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Limestone and Nitrogen Application Influence on Cotton Yields and Soil Tests

IN PORTAGEVILLE CLAY SOIL IN SOUTHEAST MISSOURI

James A. Roth and Thomas E. Fisher



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COLUMBIA, MISSOURI

SUMMARY

Seed cotton yields were increased by the application of agricultural limestone on a Portageville clay soil with an initial pHs of 5.8. The addition of four tons or above resulted in a significant increase of seed cotton of the eight crops grown as compared to the check treatment. Five hundred pounds of fine lime applied annually increased yields but the increase over the check was not statistically significant.

The application of limestone, as measure by the soil test, decreased the exchangeable potassium as compared to the check. It apparently did not influence phosphate content of the soil but reduced neutralizable acidity and pHs. Cation exchange capacity was increased, except within the eight-ton application, as limestone was increased.

Over the eight crops of cotton, 113 pounds of nitrogen produced the highest yield, averaging 1670 pounds of seed cotton. This was significantly higher than yields obtained with either the 38 or 63-pound rates of nitrogen. Nitrogen did not increase acidity of the soil significantly although there was a small reduction in pHs over the ten-year period.

ACKNOWLEDGEMENT

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Cotton requirements for agricultural limestone and nitrogen have been of concern to farmers of southeast Missouri for several years. With the application of each pound of nitrogen as ammonium nitrate, 1.8 (2) to 3.57 (4) of calcium carbonate are required to neutralize the acid produced in the soil by the chemical reaction. Thus, a question arises of the need to control soil acidity to create a more favorable soil environment for making plant nutrients available to cotton.

According to Neal and Lovett, as reported in *Hunger Signs in Crops* (5), a low pH causes "crinkle leaf" (Manganese toxicity), which results in an excess of water-soluble manganese in the soil solution on some soils. Raising the pH by the addition of limestone eliminates the causes of "crinkle leaf." Finding what level the pHs* should be was one of the objectives of this study. Another was to determine the effect of nitrogen on the acidity of the soil over a period of years. In addition, opportunity to observe changes in soil test values was provided.

EXPERIMENTAL PROCEDURE

A field experiment was established on a Portageville clay soil located seven miles southeast of Portageville, Mo. The Portageville soil series consists of deep, poorly drained, level to depressional soils which occur in oxbows, lakebeds, and meanders left by former channels of the Mississippi River (1). The soil texture consisted of approximately 1 percent sand, 38 percent silt, and 61 percent clay. Soil samples (0-6 inches) were obtained from each plot prior to any soil treatment. These tests are reported in Table 1.

A split plot design was used; the main blocks consisted of five rates of limestone and a check block divided each with three subplots of three rates of nitrogen sidedressed. A recommended cotton variety was planted in 38 inch rows as near May 1 as soil conditions permitted. Three replications of four-row plots 90

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*Refers to salt pH (pHs) as measured in 1:1 soil : 0.01M CaCl₂ suspension.

feet long were included in each subplot. Agricultural calcium carbonate limestone¹ from Jonesboro, Ill. was applied, disced, and plowed down at the beginning of the experiment. No additional limestone was applied throughout the experiment except the annual treatment. Limestone used for the annual treatment was fine lime² (100 mesh or less) obtained from Ste. Genevieve and applied in a band near the row.

The cotton was irrigated by the row method as needed throughout the experiment. This averaged only one irrigation per season. It was very difficult on this soil to prevent an excessive amount of water per irrigation due to large cracks which developed as the soil dried out.

Harvesting the two center rows of each plot was accomplished by a spindle picker, usually in two pickings. Samples of seed cotton were obtained to determine percent lint, staple, and bolls per pound. Quality-of-lint data is not included in this publication as differences were not statistically significant.

After each harvest except 1962, soil samples were obtained from each plot and analyzed according to methods used in the soil testing laboratories of Missouri (3). Results of soil tests after each harvest are reported in Tables 3 through 9. Soil samples were also obtained after completion of the experiment and reported in Table 10.

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

RESULTS AND DISCUSSION

The application of limestone increased the soil pH as the rate of limestone was increased. The results of the eight-year average yield data indicated the most optimum pHs for cotton on this soil ranged from 6.1 to 7.1. All limestone treated plots had as high or higher pHs after ten years than they had initially, which indicates that a limestone application may last longer than anticipated. The pHs increased to a maximum in five to six years, after which there was a decline, but only the two-ton rate of application declined to the initial level of acidity (Figure 1). All other limestone treatments were above the initial pHs at the conclusion of the experiment.

Nitrogen applications over the ten-year period did not reduce the pHs of the soil (Table 12). There was no significant difference between the pHs of the 38, 63, and 113 pound rates of nitrogen application. To change the pHs significantly would require higher rates of nitrogen than would be advisable in cotton production in Southeast Missouri.

Soil Tests Results

Organic Matter: Percent of organic matter changed over the ten year period from 2.88% to 2.59% or an average change of minus 0.30% (Table 11). In con-

¹98.2% calcium carbonate with 56.5% passing through a 40 mesh sieve.

²98.5% calcium carbonate with 100% passing through a 100 mesh sieve and 80% through a 200 mesh sieve.

sideration of treatments there appeared to be no relationship except to the fact that over a period of time the organic matter has decreased under a system of continued row cropping of cotton.

Phosphate: Over the nine year period a total of 450 pounds of phosphate was added (50 pounds annually) to the soil which increased the soil test an average of 257 pounds (Table 11). The rate of limestone or nitrogen application did not apparently effect the available phosphate over the ten year period.

Potassium: The soil test for potassium increased an average of 86 pounds following applications of a total of 374 pounds over the ten-year period (Table 11). Limestone applications reduced the available potassium. On the no-treatment plot the potassium soil test increased two times or 178 pounds over the ten-year period. On the plots on which limestone was applied the increase varied from 40 to 95 pounds, depending on rate of limestone application.

Magnesium: No magnesium was added during the experiment but the soil test data indicated an increase of 136 pounds over the ten-year period. Neither limestone nor nitrogen applications appeared to have any effect on available magnesium (Table 11).

Calcium: Pounds of exchangeable calcium in the soil test increased as the rates of limestone were increased. Over the ten-year period exchangeable calcium decreased 442 pounds on the no-treatment plot, whereas, in the plot on which 24 tons was applied the calcium increased 2,995 pounds (Table 11).

N.A.: Neutralizable acidity increased on the plots on which no limestone was applied; where limestone was applied a decrease in N.A. occurred. On the plot receiving a 24-ton limestone application N.A. decreased to zero in 1964, followed by an increase to 0.3 in 1970 (Tables 4 and 10).

pHs: The pHs of the soil increased with the application of limestone. On the check plot the pHs remained about constant throughout the ten-year period. On plots on which limestone was applied the pHs increased but on the plot receiving 24 tons, the pHs reached 7.2 in 1966, then decreased to 6.8 in 1970 (Figure 1). The pHs on all limestone treated plots reached maximum level five to six years after application and then declined. The check plot maintained the initial pHs over the ten year period.

