	24.4	18.5	3.8	10.5	12.0	11.3

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

Table 7

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1968

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	1.00ab	335abc	200b	113fgh	650kl	2.00abc	4.63m-p	4.37ef	911g	1307h
None (2)	0.90a-e	309a-f	193b	80gh	550 1	2.33a	4.37p	4.30f	570h	940i
None (3)	0.93a-d	325a-e	367b	143c-g	650kl	2.17ab	4.57nop	4.90c-f	547hi	.888i
1/ 2 Tons (1)	0.87b-e	322a-f	237b	170a-f	1003f-k	1.83a-d	5.00h-m	5.33b-f	1212f	1575gh
2 Tons (2)	1.00ab	334a-d	250b	190a-e	1000f-k	2.00abc	4.97i-m	5.63b-e	1435def	1844b-g
2 Tons (3)	0.97abc	325a-e	252b	200abc	1033f-j	2.00abc	4.871-0	5.73bcd	1353ef	1769d-g
4 Tons (1)	1.00ab	328a-e	240b	217abc	1100e-j	1.50b-f	5.27g-k	5.47b-f	1428def	1723efg
4 Tons (2)	0.93a-d	315a-f	225b	233a	1100e-j	1.50b-f	5.30g-j	5.53b-f	1458c-f	1795c-g
4 Tons (3)	0.97abc	294c-f	220b	150b-g	767jkl	1.83a-d	4.90k-o	4.67c-f	1503a-f	1864b-g
8 Tons (1)	0.80de	270f	205b	203abc	1133e-j	0.67g-j	5.87a-e	4.63c-f	1507a-f	1854b-g
8 Tons (2)	0.77e	306a-f	237b	197a-d	1117e-j	0.67g-j	5.80b-e	4.57def	1474b-f	1867b-g
8 Tons (3)	0.83cde	283def	215b	200abc	1050f-j	0.67g-j	5.63d-g	4.40ef	1572a-e	1965a-f
12 Tons (1)	0.93a-d	298b-f	237b	222ab	1317c-g	0.50hij	6.10abc	5.00b-f	1818a	2231a
12 Tons (2)	0.80de	295b-f	205b	235a	1367c-f	0.17j	6.20a	4.83c-f	1706a-d	2142abc
12 Tons (3)	0.83cde	281ef	242b	218ab	1250d-h	0.33ij	5.93a-e	4.67c-f	1710a-d	2188ab
2/ 2 Tons (1)	0.93a-d	347ab	260b	107fgh	967g-k	2.00abc	4.93i-n	5.20b-f	1395def	1746d-g
2 Tons (2)	0.93a-d	325a-e	242b	83gh	933h-k	1.83a-d	4.871-o	4.83c-f	1238f	1644fg
2 Tons (3)	0.90a-e	325a-e	218b	80gh	800i-l	2.17ab	4.53op	4.80c-f	1310ef	1759d-g
4 Tons (1)	0.90a-e	300b-f	213b	97fgh	1167e-i	1.33c-g	5.57efg	4.93b-f	1497a-f	1877b-g
4 Tons (2)	0.93a-d	301b-f	217b	53h	1433cde	1.67a-e	5.33ghi	5.73bcd	1349ef	1762d-g
4 Tons (3)	0.87b-e	303a-f	210b	88gh	1033f-j	1.50b-f	5.17h-l	4.73c-f	1421d-f	1831c-g
8 Tons (1)	0.93a-d	292c-f	710a	127d-h	2033a	1.00e-i	6.17ab	7.53a	1785ab	2103a-d
8 Tons (2)	0.87b-e	355a	237b	97fgh	1867ab	0.83f-j	6.17ab	6.20b	1628a-e	2031a-e
8 Tons (3)	0.93a-d	309a-f	227b	123e-h	1633bc	1.00e-i	6.00a-d	5.90bc	1779abc	2188ab
3/ 500 Lbs. (1)	0.90a-e	328a-e	232b	90gh	1567bcd	1.17d-h	5.60efg	5.77bcd	1209f	1523gh
500 Lbs. (2)	1.03a	335a-d	232b	110fgh	1633bc	1.00e-i	5.73c-f	5.83bcd	1353ef	1706efg
500 Lbs. (3)	0.93a-d	313a-f	232b	103fgh	1250d-h	1.67a-e	5.37fgh	5.53b-f	1382ef	1716efg
Min. LSR,LSD	0.12	44.1	291.9	63.8	319.2	0.65	0.35	1.07	276.1	303.2
Max. LSR	0.14	52.6	348.3	76.1	380.9	0.78	0.42	1.28	329.5	361.8
C.V. %	7.8	8.4	69.5	26.1	16.4	28.1	3.9	12.2	11.8	10.2

Clarkton - Sand - 1968 - Cont.