Seed Cotton Yields: In only one year (1962) did limestone applications increase yields of seed cotton significantly over the check. In the summary of eight years of data (Table 10 and Table 12), however, the 4, 8, 12, and 24-ton rates of application of limestone significantly increased first picking and total yields of seed cotton over the check and the 2-ton application.

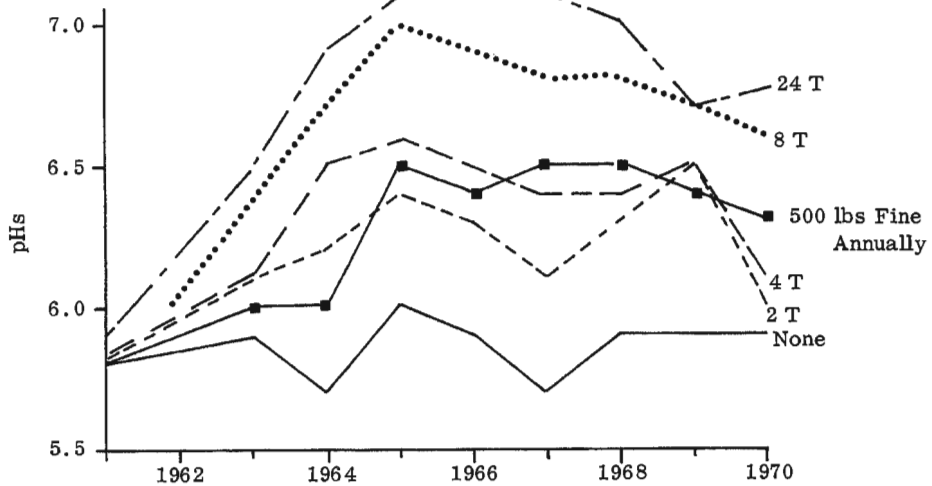


Fig. 1—Influence of limestone on pHs over ten-year period (1961-70) on a Portageville clay soil.

Seed cotton yields increased as the rate of nitrogen was increased (Tables 10 and 12) over the eight-year period. Only one year, 1963, (Table 3) did the 25 pounds of nitrogen sidedress average higher in yield than the 50 and 100 pound applications on this soil type. In seven of the eight years the sidedress of 100 pounds of nitrogen produced highest yield but not always significantly higher than the 50 pound rate of applications.

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TABLE 1: SOIL TEST RESULTS^{4/} AND SEED COTTON YIELDS^{5/} ON A PORTAGEVILLE CLAY SOIL, 1961

Soil Treatment	%	Lbs/A	Exchangeable Lbs/A			N.A.	pHs	C.E.C.	Seed Cotton Yield-Lbs/A ^{5/}	
			P ₂ O ₅	K	Mg.				Ca	1st Pick
Limestone ^{1/}	O.M.									
None (1)	2.43 ab	193 a	465 ab	891 ab	6430 a	3.10 abc	5.67 b	23.50 a	854 bcd	1265 cd
None (2)	3.03 ab	220 a	414 ab	891 ab	6667 a	2.53 c	5.77 ab	23.50 a	871 bcd	1342 bcd
None (3)	2.73 ab	183 a	436 ab	891 ab	6497 a	3.00 abc	5.90 ab	23.50 a	989 a-d	1431 a-d
2 Tons (1)	3.00 ab	239 a	547 a	867 bc	6660 a	3.00 abc	5.87 ab	23.83 a	770 d	1125 d
2 Tons (2)	3.03 ab	247 a	383 b	891 ab	6593 a	3.87 a	5.73 ab	23.50 a	895 b-d	1308 bcd
2 Tons (3)	3.17 a	243 a	512 ab	867 bc	6363 a	2.83 bc	5.87 ab	23.00 a	823 d	1388 bcd
4 Tons (1)	2.83 ab	228 a	482 ab	867 bc	6497 a	2.67 c	5.83 ab	23.17 a	1072 a-d	1569 a-d
4 Tons (2)	2.90 ab	223 a	495 ab	887 ab	6593 a	3.17 abc	5.73 ab	24.00 a	1016 a-d	1622 abc
4 Tons (3)	2.83 ab	231 a	482 ab	867 bc	6430 a	2.47 c	5.97 ab	22.83 a	965 a-d	1494 a-d
8 Tons (1)	2.83 ab	250 a	498 ab	913 a	6500 a	3.00 abc	5.77 ab	23.67 a	1173 abc	1677 abc
8 Tons (2)	2.90 ab	263 a	478 ab	900 a	6697 a	3.00 abc	5.67 b	24.17 a	1274 a	1892 a
8 Tons (3)	2.97 ab	202 a	522 ab	913 a	6357 a	3.00 abc	5.73 ab	23.33 a	1035 a-d	1759 ab
12 Tons (1)	2.77 ab	217 a	439 ab	847 cd	6330 a	3.27 abc	5.77 ab	23.17 a	907 bcd	1320 bcd
12 Tons (2)	2.90 ab	244 a	410 ab	833 d	6763 a	2.37 c	5.87 ab	23.33 a	1081 a-d	1571 a-d
12 Tons (3)	2.70 ab	199 a	462 ab	847 cd	6417 a	3.00 abc	5.93 ab	23.00 a	1055 a-d	1878 a
24 Tons (1)	2.37 b	247 a	504 ab	847 cd	6430 a	2.83 bc	5.77 ab	23.00 a	1055 a-d	1506 a-d
24 Tons (2)	2.90 ab	248 a	400 b	847 cd	6660 a	2.50 c	5.83 ab	23.17 a	999 a-d	1607 abc
24 Tons (3)	3.03 ab	248 a	489 ab	847 cd	6363 a	2.67 c	6.03 a	22.67 a	1108 a-d	1767 ab
^{2/} 500 Lbs. (1)	3.00 ab	210 a	501 ab	867 bc	6660 a	2.67 c	5.90 ab	23.50 a	975 a-d	1438 a-d
500 Lbs. (2)	3.10 ab	243 a	405 ab	911 a	6593 a	3.70 ab	5.70 ab	23.50 a	1216 ab	1726 abc
500 Lbs. (3)	3.13 ab	251 a	485 ab	867 bc	6660 a	2.63 c	5.93 ab	23.50 a	1105 a-d	1694 abc
Min. LSR, LSD	0.64	76.4	121.3	27.1	379.1	0.86	0.28	1.57	292.8	398.7
Max. LSR	0.77	91.4	145.1	32.4	453.6	1.03	0.34	1.87	350.3	477.1
C.V. %	13.3	19.8	15.5	1.9	3.5	17.6	2.9	4.0	17.3	15.5