Table 7 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.94a	323a	253a	112bc	617e	2.17a	4.52g	4.52b	676c	1045d
2 Tons[1/]	0.94a	327a	246a	187ab	1012cd	1.94ab	4.94ef	5.57ab	1333b	1729c
4 Tons	0.97a	312a	228a	200a	989cd	1.61abc	5.16de	5.22ab	1463ab	1794c
8 Tons	0.80a	286a	219a	200a	1100cd	0.67ef	5.77ab	4.53b	1518ab	1895bc
12 Tons	0.86a	291a	228a	225a	1311bc	0.33f	6.08a	4.83b	1745a	2187a
2 Tons[2/]	0.92a	332a	240a	90c	900de	2.00ab	4.78fg	4.94b	1315b	1716c
4 Tons	0.90a	302a	213a	79c	1211bcd	1.50bcd	5.36cd	5.13ab	1423ab	1823c
8 Tons	0.91a	318a	391a	116bc	1844a	0.94de	6.11a	6.54a	1730a	2107ab
500 Lbs.[3/]	0.96a	325a	232a	101c	1483b	1.28cd	5.57bc	5.71ab	1315b	1649c
Min. LSR,LSD	0.19	57.0	167.1	74.2	353.2	0.58	0.33	1.38	304.3	259.8
Max. LSR	0.22	64.8	190.0	84.3	401.4	0.65	0.38	1.57	345.9	295.3
C.V. %	21.1	18.2	66.8	51.0	30.4	41.6	6.2	26.4	21.9	14.7
					NITROGEN MEANS					
38+50+50[4/]	0.92a	313a	281a	149a	1215a	1.33a	5.46a	5.36a	1418a	1771a
63+50+50	0.91a	319a	226a	142a	1222a	1.33a	5.41a	5.27a	1357a	1748a
113+50+50	0.91a	307a	242a	145a	1052b	1.48a	5.22b	5.04a	1397a	1796a
Min. LSR,LSD	.040	14.7	97.3	21.3	106.4	0.22	0.12	0.36	92.0	101.1
Max. LSR	0.42	15.5	102.3	22.4	111.9	0.23	0.12	0.38	96.8	106.3
C.V. %	7.8	8.4	69.5	26.1	16.4	28.1	3.9	12.2	11.8	10.2

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.

(2) 63 pounds of nitrogen per acre.

(3) 113 pounds of nitrogen per acre.

Table 8

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1969

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	0.87c	307a-d	260abc	93c-g	600ij	2.00bc	5.03ghi	4.20gh	1084f	1235fg
None (2)	1.00abc	323a-d	247abc	63fgh	367j	2.50abc	4.80hi	4.00h	740g	868g
None (3)	0.97abc	319a-d	257abc	50gh	367j	3.00a	4.67i	4.47e-h	727g	871g
[1] 2 Tons (1)	1.03abc	318a-d	277a	113b-e	767hij	2.00bc	5.23efg	4.77d-h	1389def	1523ef
2 Tons (2)	1.03abc	327a-d	277a	120bcd	900e-i	2.17bc	5.27efg	5.30b-g	1520b-e	1739b-e
2 Tons (3)	1.13a	322a-d	267ab	140b	833ghi	2.00bc	5.23efg	5.00b-h	1408def	1618c-f
4 Tons (1)	0.97abc	314a-d	247abc	133bc	933d-i	2.00bc	5.37efg	5.23b-g	1592b-e	1736b-e
4 Tons (2)	1.03abc	333abc	240abc	143b	1033d-i	1.83bcd	5.40efg	5.30b-g	1808abc	2005abc
4 Tons (3)	1.03abc	337ab	247abc	103b-f	867f-i	2.00bc	5.27efg	4.90b-h	1579b-e	1792b-e
8 Tons (1)	1.00abc	265e	213bc	190a	1033d-i	0.83f	6.00abc	4.50e-h	1389def	1575def
8 Tons (2)	0.97abc	295cde	210c	193a	1200c-h	0.67f	6.07a	4.73d-h	1477c-e	1726b-e
8 Tons (3)	1.07abc	265e	210c	200a	1033d-i	0.67f	6.03ab	4.33fgh	1598b-e	1860b-e
12 Tons (1)	0.97abc	309a-d	233abc	217a	1167c-h	0.67f	6.13a	4.80d-h	1602b-e	1837b-e
12 Tons (2)	0.90bc	302a-e	243abc	213a	1267c-g	0.67f	6.20a	5.03b-h	1657a-e	1975a-d
12 Tons (3)	1.03abc	312a-d	247abc	210a	1333b-f	0.67f	6.20a	5.30b-g	1759a-d	2077ab
[2] 2 Tons (1)	1.10ab	318a-d	240abc	77d-h	1100d-h	1.83bcd	5.47def	5.23b-g	1330ef	1464ef
2 Tons (2)	1.00abc	306a-d	233abc	53gh	933d-i	2.50ab	5.13fgh	5.37a-f	1300ef	1510ef
2 Tons (3)	1.00abc	323a-d	233abc	47gh	867f-i	2.17bc	5.17fgh	4.83c-h	1313ef	1536ef
4 Tons (1)	1.00abc	292de	237abc	90c-g	1167c-h	1.17def	5.80a-d	4.73d-h	1572b-e	1782b-e
4 Tons (2)	0.93abc	300b-e	217bc	80d-h	1067d-i	1.83bcd	5.63b-e	5.10b-h	1582b-e	1808b-e
4 Tons (3)	1.03abc	309a-d	233abc	67e-h	1400bcd	1.67cde	5.60cde	5.73a-d	1746a-d	2011abc
8 Tons (1)	0.90bc	341a	257abc	60fgh	1633abc	0.83f	6.00abc	5.50a-e	1844abc	2067ab
8 Tons (2)	0.97abc	323a-d	247abc	67e-h	1900a	0.67f	6.13a	6.00ab	1880ab	2116ab
8 Tons (3)	1.03abc	323a-d	260abc	87c-g	1967a	0.83f	6.10a	6.43a	1972a	2286a
[3] 500 Lbs. (1)	1.03abc	330a-d	257abc	37h	1733ab	1.17def	6.07a	5.97abc	1300ef	1461ef
500 Lbs. (2)	1.00abc	319a-d	247abc	33h	1367b-e	1.00ef	5.87a-d	4.87b-h	1589b-e	1828b-e
500 Lbs. (3)	1.00abc	314a-d	223abc	70e-h	1333b-f	1.00ef	5.87a-d	4.90b-h	1543b-e	1775b-e
Min. LSR,LSD	0.19	33.3	44.9	41.3	410.6	0.71	0.36	0.98	313.4	359.5
Max. LSR	0.23	39.8	53.5	49.2	490.0	0.85	0.43	1.16	373.9	429.0
C.V. %	11.4	6.3	11.0	22.5	21.9	28.4	3.8	11.5	12.5	12.6