LIMESTONE MEANS

None	2.73 a	199 a	438 a	891 a	6531 a	2.88 a	5.78 a	23.50 a	905 a	1346 a
2 Tons	3.07 a	243 a	481 a	875 a	6539 a	3.23 a	5.82 a	23.44 a	829 a	1273 a
4 Tons	2.86 a	228 a	486 a	873 a	6507 a	2.77 a	5.84 a	23.33 a	1018 a	1561 a
8 Tons	2.90 a	239 a	499 a	909 a	6518 a	3.00 a	5.72 a	23.72 a	1161 a	1776 a
12 Tons	2.79 a	220 a	437 a	842 a	6503 a	2.88 a	5.86 a	23.17 a	1014 a	1590 a
24 Tons	2.77 a	248 a	464 a	847 a	6484 a	2.67 a	5.88 a	22.94 a	1054 a	1627 a
500 Lbs. ^{2/}	3.08 a	235 a	464 a	881 a	6638 a	3.00 a	5.84 a	23.50 a	1099 a	1619 a
Min. LSR,LSD	0.50	70.4	91.6	99.4	462.5	0.97	0.31	1.60	390.9	502.0
Max. LSR	0.56	78.1	101.7	110.4	513.6	1.08	0.34	1.78	434.1	557.4
C.V. %	17.0	29.8	19.1	11.1	6.9	32.6	5.1	6.7	37.7	31.7

NITROGEN MEANS

38+50+50 ^{3/}	2.75 a	226 a	491 a	871 a	6501 b	2.93 a	5.80 b	23.40 a	972 a	1414 b
63+50+50	2.97 a	241 a	426 b	880 a	6652 a	3.02 a	5.76 b	23.60 a	1050 a	1581 a
113+50+50	2.94 a	222 a	484 a	871 a	6441 b	2.80 a	5.91 a	23.12 a	1012 a	1630 a
Min. LSR,LSD	0.24	28.9	45.9	10.2	143.3	0.32	0.11	0.59	110.7	150.7
Max. LSR	0.26	30.3	48.1	10.7	150.2	0.34	0.11	0.62	116.0	158.0
C.V. %	13.3	19.8	15.5	1.9	3.5	17.6	2.9	4.0	17.3	15.5

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

4/ Soil samples obtained before limestone applications.

5/ 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: SEED COTTON YIELDS ON PORTAGEVILLE CLAY SOIL, 1962

Soil Treatment	Seed Cotton Yield-Lbs/A	
	1st Pick	Total
Limestone ^{1/}		
None (1)	792 j	1021 i
None (2)	1240 d-h	1634 d-g
None (3)	1438 a-e	1938 abc
2 Tons (1)	845 ij	1091 i
2 Tons (2)	1272 d-h	1726 c-f
2 Tons (3)	1417 a-f	1914 bcd
4 Tons (1)	963 hij	1272 hi
4 Tons (2)	1552 a-d	2005 abc
4 Tons (3)	1552 a-d	2061 ab
8 Tons (1)	1096 f-j	1441 fgh
8 Tons (2)	1622 abc	2049 ab
8 Tons (3)	1706 a	2237 a
12 Tons (1)	982 g-j	1262 hi
12 Tons (2)	1301 c-g	1742 cde
12 Tons (3)	1467 a-e	1952 abc
24 Tons (1)	1158 e-i	1426 gh
24 Tons (2)	1513 a-d	1935 abc
24 Tons (3)	1639 ab	2056 ab
^{2/} 500 Lbs. (1)	862 ij	1129 i
500 Lbs. (2)	1110 f-j	1528 e-h
500 Lbs. (3)	1342 b-f	1892 bcd
Min. LSR, LSD	282.5	264.5
Max. LSR	338.0	316.4
C.V. %	13.2	9.4

SOIL TEST NOT RUN IN 1962

LIMESTONE MEANS

None		1157 ab	1531 b
2 Tons		1178 ab	1577 ab
4 Tons		1355 ab	1779 ab
8 Tons		1475 a	1909 a
12 Tons		1250 ab	1652 ab
24 Tons		1437 a	1806 ab
500 Lbs. ^{2/}		1105 b	1516 b
Min. LSR,LSD	SOIL TEST NOT RUN IN 1962	300.3	332.6
Max. LSR		333.4	369.3
C.V. %		22.9	19.3

NITROGEN MEANS

38+50+50 ^{3/}		957 c	1235 c
63+50+50		1373 b	1803 b
113+50+50		1509 a	2007 a
Min. LSR,LSD		106.8	100.0
Max. LSR		111.9	104.8
C.V. %		13.2	9.4

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1963

Soil Treatment	%	Lb/A	Exchangeable Lbs/A				Seed Cotton Yield-Lb/A				
			P_2O_5	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
Limestone ^{1/}	O.M.										
None (1)	1.50bc	192bc	587a-d	1000ab	5433de	2.33a	5.63f	20.83ab	1256a	1256a	
None (2)	1.63bc	209ab	603abc	1020a	5800cde	2.00ab	5.97def	21.50ab	1148a	1148a	
None (3)	1.87bc	176c	557a-f	1020a	6133a-d	1.67a-d	5.97def	22.00a	1232a	1232a	
2 Tons (1)	2.47a	211ab	587a-d	980ab	6267abc	1.33b-e	6.20a-e	21.83a	971a	971a	
2 Tons (2)	1.97ab	218ab	617ab	980ab	6533ab	1.67a-d	6.03b-f	22.83a	1178a	1178a	
2 Tons (3)	2.07ab	213ab	603abc	1020a	6533ab	1.33b-e	6.10a-f	22.67a	1076a	1076a	
4 Tons (1)	1.93abc	224a	570a-e	980ab	6200abc	1.50a-d	6.07b-f	21.83a	1202a	1202a	
4 Tons (2)	1.50bc	218ab	563a-f	960b	6067a-e	1.50a-d	5.97def	21.33ab	1291a	1291a	
4 Tons (3)	1.73bc	220ab	527b-f	980ab	6267abc	1.33b-e	6.27a-e	21.83a	1189a	1189a	
8 Tons (1)	1.73bc	196abc	540b-f	980ab	6400abc	0.83de	6.47a-d	21.50ab	1157a	1157a	
8 Tons (2)	1.70bc	190bc	557a-f	980ab	6700a	0.83de	6.53ab	22.17a	1159a	1159a	
8 Tons (3)	2.03ab	203abc	580a-e	980ab	6533ab	1.17b-e	6.30a-e	22.33a	1173a	1173a	
12 Tons (1)	1.77bc	213ab	510c-f	980ab	6200abc	1.50a-d	6.20a-e	21.83a	1283a	1283a	
12 Tons (2)	1.67bc	194abc	523b-f	980ab	5933b-e	1.50a-d	6.10a-f	21.00ab	1375a	1375a	
12 Tons (3)	1.83bc	209ab	490f	960b	5400e	1.50a-d	6.13a-f	19.67b	1270a	1270a	
24 Tons (1)	1.60bc	194abc	470f	960b	6467abc	0.50e	6.60a	21.33ab	1299a	1299a	
24 Tons (2)	1.57bc	191bc	500def	960b	6067a-e	1.00cde	6.27a-e	20.83ab	1159a	1159a	
24 Tons (3)	1.37bc	175c	473f	1000ab	6333abc	0.83de	6.50abc	21.33ab	1014a	1014a	
^{2/} 500 Lbs. (1)	1.87bc	215ab	640a	980ab	6067a-e	1.83abc	6.03b-f	22.00a	1232a	1232a	
500 Lbs. (2)	1.93abc	218ab	607ab	1000ab	5433de	2.33a	5.80ef	20.83ab	979a	979a	
500 Lbs. (3)	1.67bc	218ab	563a-f	960b	6000a-e	1.67a-d	6.00c-f	21.33ab	1105a	1105a	
Min. LSR, LSD	0.50	25.7	79.9	49.8	611.4	0.75	0.43	1.71	357.2	357.2	
Max. LSR	0.60	30.8	95.7	59.6	731.5	0.89	0.51	2.05	427.4	427.4	
C.V. %	16.9	7.5	8.6	3.0	6.0	31.0	4.2	4.8	18.1	18.1	

LIMESTONE MEANS										
None	1.67bc	192a	582a	1013a	5789c	2.00a	5.86a	21.44a	1212a	1212a
2 Tons	2.17a	214a	602a	993a	6444ab	1.44a	6.11a	22.44a	1075a	1075a
4 Tons	1.72bc	221a	553ab	973a	6178abc	1.44a	6.10a	21.67a	1228a	1228a
8 Tons	1.82b	196a	559ab	980a	6544a	0.94a	6.43a	22.00a	1163a	1163a
12 Tons	1.76bc	206a	508ab	973a	5844bc	1.50a	6.14a	20.83a	1309a	1309a
24 Tons ^{2/}	1.51c	187a	481b	973a	6289abc	0.78a	6.46a	21.17a	1157a	1157a
500 Lbs. ^{2/}	1.82b	217a	603a	980a	5833bc	1.94a	5.94a	21.39a	1105a	1105a
Min. LSR,LSD	0.26	44.5	90.6	61.2	593.6	1.16	0.56	1.75	372.8	372.8
Max. LSR	0.29	49.2	100.6	68.0	659.1	1.29	0.62	1.95	414.0	414.0
C.V. %	14.4	21.2	15.9	6.1	9.4	78.7	8.8	7.9	30.8	30.8
NITROGEN MEANS										
38+50+50 ^{3/}	1.84a	207a	558a	980a	6148a	1.40a	6.17a	21.60a	1200a	1200a
63+50+50	1.71a	205a	567a	983a	6076a	1.55a	6.10a	21.50a	1184a	1184a
113+50+50	1.80a	202a	542a	989a	6171a	1.36a	6.18a	21.60a	1151a	1151a
Min. LSR,LSD	0.19	9.7	30.2	18.8	231.1	0.28	0.16	0.65	135.0	135.0
Max. LSR	0.20	10.1	31.7	19.7	242.2	0.30	0.17	0.68	141.5	141.5
C.V. %	16.9	7.5	8.6	3.0	6.0	31.0	4.2	4.8	18.1	18.1

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

(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 ON PORTAGEVILLE CLAY SOIL, 1964

Soil Treatment	%	Lb/A P ₂ O ₅	Exchangeable Lbs/A			N.A.	pHs	C.E.C.	Seed Cotton Yield-Lb/A	
			K	Mg.	Ca				1st Pick	Total
Limestone ^{1/}	O.M.									
None (1)	1.80c	339d	433abc	933ab	5633e	2.17a	5.73i	20.50ab	1882abc	2143bc
None (2)	2.07abc	365cd	443abc	1020ab	5633e	2.00a	5.73i	20.83a	1833abc	2197abc
None (3)	2.00abc	382bc	427bc	987ab	5667de	2.00a	5.77hi	20.50ab	1871abc	2391ab
2 Tons (1)	2.20ab	418ab	443abc	1040ab	5700cd	1.17bcd	6.17efg	20.33abc	1777abc	2087bc
2 Tons (2)	2.00abc	395abc	443abc	1007ab	5700cd	1.00b-e	6.30de	19.83b-f	1855abc	2257abc
2 Tons (3)	2.17ab	410ab	460abc	947ab	5700cd	0.83c-f	6.23ef	19.67c-g	1647c	2195abc
4 Tons (1)	2.13ab	411ab	460abc	980ab	5700cd	0.50e-h	6.50cd	19.17fg	1920abc	2243abc
4 Tons (2)	2.07abc	399abc	493a	1040ab	5700cd	0.67d-g	6.50cd	20.00b-e	2038ab	2372ab
4 Tons (3)	2.10ab	427a	453abc	987ab	5667de	0.67d-g	6.50cd	19.50d-g	1906abc	2486a
8 Tons (1)	1.93bc	429a	473abc	1000ab	5733bc	0.17gh	6.77ab	19.33efg	1928abc	2246abc
8 Tons (2)	2.10ab	422ab	480ab	1000ab	5767ab	0.00h	6.77ab	19.00g	2017ab	2346abc
8 Tons (3)	2.03abc	405abc	417bc	987ab	5733bc	0.33fgh	6.60c	19.17fg	1874abc	2386ab
12 Tons (1)	2.23ab	418ab	453abc	1027ab	5733bc	0.00h	6.73abc	19.17fg	1798abc	2030c
12 Tons (2)	2.20ab	422ab	473abc	913b	5733bc	0.33fgh	6.70abc	19.17fg	1990ab	2319abc
12 Tons (3)	2.27a	405abc	467abc	987ab	5700cd	0.17gh	6.67abc	19.00g	1885abc	2375ab
24 Tons (1)	1.80c	384bc	413c	1020ab	5800a	0.00h	6.87a	19.17fg	1955ab	2176abc
24 Tons (2)	2.13ab	412ab	467abc	1007ab	5800a	0.00h	6.83ab	19.33efg	2065a	2362ab
24 Tons (3)	2.23ab	403abc	453abc	1060a	5800a	0.00h	6.87a	19.33efg	1774abc	2189abc
^{2/} 500 Lbs. (1)	2.13ab	382bc	473abc	927ab	5700cd	1.33bc	6.03fg	20.00b-e	1774abc	2071bc
500 Lbs. (2)	2.00abc	382bc	440abc	1020ab	5667de	1.33bc	6.07fg	20.17a-d	1898abc	2222abc
500 Lbs. (3)	2.20ab	384bc	467abc	1020ab	5700cd	1.50b	5.97gh	20.50ab	1763bc	2340abc
Min. LSR, LSD	0.25	35.3	55.6	116.3	53.8	0.47	0.21	0.66	251.2	270.2
Max. LSR	0.30	42.3	66.5	139.2	64.4	0.56	0.25	0.79	300.6	323.3
C.V. %	7.3	5.3	7.3	7.0	0.6	36.1	2.0	2.0	8.0	7.1