Clarkton - Sand - 1969 - Cont.

Table 8 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	0.94a	316a	254ab	69c	444d	2.50a	4.83e	4.22a	850c	991c
2 Tons[1/]	1.07a	322a	273a	124b	833c	2.06ab	5.24d	5.02a	1439ab	1627ab
4 Tons	1.01a	328a	244ab	127b	944c	1.94abc	5.34cd	5.14a	1660ab	1844ab
8 Tons	1.01a	275a	211b	194a	1089bc	0.72d	6.03a	4.52a	1488ab	1721ab
12 Tons	0.97a	308a	241ab	213a	1256bc	0.67d	6.18a	5.04a	1673ab	1963ab
2 Tons[2/]	1.03a	316a	236ab	59c	967c	2.17ab	5.26d	5.14a	1315bc	1503b
4 Tons	0.99a	300a	229ab	79c	1211bc	1.56bcd	5.68bc	5.19a	1633ab	1867ab
8 Tons	0.97a	329a	254ab	71c	1833a	0.78d	6.08a	5.98a	1899a	2156a
500 Lbs.[3/]	1.01a	321a	242ab	47c	1478ab	1.06cd	5.93ab	5.24a	1477ab	1688ab
Min. LSR,LSD	0.26	73.0	46.2	35.0	386.3	0.86	0.34	1.58	480.6	491.5
Max. LSR	0.30	83.0	52.6	39.8	439.0	0.97	0.38	1.79	546.3	558.6
C.V. %	26.0	23.4	19.0	32.0	34.6	57.4	6.0	31.2	32.2	28.8
					NITROGEN MEANS					
38+50+50[4/]	0.99a	311a	247a	112a	1126a	1.39a	5.68a	4.99a	1456a	1631b
63+50+50	0.98a	314a	240a	107a	1115a	1.54a	5.61a	5.08a	1506a	1730ab
113+50+50	1.03a	314a	242a	108a	1111a	1.56a	5.57a	5.10a	1516a	1758a
Min. LSR,LSD	.064	11.1	15.0	13.8	136.9	0.24	0.12	0.33	104.5	119.8
Max. LSR	.067	11.7	15.7	14.5	143.9	0.25	0.13	0.34	109.8	126.0
C.V. %	11.4	6.3	11.0	22.5	21.9	28.4	3.8	11.5	12.5	12.6

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

Table 9

Soil Test Results and Seed Cotton Yields
Limestone and Nitrogen Experiments
Beulah Sandy Loam Soil - Clarkton Field - 1970