LIMESTONE MEANS

None	1.96a	362a	434a	980a	5644c	2.06a	5.74e	20.61a	1862a	2244a
2 Tons	2.12a	407a	449a	998a	5700bc	1.00bc	6.23cd	19.94abc	1760a	2179a
4 Tons	2.10a	412a	469a	1002a	5689bc	0.61bcd	6.50bc	19.56bcd	1955a	2367a
8 Tons	2.02a	419a	457a	996a	5744ab	0.17cd	6.71ab	19.17cd	1939a	2326a
12 Tons	2.23a	415a	464a	976a	5722b	0.17cd	6.70ab	19.11d	1891a	2241a
24 Tons	2.06a	400a	444a	1029a	5800a	0.00d	6.86a	19.28cd	1931a	2242a
500 Lbs. ^{2/}	2.11a	383a	460a	989a	5689bc	1.39ab	6.02de	20.22ab	1812a	2211a
Min. LSR, LSD	0.49	51.3	44.8	123.0	56.6	0.89	0.32	0.73	340.7	360.7
Max. LSR	0.55	57.0	49.7	136.6	62.9	0.99	0.35	0.81	378.3	400.5
C.V. %	23.1	12.5	9.6	12.0	1.0	12.7	4.8	3.6	17.7	15.6

NITROGEN MEANS

38+50+50 ^{3/}	2.03b	397a	450a	990a	5714a	0.76a	6.40a	19.67a	1862ab	2142b
63+50+50	2.08ab	400a	463a	1001a	5714a	0.76a	6.41a	19.76a	1957a	2296a
113+50+50	2.14a	402a	449a	996a	5710a	0.79a	6.37a	19.67a	1817b	2337a
Min. LSR, LSD	.096	13.4	21.0	44.0	20.3	0.18	.080	0.25	95.0	102.1
Max. LSR	0.10	14.0	22.0	46.1	21.3	0.18	.084	0.26	99.5	107.0
C.V. %	7.3	5.3	7.3	7.0	0.6	36.1	2.0	2.0	8.0	7.1

^{1/} Agricultural limestone (calcium carbonate) applied April 1961.

^{2/} Fine lime (calcium carbonate less than 100 mesh) applied annually.

^{3/} Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1965

Soil Treatment	%	Lb/A	Exchangeable Lbs/A					Seed Cotton Yield-Lb/A			
			P ₂ O ₅	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick	Total
Limestone 1/	O.M.										
None (1)	NOT	416cd	503abc	1180ab	6400fg	2.83ab	6.07g	24.33ab	1480fg	1707gh	
None (2)	RUN	420bcd	537a	1200ab	6433efg	3.33a	5.90g	25.00a	1720c-e	2049c-f	
None (3)		407d	497abc	1180ab	6300g	2.33bc	6.10g	23.50bcd	1588efg	1984ef	
2 Tons (1)		439abc	530ab	1220a	6567c-f	1.50de	6.40f	23.67bcd	1399g	1607h	
2 Tons (2)		435abc	520abc	1200ab	6633b-e	1.67cd	6.37f	24.00bc	1690def	2006c-f	
2 Tons (3)		444ab	530ab	1200ab	6633b-e	1.67cd	6.40f	24.00bc	1787b-e	2240a-e	
4 Tons (1)		444ab	493abc	1200ab	6633b-e	1.00d-g	6.67de	23.17cde	1467fg	1701gh	
4 Tons (2)		439abc	460c	1180ab	6633b-e	0.83e-h	6.67de	23.00def	1890a-d	2238a-e	
4 Tons (3)		439abc	510abc	1147ab	6567c-f	1.33def	6.47ef	23.17cde	1744c-e	2159a-e	
8 Tons (1)		444ab	503abc	1127ab	6633b-e	0.00i	6.97abc	21.83g	1871a-d	2127b-f	
8 Tons (2)		439abc	490abc	1140ab	6700a-d	0.17hi	6.93abc	22.17fg	2057a	2391a	
8 Tons (3)		435abc	493abc	1127ab	6633b-e	0.33ghi	6.83bcd	22.17fg	1928abc	2389a	
12 Tons (1)		448a	497abc	1140ab	6733a-d	0.17hi	6.93abc	22.50efg	1674def	1901fg	
12 Tons (2)		448a	477abc	1160ab	6800abc	0.00i	6.93abc	22.33efg	1855a-d	2173a-e	
12 Tons (3)		444ab	480abc	1180ab	6733a-d	0.67f-i	6.80cd	23.00def	1804b-e	2259abc	
24 Tons (1)		444ab	460c	1107b	6700a-d	0.00i	7.13a	21.83g	1868a-d	2122b-f	
24 Tons (2)		431a-d	463c	1140ab	6833ab	0.00i	7.07ab	22.33efg	1984ab	2367ab	
24 Tons (3)		431a-d	470bc	1093b	6867a	0.00i	7.10a	22.17fg	1858a-d	2235a-e	
2/											
500 Lbs. (1)		439abc	517abc	1147ab	6400fg	1.33def	6.53ef	23.50bcd	1464fg	1698gh	
500 Lbs. (2)		439abc	510abc	1200ab	6567c-f	1.67cd	6.43ef	24.00bc	1663def	1998d-f	
500 Lbs. (3)		431a-d	510abc	1160ab	6533def	1.67cd	6.43ef	23.50bcd	1836a-d	2254a-d	
Min. LSR, LSD		22.4	51.4	89.8	197.3	0.70	0.21	0.80	202.0	222.4	
Max. LSR		26.8	61.5	107.4	236.1	0.84	0.25	0.95	241.7	266.1	
C.V. %		3.1	6.2	4.6	1.8	39.2	1.9	2.1	6.9	6.4	

LIMESTONE MEANS									
None	415b	512ab	1187ab	6378c	2.83a	6.02d	24.28a	1596a	1913a
2 Tons	439ab	527a	1207a	6611abc	1.61b	6.39cd	23.89ab	1626a	1951a
4 Tons	441ab	488ab	1176ab	6611abc	1.06bc	6.60bc	23.11bcd	1700a	2033a
8 Tons	439ab	496ab	1131bc	6656ab	0.17c	6.91ab	22.06d	1952a	2302a
12 Tons	447a	484ab	1160abc	6756a	0.28c	6.89ab	22.61cd	1778a	2111a
24 Tons	435ab	464b	1113c	6800a	0.00c	7.10a	22.11d	1903a	2241a
500 Lbs. ^{2/}	437ab	512ab	1169abc	6500bc	1.56b	6.47c	23.67abc	1654a	1983a
Min. LSR, LSD	27.6	53.8	54.2	218.8	1.06	0.39	1.02	374.3	405.6
Max. LSR	30.7	59.7	60.2	243.0	1.17	0.44	1.13	415.6	450.3
C.V. %	6.2	10.5	4.5	3.2	96.1	5.8	4.3	20.9	19.0
NITROGEN MEANS									
38+50+50 ^{3/}	439a	500a	1160a	6581a	0.98a	6.67a	22.98a	1603b	1837b
63+50+50	436a	494a	1174a	6657a	1.10a	6.61a	23.26a	1837a	2175a
113+50+50	433a	499a	1155a	6610a	1.14a	6.59a	23.07a	1792a	2217a
Min. LSR, LSD	8.5	19.4	33.9	74.6	0.27	.080	0.30	76.3	84.1
Max. LSR	8.9	20.4	35.6	78.2	0.28	.084	0.32	80.0	88.1
C.V. %	3.1	6.2	4.6	1.8	39.2	1.9	2.1	6.9	6.4

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1966

Soil Treatment	%	Lb/A	Exchangeable Lbs/A				N.A.	pHs	C.E.C.	Seed Cotton Yield-Lb/A	
			P ₂ O ₅	K	Mg.	Ca				1st Pick	Total
Limestone ^{1/}	O.M.										
None (1)	NOT	418bcd	460ab	1047abc	5733f	2.50b	6.00h	21.67ab	Cotton not harvested		
None (2)	RUN	405cd	487ab	1053abc	5467g	3.33a	5.83hi	22.00a	due to adverse		
None (3)		403d	480ab	1087ab	5400g	3.17ab	5.77i	21.67ab	weather.		
2 Tons (1)		444ab	480ab	1073abc	5933def	1.50c	6.33g	21.33abc	(early freeze)		
2 Tons (2)		427a-d	487ab	1073abc	5800ef	1.67c	6.30g	21.17a-d			
2 Tons (3)		444ab	487ab	1087ab	5900def	1.67c	6.37fg	21.50abc			
4 Tons (1)		431abc	480ab	1013bc	5900def	1.00cd	6.57ef	20.50cde			
4 Tons (2)		425a-d	460ab	1060abc	6033cde	1.00cd	6.60e	21.17a-d			
4 Tons (3)		420a-d	500a	1040abc	5967def	1.50c	6.43efg	21.33abc			
8 Tons (1)		418bcd	450b	1053abc	6067cde	0.00e	6.93cd	20.17de			
8 Tons (2)		431abc	467ab	1040abc	6133bcd	0.17e	6.97bcd	20.50cde			
8 Tons (3)		435ab	460ab	1100a	6067cde	0.33de	6.83d	20.67b-e			
12 Tons (1)		435ab	453b	1033abc	6067cde	0.17e	6.93cd	20.00e			
12 Tons (2)		435ab	443b	1027abc	6100bcd	0.00e	6.90d	20.17de			
12 Tons (3)		431abc	467ab	1040abc	5967def	0.33de	6.83d	20.17de			
24 Tons (1)		448a	460ab	1013bc	6433a	0.00e	7.23a	20.83b-e			
24 Tons (2)		431abc	467ab	1000c	6367ab	0.00e	7.17ab	20.50cde			
24 Tons (3)		444ab	453b	1040abc	6300abc	0.00e	7.13abc	20.67b-e			
^{2/} 500 Lbs. (1)		439ab	467ab	1073abc	5967def	1.33c	6.47efg	21.17a-d			
500 Lbs. (2)		431abc	473ab	1027abc	6033cde	1.50c	6.43efg	21.33abc			
500 Lbs. (3)		435ab	473ab	1047abc	5900def	1.67c	6.30g	21.33abc			
Min. LSR, LSD		23.5	36.9	71.6	249.1	0.67	0.20	0.93			
Max. LSR		28.1	44.2	85.7	298.1	0.80	0.24	1.11			
C.V. %		3.3	4.7	4.1	2.5	36.6	1.8	2.7			

LIMESTONE MEANS									
None		409b	476a	1062a	5533c	3.00a	5.87d	21.78a	
2 Tons		438ab	484a	1078a	5878b	1.61b	6.33c	21.33ab	
4 Tons		425ab	480a	1038a	5967b	1.17bcd	6.53bc	21.00abc	
8 Tons		428ab	459a	1064a	6089ab	0.17cd	6.91ab	20.44bc	
12 Tons	NOT RUN	434ab	454a	1033a	6044b	0.17cd	6.89ab	20.11c	
24 Tons		441a	460a	1018a	6367a	0.00d	7.18a	20.67bc	
500 Lbs. ^{2/}		435ab	471a	1049a	5967b	1.50bc	6.40c	21.28ab	
Min. LSR, LSD		26.7	36.1	62.2	281.6	1.30	0.42	0.95	
Max. LSR	29.6	40.1	69.0	312.6	1.45	0.46	1.05		Cotton not harvested due to adverse weather.
C.V. %	6.0	7.5	5.8	4.6	17.0	6.2	4.4		(early freeze)
NITROGEN MEANS									
38+50+50 ^{3/}		433a	464a	1044a	6014a	0.93b	6.64a	20.81a	
63+50+50		426a	469a	1040a	5990a	1.10ab	6.60a	20.98a	
113+50+50		430a	474a	1063a	5929a	1.24a	6.52b	21.05a	
Min. LSR, LSD		8.9	14.0	27.1	94.2	0.25	.075	0.35	
Max. LSR		9.3	14.6	28.4	98.7	0.26	.079	0.37	
C.V. %		3.3	4.7	4.1	2.5	36.6	1.8	2.7	