Soil Treatment	%	Lb/A	Exchangeable Lbs/A						Eight Year Summary Seed Cotton Yield-Lb/A	
Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
None (1)	1.13a-d	223k	215bcd	123e-h	300hi	2.83b-f	4.671mn	4.37d-e	1043g	1419m
None (2)	1.13a-d	245ijk	203cd	87h	133i	3.67ab	4.27mn	4.60d-e	801h	1163h
None (3)	1.20ab	240jk	203cd	103gh	33i	4.00a	4.17h	4.77c-e	749h	1121h
[1] 2 Tons (1)	1.17abc	346abc	243a-d	157c-g	700e-h	3.00a-e	4.83jkl	5.73b-e	1443de	1778k
2 Tons (2)	1.17abc	348abc	243a-d	170b-f	800c-h	3.17a-d	4.93i-l	6.20abc	1538cd	1927d-i
2 Tons (3)	1.20ab	324a-f	233a-d	140e-h	400ghi	3.50abc	4.701m	5.40b-e	1471de	1907f-j
4 Tons (1)	1.13a-d	328a-e	257abc	173b-e	933b-g	2.00e-j	5.40e-i	5.37b-e	1525cd	1823h-k
4 Tons (2)	1.10bcd	338a-d	270a	173b-e	767d-h	2.00e-j	5.37f-j	4.97b-e	1644ab	1993def
4 Tons (3)	1.00cde	301c-h	227a-d	137e-h	483f-i	2.83b-f	4.80kl	4.90b-e	1618abc	2011def
8 Tons (1)	0.90e	300c-h	208cd	213bc	1067b-e	1.50h-k	5.73c-g	5.30b-e	1508de	1825h-k
8 Tons (2)	0.97de	289d-i	227a-d	223b	1000b-f	1.67g-j	5.77c-g	5.40b-e	1528cd	1919e-j
8 Tons (3)	1.10bcd	264g-k	193d	203bcd	767d-h	2.33d-i	5.27g-k	5.37b-e	1515cde	1940d-h
12 Tons (1)	1.07b-e	285e-i	237a-d	223b	1067b-e	1.00jk	6.10abc	4.90b-e	1652a	2032cde
12 Tons (2)	1.10bcd	275f-j	247a-d	290a	1300a-d	0.50k	6.33ab	5.27b-e	1708a	2147ab
12 Tons (3)	1.10bcd	258h-k	238a-d	173b-e	1067b-e	1.33ijk	5.83b-f	5.03b-e	1709a	2184a
[2] 2 Tons (1)	1.17abc	344abc	243a-d	150d-h	1000b-f	2.50c-h	5.40e-i	5.97a-d	1482de	1801jk
2 Tons (2)	1.03b-e	353ab	230a-d	120e-h	800c-h	2.67b-g	5.13h-l	5.47b-e	1415e	1810ij
2 Tons (3)	1.03b-e	348abc	243a-d	93gh	783d-h	3.00a-e	4.93i-l	5.63b-e	1525cd	1975d-g
4 Tons (1)	1.10bcd	306b-h	220a-d	133e-h	1283a-d	1.17jk	5.77c-g	5.20b-e	1523cd	1869g-k
4 Tons (2)	1.07b-e	313a-g	263ab	110e-h	1033b-f	1.83f-j	5.50d-h	5.20b-e	1470de	1869g-k
4 Tons (3)	1.07b-e	314a-g	213bcd	123e-h	867c-g	2.00e-j	5.30f-k	4.93b-e	1549bcd	1966d-g
8 Tons (1)	1.20ab	231jk	243a-d	123e-h	1333a-d	1.33ijk	6.00a-d	5.50b-e	1659a	2004def
8 Tons (2)	1.17abc	272g-k	253abc	110e-h	1433ab	1.00jk	5.93a-e	5.37b-e	1658a	2045bcd
8 Tons (3)	1.30a	292d-i	230a-d	110e-h	1367abc	1.67g-j	5.73c-g	5.83a-e	1693a	2123abc
[3] 500 Lbs. (1)	1.03b-e	351abc	223a-d	100gh	1733a	1.00jk	6.40a	6.03a-d	1090g	1428m
500 Lbs. (2)	1.10bcd	346abc	247a-d	113e-h	1667a	1.33ijk	6.27abc	6.27ab	1252f	1638 1
500 Lbs. (3)	1.17abc	357a	250abc	107fgh	1833a	1.83f-j	5.83b-f	7.20a	1196f	1626 1
Min. LSR,LSD	.159	43.2	45.9	54.7	482.7	0.89	0.48	1.25	91.4	102.1
Max. LSR	.190	51.5	54.7	65.2	576.0	1.07	0.57	1.49	114.5	127.8
C.V. %	8.5	8.5	11.7	22.1	29.9	25.4	5.3	13.7	11.2	9.9

Table 9 - Cont.

Limestone	O.M.	P_2O_5	K	Mg	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
					LIMESTONE MEANS					
None	1.16ab	236a	207a	104c	156e	3.50a	4.37f	4.58a	865d	1234e
2 Tons[1/]	1.18ab	339a	240a	156c	633d	3.22ab	4.82e	5.78a	1484b	1870c
4 Tons	1.08ab	322a	251a	161bc	728cd	2.28bcd	5.19cde	5.08a	1595ab	1942bc
8 Tons	0.99b	284a	209a	213ab	944bcd	1.83cde	5.59bc	5.36a	1517b	1895c
12 Tons	1.09ab	273a	241a	229a	1144bc	0.94e	6.09a	5.07a	1690a	2121a
2 Tons[2/]	1.08ab	348a	239a	121c	861cd	2.72abc	5.16de	5.69a	1474b	1862c
4 Tons	1.08ab	311a	232a	122c	1061bcd	1.67cde	5.52bcd	5.11a	1514b	1901c
8 Tons	1.22a	265a	242a	114c	1378ab	1.33de	5.89ab	5.57a	1670a	2057ab
500 Lbs.[3/]	1.10ab	351a	240a	107c	1744a	1.39de	6.17a	6.50a	1179c	1564d
Min. LSR,LSD	0.188	105.3	60.5	54.9	439.6	1.11	0.39	1.76	131.0	135.0
Max. LSR	0.214	119.6	68.8	62.4	499.7	1.27	0.44	2.00	154.1	158.9
C.V. %	17.0	34.7	25.9	37.2	45.7	53.0	7.2	32.5	27.8	22.6
					NITROGEN MEANS					
38+50+50[4/]	1.10a	302a	232ab	155a	1046a	1.81b	5.59a	5.37a	1436a	1775c
63+50+50	1.09a	309a	243a	155a	993ab	1.98b	5.50a	5.41a	1446a	1834b
113+50+50	1.13a	300a	226b	132b	844b	2.50a	5.17b	5.45a	1447a	1873a
Min. LSR,LSD	.053	14.4	15.3	18.2	160.9	.298	0.16	0.415	30.5	34.0
Max. LSR	.056	15.1	16.1	19.2	169.2	.314	0.17	0.436	32.1	35.9
C.V. %	8.5	8.5	11.7	22.1	29.9	25.4	5.3	13.7	11.2	9.9

1/ Dolomitic limestone, agricultural grade from Piedmont, Missouri applied April 1962.

2/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

3/ Calcium carbonate limestone (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

4/ Fertilizer applied annually ($N+P_2O_5+K_2O$).

(1) 38 pounds of nitrogen per acre.
(2) 63 pounds of nitrogen per acre.
(3) 113 pounds of nitrogen per acre.