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1967

Soil Treatment	%	Lb/A P ₂ O ₅	Exchangeable Lbs/A			N.A.	pHs	C.E.C.	Seed Cotton Yield-Lb/A	
			K	Mg.	Ca				1st Pick	Total
Limestone ^{1/}	O.M.									
None (1)	1.83cde	361cd	410abc	980ab	5500fg	3.67a	5.701	22.00ab	669b-e	669b-e
None (2)	1.83cde	365bcd	407a-d	1027a	5533efg	3.67a	5.671	22.17a	825a-e	825a-e
None (3)	1.97b-e	348d	390bcd	987ab	5467g	3.33a	5.80kl	21.50abc	841a-d	841a-d
2 Tons (1)	2.10abc	414ab	460a	987ab	5733def	2.17b	6.10ijk	21.00b-e	685a-e	685a-e
2 Tons (2)	2.10abc	412abc	433ab	973ab	5733def	1.83bc	6.20hij	20.83c-f	723a-e	723a-e
2 Tons (3)	2.10abc	420a	437ab	953ab	5733def	2.17b	6.07jk	21.17a-d	890ab	890ab
4 Tons (1)	2.03a-e	439a	420abc	907bc	5833d	1.33bcd	6.40f-i	20.17d-i	671a-e	671a-e
4 Tons (2)	1.93b-e	403abc	390bcd	927abc	5867d	1.17bcd	6.50e-h	20.17d-i	760a-e	760a-e
4 Tons (3)	2.00b-e	439a	443ab	980ab	5900cd	2.00b	6.20hij	21.50abc	830a-e	830a-e
8 Tons (1)	2.13ab	444a	423abc	880bc	6133abc	0.00e	6.87bcd	19.50ghi	663cde	663cde
8 Tons (2)	2.00b-e	418a	410abc	893bc	6167ab	0.50de	6.83b-e	20.00e-i	785a-e	785a-e
8 Tons (3)	2.07a-d	435a	423abc	900bc	5867d	0.83cde	6.60def	19.83f-i	677a-e	677a-e
12 Tons (1)	1.97b-e	418a	400bcd	953ab	5967bcd	0.33de	6.77b-e	19.67ghi	763a-e	763a-e
12 Tons (2)	2.10abc	439a	407a-d	920abc	5967bcd	0.00	6.83b-e	19.17i	779a-e	779a-e
12 Tons (3)	2.30a	427a	383cd	887bc	5900cd	0.50de	6.70c-f	19.33hi	855abc	855abc
24 Tons (1)	1.80de	412abc	377cd	933abc	6300a	0.00c	7.20a	20.17d-i	760a-e	760a-e
24 Tons (2)	1.77e	390a-d	353d	840c	6167ab	0.33de	6.97abc	19.67ghi	607e	607e
24 Tons (3)	1.90b-e	409abc	353d	887bc	6200ab	0.00	7.07ab	19.50ghi	617de	617de
^{2/} 500 Lbs. (1)	2.03a-e	423a	410abc	927abc	5800d	1.17bcd	6.57d-g	20.17d-i	652cde	652cde
500 Lbs. (2)	1.90b-e	435a	430abc	953ab	5867d	1.17bcd	6.53d-h	20.33d-h	687a-e	687a-e
500 Lbs. (3)	2.00b-e	393a-d	417abc	940abc	5767de	1.67bc	6.27g-j	20.50c-g	895a	895a
Min. LSR, LSD	0.24	45.0	46.7	95.5	218.7	0.89	0.29	0.92	188.9	188.9
Max. LSR	0.29	53.9	55.9	114.3	261.7	1.06	0.35	1.10	226.1	226.1
C.V. %	7.2	6.5	6.8	6.1	2.2	40.1	2.7	2.7	15.2	15.2

LIMESTONE MEANS

None	1.88a	358b	402ab	998a	5500c	3.56a	5.72d	21.89a	778a	778a
2 Tons	2.10a	415ab	443a	971ab	5733bc	2.06b	6.12cd	21.00ab	766a	766a
4 Tons	1.99a	427a	418ab	938ab	5867b	1.50bc	6.37bc	20.61bc	754a	754a
8 Tons	2.07a	432a	419ab	891b	6056ab	0.44cd	6.77ab	19.78bc	708a	708a
12 Tons	2.12a	428a	397ab	920ab	5944ab	0.28cd	6.77ab	19.39c	799a	799a
24 Tons	1.82a	404ab	361b	887b	6222a	0.11d	7.08a	19.78bc	661a	661a
500 Lbs. ^{2/}	1.98a	417ab	419ab	940ab	5811bc	1.33bcd	6.46bc	20.33bc	745a	745a
Min. LSR, LSD	0.59	63.3	53.5	81.1	309.5	1.21	0.44	1.22	224.7	224.7
Max. LSR	0.65	70.2	59.4	90.1	343.7	1.34	0.49	1.35	249.5	249.5
C.V. %	28.7	15.0	12.8	8.5	5.1	88.9	6.7	5.8	29.4	29.4

NITROGEN MEANS

38+50+50 ^{3/}	1.99b	416a	414a	938a	5895a	1.24a	6.51a	20.38a	695b	695b
63+50+50	1.95b	409a	404a	933a	5900a	1.24a	6.50a	20.33a	738ab	738ab
113+50+50	2.05a	410a	407a	933a	5833a	1.50a	6.39b	20.48a	801a	801a
Min. LSR, LSD	.091	17.0	17.7	36.1	82.7	0.34	0.11	0.35	71.4	71.4
Max. LSR	.095	17.8	18.5	37.8	86.7	0.35	0.12	0.36	74.9	74.9
C.V. %	7.2	6.5	6.8	6.1	2.2	40.1	2.7	2.7	15.2	15.2