The influence of calcium carbonate fine limestone on cotton growing on a Beulah fine sandy loam soil, four tons of limestone (left) compared to no limestone (right). The same amount of total fertilizer applied on both plots (68 N + 50 P_2O_5 + 50 K_2O), which were irrigated as needed.

RESULTS AND DISCUSSION

Limestone application on a Beulah sandy loam soil (initial pHs† of 4.0) produced significant increases in seed cotton yields. The results (Table 1) indicated an increase of 848 pounds of seed cotton the first season with 12 tons of dolomitic limestone but was statistically equivalent to 4 tons of the same limestone source. Dolomitic limestone was superior to the calcium carbonate fine limestone the first year in yield, probably due to the low magnesium content of the soil, but the difference was not significant.

All treatments, including the check, had a higher pHs at the conclusion of the experiment, after nine years, than initially. Due to the chemicals present in the irrigation water and the high frequency of application, some of the increase in pHs may be accounted for. This was evident as shown by the increase in pHs of the check treatment on which no limestone was applied but which did receive irrigation water pumped from a well.

†Refers to salt pH (pH_s) as measured in 1:1 soil: 0.01M $CaCl_2$ suspension.

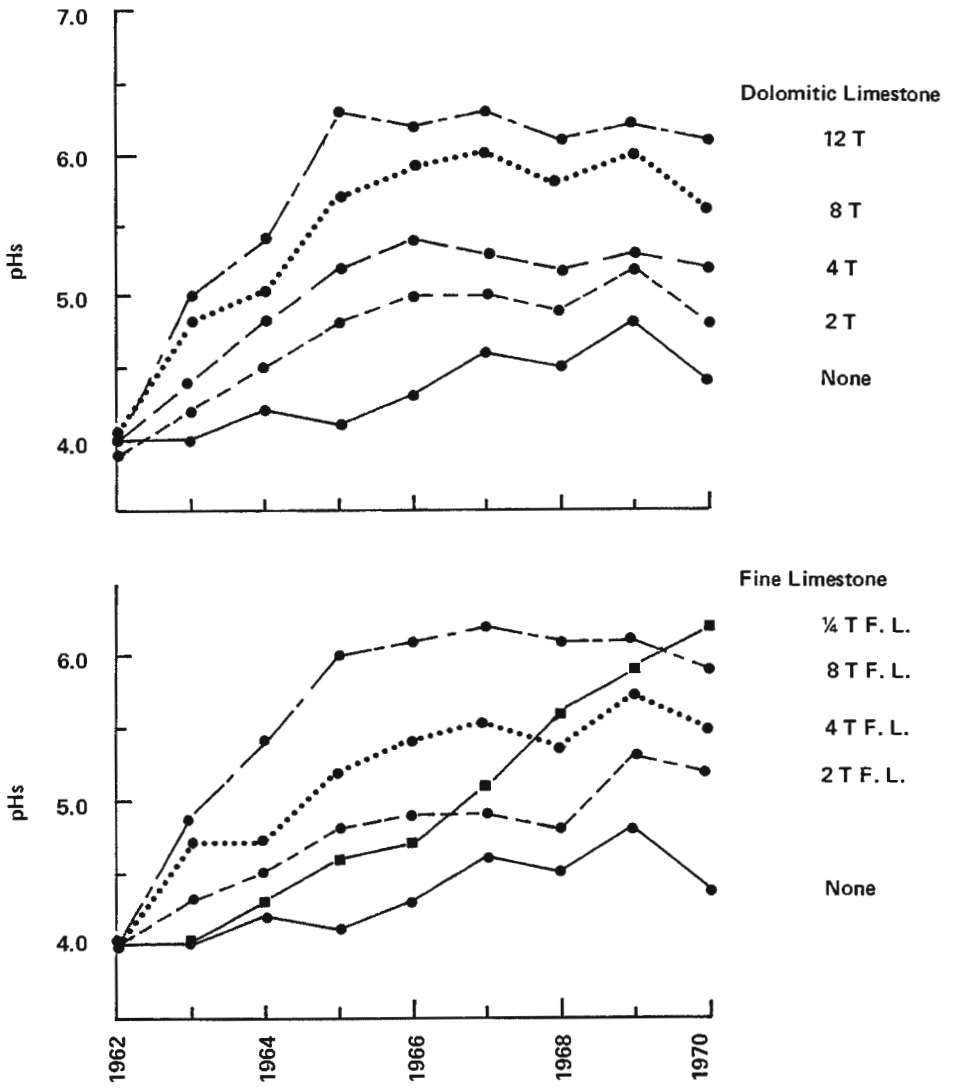

Figure 1: Influence of Dolomitic and Fine Limestone on pHs of a Beulah Fine Sandy Loam over nine years.

As shown in the graph (Figure 1), limestone application may last longer than previously considered. The two-ton application was higher at the conclusion of the experiment than initially but higher rates of limestone were required

The influence of dolomitic agricultural limestone on cotton growing on a Beulah fine sandy loam soil, no limestone (left) as compared to four tons of limestone (right). The same total fertilizer was applied on both plots (68 N + 50 P_2O_5 + 50 K_2O) and both were irrigated as needed.

to approach the soil pHs that were considered optimum. The ¼ ton applied annually continued to raise the pHs and at the conclusion of the experiment this treatment gave a higher pHs than any of the other limestone treatments.

The optimum rate of nitrogen over he eight-year summary was 113 pounds of nitrogen. In some years this high rate produced rank growth and caused harvesting difficulties. These data indicate (Table 9) that the highest rate of nitrogen application reduced the pHs and increased the neutralizable acidity significantly over the eight year period.

Soil Testing Results

Organic Matter: The soil organic matter content increased from an average of 0.70 percent to 1.11 percent or an average increase of 0.41 percent (Table 10) over the eight-year period with continuous cotton crops and winter cover crops of rye. The rye was turned under just prior to planting each season and was used mainly to control wind erosion during the winter months. No fertilizer was applied to the rye which was usually planted by broadcasting and cultivating into the soil either before or after the first picking of cotton.

Phosphate: Over the eight-year period a total of 400 pounds of phosphate were applied and the soil test indicated an average increase of 137 pounds (Table 10) per acre at the conclusion of the experiment. The lowest available phosphate test at the conclusion of the experiment was on the plots which received no limestone and produced the lowest yield. Thus we may conclude than an annual application of 50 pounds of phosphate per acre was sufficient to maintain an adequate phosphorous level in the soil.

Potassium: During the eight-year period a total of 400 pounds of potash was applied or the equivalent of 332 pounds of potassium. The results, reported in Table 10, indicate that the potash applied was not sufficient to maintain the initial amount in the soil. The potassium content of the soil declined an average of 104 pounds the first year (Table 2), compared to the content at the initiation of the experiment (Table 1), before the limestone was applied. These data relate (Table 10) that 50 pounds of potash was not sufficient to maintain the potassium content of this sandy loam soil over an eight-year period.

Magnesium: The initial soil tests (Table 1) indicated low magnesium content in the soil at the beginning of the experiment. The application of dolomitic limestone increased the average content of exchangeable magnesium in the soil 127 pounds (Table 10) over the eight-year period, whereas the average increase on the calcium carbonate fine limestone treatments was 57 pounds.

There was an increase of 33 pounds per acre of magnesium on the no-treatment plot.

Calcium: Exchangeable calcium increased (Table 10) with the application of limestone. The highest increase over the eight-year period occurred on the plots which received the annual application of 500 pounds of fine lime. The soil tests of the no-limestone plots indicate a reduction in exchangeable calcium of 522 pounds. The 113 pounds annual rate of nitrogen application reduced the average increase of exchangeable calcium to less than one-half, compared to the 38 and 63 pound rates of application.

N.A.: Neutralizable acidity was reduced during the experiment on all of the plots on which limestone was applied. An increase in N.A. of 0.7 was reported by soil test on the check plot (Table 10) over eight seasons, 1962 to 1970. None of the limestone treatments reduced the N.A. to zero as occurred on the clay soil at Portageville with a 24-ton rate of application (5).

pHs: The pHs of the soil increased with the application of limestone (Tables 10 and 11). All limestone treatments applied before planting the first cotton crop increased pHs. A decline followed toward the conclusion of the experiment (Tables 1 through 9). The annual application of ¼ ton of fine limestone per acre or a total of two tons applied during the experiment attained the pHs 6.2, which was the highest for all limestone treatments at the conclusion of the ex-

Table 10

Change in Soil Test Values from Initial Soil Test in 1962 and Final Test in 1970

Soil Treatment[1]	% O.M	Pounds/Acre P_2O_5	Exchangeable lbs./A K	Mg	Ca	N.A.	pHs	C.E.C.
Limestone Summary:								
None	+0.69	+ 98	-104	+ 33	-522	+0.7	+0.4	-0.7
2T (Dolomitic)[2]	+0.51	+172	-107	+107	+222	-0.1	+0.9	+0.9
2T (Calcium Carbonate)[3]	+0.28	+175	- 98	+ 70	+493	-0.4	+1.2	+1.1
4T (Dolomitic)	+0.11	+130	-130	+ 88	+128	-0.8	+1.2	-0.3
4T (Calcium Carbonate)	+0.47	+155	- 89	+ 89	+417	-1.2	+1.5	+0.1
8T (Dolomitic)	+0.49	+125	- 91	+140	+244	-0.9	+1.6	+0.3
8T (Calcium Carbonate)	+0.49	+ 99	- 78	+ 50	+800	-1.8	+1.9	+0.4
12T (Dolomitic)	+0.41	+115	- 86	+171	+411	-2.0	+2.1	-0.3
500 lbs. Fine Lime[3] (annaully)	+0.28	+168	-121	+ 20	+1066	-1.6	+2.2	+1.0
Mean	+ .41	+137	-133	+ 85	+362	-0.9	+1.4	+0.3
			Dol.	+127				
			Ca.	+ 57				
Nitrogen Summary:								
Nitrogen lbs./A								
38	+0.39	+136	-111	+ 85	+427	-1.2	+1.6	+0.2
63	+0.36	+146	- 88	+ 96	+452	-1.0	+1.5	+0.4
113	+0.48	+131	-102	+ 74	+207	-0.4	+1.3	+0.3

[1] Agricultural limestone (dolomitic) from Piedmont, Missouri applied April 1962.

[2] Fine lime (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

[3] Fine lime (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

* Refers to salt pH (pHs) as measured in 1:1 soil: 0.01M C_aCl_2 suspension.

Table 11

Eight Year Summary of Limestone and Nitrogen Experiment on the Beulah Fine Sandy Loam at the Clarkton Field

Limestone	Seed Cotton Yield Pounds/Acre 8 year average		pHs*		
	First Picking	Total	Initial (1962)	4 years (1966)	8 years (1970)
None	865d	1234e	4.0a	4.3f	4.4f
2T (Dolomitic)[1/]	1484b	1870c	3.9a	5.0d	4.8e
2T (Calcium Carbonate)[2/]	1474b	1862c	4.0a	4.9de	5.2de
4T (Dolomitic)	1595ab	1942bc	4.0a	5.4c	5.2cde
4T (Calcium Carbonate)	1514b	1901c	4.0a	5.4c	5.5bcd
8T (Dolomitic)	1517b	1895c	4.0a	5.9b	5.6bc
8T (Calcium Carbonate)	1670a	2057ab	4.0a	6.1ab	5.9ab
12T (Dolomitic)	1690a	2121a	4.0a	6.2a	6.1a
500 lbs. Fine Lime[2/] (annually)	1179c	1564d	4.0a	4.7e	6.2a
Min. L.S.R. (L.S.D. .05)	131	135	0.10	0.22	0.39
Max. L.S.R.	154	159	0.12	0.25	0.44
C.V. %	27.8%	22.6%	2.6%	4.1%	7.2%
Nitrogen					
38+50+50	1436a	1775c	4.0a	5.4a	5.6a
63+50+50	1444a	1834b	4.0a	5.3ab	5.5a
113+50+50	1447a	1873a	3.9a	5.2b	5.2b
Min. L.S.R. (L.S.D. .05)	30.5	34.0	.04	0.11	0.16
Max. L.S.R.	32.1	35.9	.04	0.11	0.17
C.V. %	11.2%	9.9%	1.6%	3.6%	5.3%

[1/] Agricultural limestone (dolomitic) from Piedmont, Missouri applied April 1962.

[2/] Fine lime (less than 100 mesh) from Ste. Genevieve, Missouri applied April 1962.

[3/] Fine lime (less than 100 mesh) from Ste. Genevieve, Missouri applied annually.

* Refers to salt pH (pHs) as measured in 1:1 soil: 0.01M C_aCl_2 suspension.

periment. Nitrogen influenced pHs (Table 10) by increasing acidity as the rate of nitrogen application was increased. The increase in pHs of the check plot cannot be accounted for unless chemical content of the irrigation water had some influence. Several applications of water were made throughout each season as the water-holding capacity of this sandy loam soil was very low.

C.E.C.: The changes in cation exchange capacity of soil during the experiment (Table 10) did not appear to follow any pattern in these data as presented. There is some indication that limestone increased the C.E.C.

Seed Cotton Yields

All sources and rates of limestone increased seed cotton yields every year throughout the experiment as shown in Figures 2 and 3. Six of the eight years from which yields were obtained, the 12 tons of dolomitic limestone exceeded or was equivalent to the highest yield. Over the eight crop yields, 8 tons of calcium carbonate fine lime was statistically equivalent to the yield of 12 tons of dolomite limestone.

One hundred thirteen pounds of nitrogen, in a summary of all limestone treatments over eight years, produced higher yields, statistically, than the lower, 38 and 63 pound nitrogen treatments (Table 9). Due to the heavy vegetative growth produced by the high rate of nitrogen, the 63-pound rate of application may have been the more practical application.

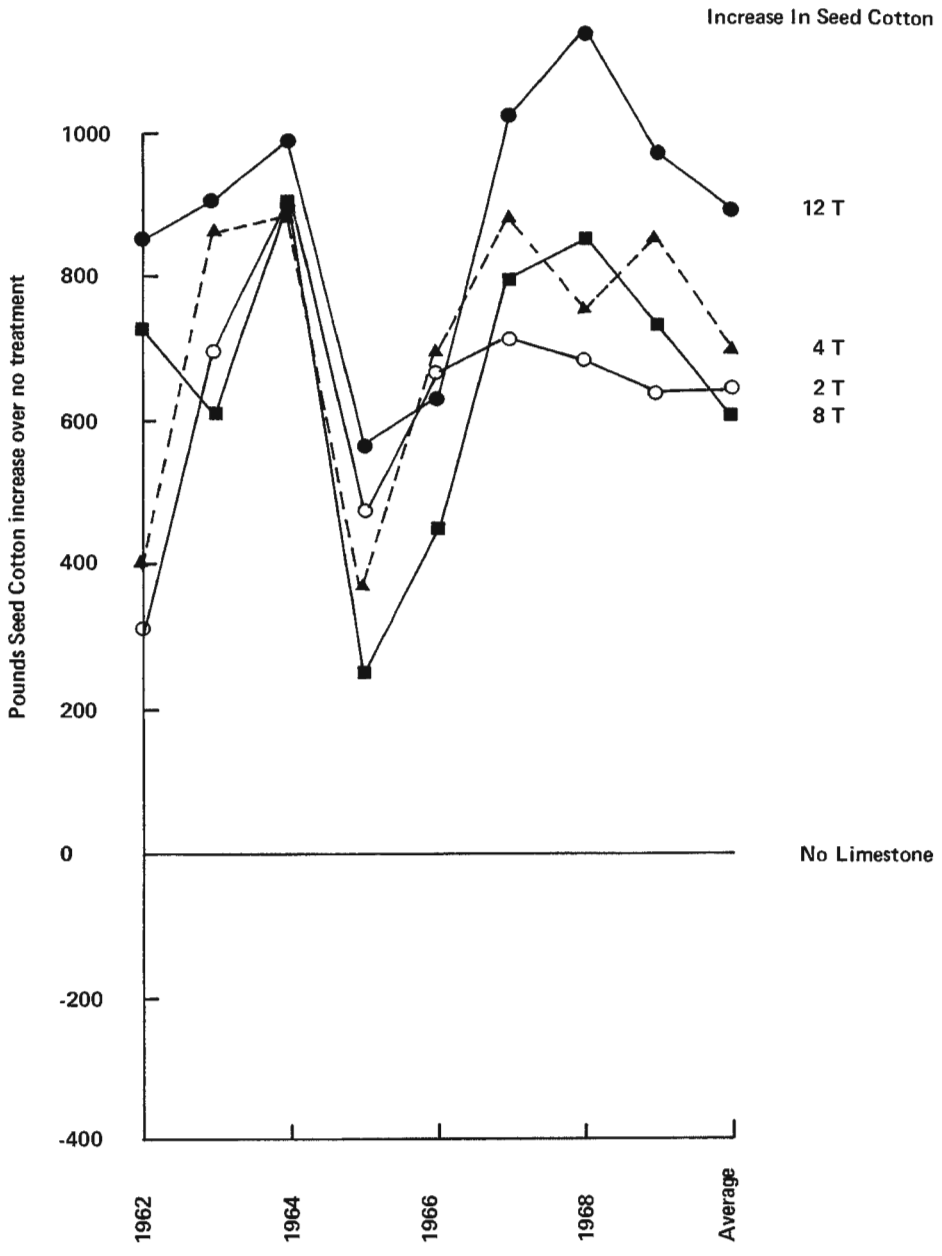

Figure 2: Increase in Seed Cotton Yield over no Limestone treatment in comparison of application of Dolomitic Agricultural Limestone.

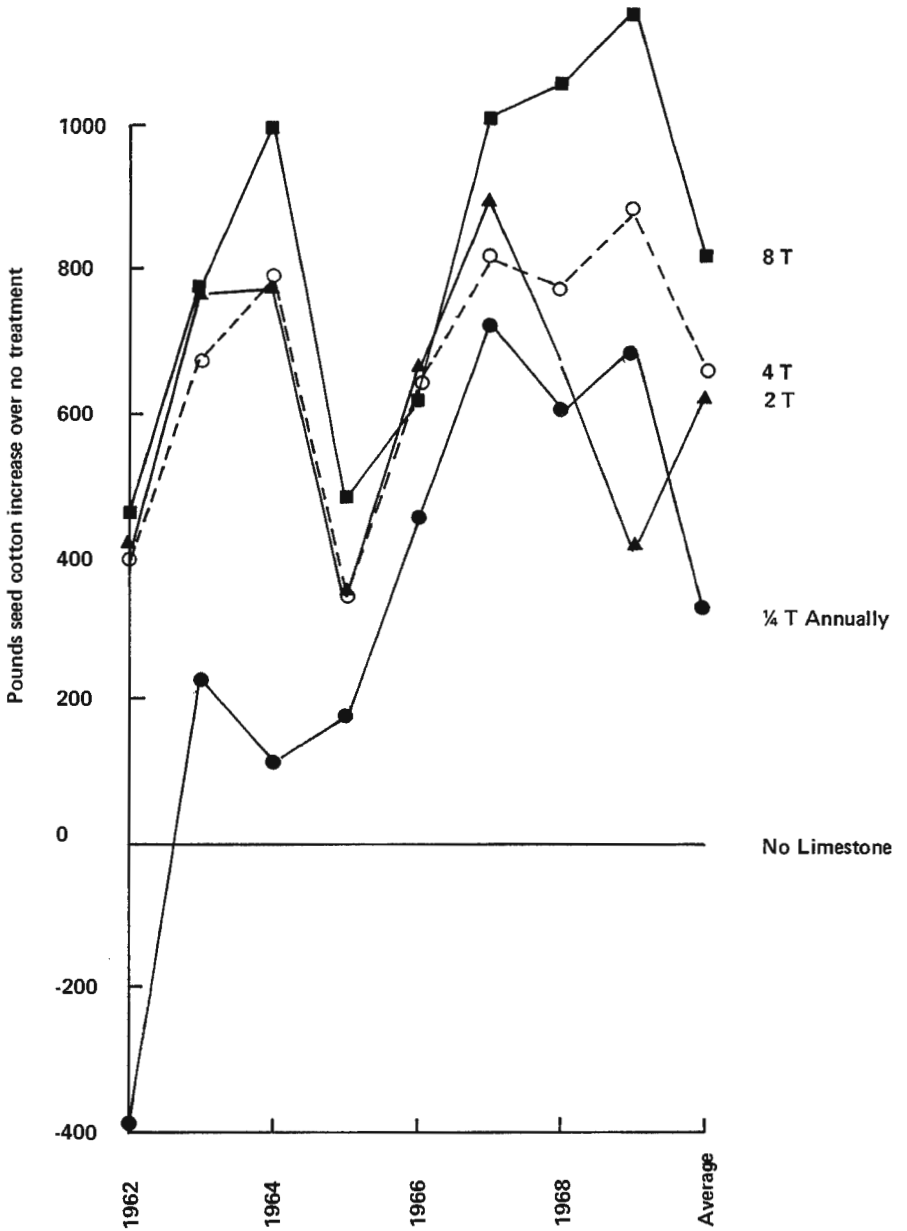

Figure 3: Increase in seed cotton yields over no limestone treatment in comparison of application of Calcium Carbonate fine limestone.

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