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1968

Soil Treatment	%	Lb/A	Exchangeable Lbs/A			N.A.	pHs	C.E.C.	Seed Cotton Yield-Lb/A	
			P ₂ O ₅	K	Mg.				Ca	1st Pick
Limestone ^{1/}	O.M.									
None (1)	2.23ab	409c	650ab	1080ab	6067de	3.00a	5.93j	23.47b-h	1092e-h	1092e-h
None (2)	2.30ab	418abc	650ab	1087a	5900e	3.17a	5.90j	23.27c-h	1095e-h	1095e-h
None (3)	2.50a	418abc	643ab	1053ab	5667e	3.67a	6.00ij	23.03e-h	1224d-h	1224d-h
2 Tons (1)	2.33ab	441ab	637ab	1040abc	6567de	2.00b	6.30h	23.10d-h	984h	984h
2 Tons (2)	2.37ab	413bc	650ab	1027a-d	5867e	2.00b	6.33gh	21.80gh	1170d-h	1170d-h
2 Tons (3)	2.33ab	441ab	683ab	1070ab	6333de	2.00b	6.30h	23.17c-h	1529abc	1529abc
4 Tons (1)	2.33ab	433abc	653ab	1023a-d	6867de	1.33cd	6.47e-h	23.60b-h	987h	987h
4 Tons (2)	2.40ab	445ab	673ab	1017a-d	7567a-d	1.17cd	6.60d-g	25.13a-g	1256c-h	1256c-h
4 Tons (3)	2.40ab	437abc	713a	1027a-d	6400de	2.00b	6.23i	23.13c-h	1337b-f	1337b-f
8 Tons (1)	2.03ab	431abc	660ab	1033abc	6300de	0.50ef	6.87a-d	21.43h	1345b-f	1345b-f
8 Tons (2)	1.93b	431abc	647ab	1047ab	6767de	0.50ef	6.83a-d	22.60fgh	1364b-e	1364b-e
8 Tons (3)	2.43ab	435abc	680ab	1047ab	6167de	1.00de	6.73b-e	21.63gh	1639a	1639a
12 Tons (1)	2.50a	443ab	603ab	1020a-d	8300abc	0.50ef	6.77bcd	26.47a-e	1060gh	1060gh
12 Tons (2)	2.40ab	443ab	623ab	1007b-e	8800a	0.50ef	6.80a-d	27.70a	1070fgh	1070fgh
12 Tons (3)	2.30ab	447a	603ab	1007b-e	8433ab	0.67ef	6.67c-f	26.73a-d	1329b-g	1329b-g
24 Tons (1)	2.27ab	427abc	623ab	943e	8467ab	0.00f	7.07a	25.90a-f	1421a-d	1421a-d
24 Tons (2)	2.03ab	427abc	613ab	957de	8867a	0.00f	7.00ab	26.93ab	1507abc	1507abc
24 Tons (3)	2.23ab	435abc	617ab	970cde	8767a	0.00f	6.93abc	26.73abc	1583ab	1583ab
^{2/} 500 Lbs. (1)	2.43ab	422abc	673ab	1040abc	6933cde	1.50bc	6.60d-g	24.03b-h	1100e-h	1100e-h
500 Lbs. (2)	2.30ab	437abc	643ab	1023a-d	6400de	1.33bcd	6.60d-g	22.47fgh	1216d-h	1216d-h
500 Lbs. (3)	2.50a	422abc	600b	1040abc	7167b-e	1.67bc	6.43fgh	24.67a-h	1510abc	1510abc
Min. LSR, LSD	0.44	27.1	93.0	63.6	1293.0	0.66	0.25	3.10	239.6	239.6
Max. LSR	0.53	32.4	111.3	76.1	1548.0	0.79	0.30	3.71	286.7	286.7
C.V. %	11.5	3.8	8.6	3.7	10.9	29.2	2.3	7.7	11.2	11.2

LIMESTONE MEANS										
None	2.34a	415a	648a	1073a	5878c	3.28a	5.94d	23.26bc	1137a	1137a
2 Tons	2.34a	432a	657a	1046ab	6256bc	2.00ab	6.31cd	22.69bc	1228a	1228a
4 Tons	2.38a	438a	680a	1022ab	6944b	1.50bc	6.43bc	23.96b	1193a	1193a
8 Tons	2.13a	432a	662a	1042ab	6411bc	0.67bc	6.81ab	21.89c	1450a	1450a
12 Tons	2.40a	444a	610a	1011ab	8511a	0.56bc	6.74abc	26.97a	1153a	1153a
24 Tons	2.18a	429a	618a	957b	8700a	0.00c	7.00a	26.52a	1503a	1503a
500 Lbs. ^{2/}	2.41a	427a	639a	1034ab	6833bc	1.50bc	6.54bc	23.72b	1275a	1275a
Min. LSR, LSD	0.67	29.4	70.9	89.0	921.1	1.44	0.42	1.61	389.7	389.7
Max. LSR	0.74	32.6	78.8	98.8	102.3	1.60	0.47	1.78	432.7	432.7
C.V. %	28.2	6.6	10.7	8.4	12.7	3.4	6.2	6.5	29.7	29.7
NITROGEN MEANS										
38+50+50 ^{3/}	2.30a	429a	643a	1026a	7071a	1.26b	6.57a	24.00a	1141c	1141c
63+50+50	2.25a	430a	643a	1023a	7167a	1.24b	6.58a	24.27a	1240b	1240b
113+50+50	2.39a	434a	649a	1030a	6990a	1.57a	6.47b	24.16a	1450a	1450a
Min. LSR, LSD	0.17	10.3	35.2	24.0	488.9	0.25	.096	1.17	90.6	90.6
Max. LSR	0.18	10.7	36.9	25.2	512.5	0.26	0.10	1.23	94.9	94.9
C.V. %	11.5	3.8	8.6	3.7	10.9	29.2	2.3	7.7	11.2	11.2

^{1/} Agricultural limestone (calcium carbonate) applied April 1961.

^{2/} Fine lime (calcium carbonate less than 100 mesh) applied annually.

^{3/} Annual fertilizer $N+P_2O_5+K_2O$.

- (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 ON PORTAGEVILLE CLAY SOIL, 1969

Soil Treatment	%	Lb/A	Exchangeable Lbs/A			Seed Cotton Yield-Lb/A					
			O.M.	P ₂ O ₅	K	Mg.	Ca	N.A.	pHs	C.E.C.	1st Pick
Limestone ^{1/}											
None (1)	2.80a-d	457a-e	665ab	1033ab	7367cde	3.17abc	5.97ef	26.77abc	973efg	1326ef	
None (2)	2.53bcd	445cde	668ab	1053a	6900e	3.50ab	5.97ef	26.20a-d	1132b-f	1577cde	
None (3)	2.83a-d	447b-e	658abc	1040ab	7200de	4.00a	5.80f	27.20ab	1051c-f	1653bcd	
2 Tons (1)	3.10a	480a	667ab	1010ab	7500b-e	1.67c-f	6.40bcd	25.50bcd	809g	1162f	
2 Tons (2)	2.87a-d	460a-e	620bc	1020ab	7367cde	2.00cde	6.47bcd	25.47bcd	1116c-f	1537cde	
2 Tons (3)	2.83a-d	463a-d	625bc	990b	7233de	1.83cde	6.50bcd	24.87cd	962fg	1561cde	
4 Tons (1)	2.93a-d	483a	667ab	1000ab	7567b-e	1.33def	6.57a-d	25.27bcd	1143b-f	1488cde	
4 Tons (2)	3.00abc	477a	663ab	990b	7767a-e	1.00ef	6.50bcd	25.40bcd	1415a	1863ab	
4 Tons (3)	2.97a-d	477a	675ab	1020ab	8100a-d	2.17b-e	6.30cde	27.53ab	1197a-e	1852ab	
8 Tons (1)	2.70a-d	473ab	627abc	1010ab	7467b-e	0.67ef	6.80ab	24.37d	1256a-d	1577cde	
8 Tons (2)	2.70a-d	467abc	625bc	1040ab	7833a-e	0.83ef	6.57a-d	25.57bcd	1262a-d	1647bcd	
8 Tons (3)	2.50cd	470abc	627abc	1013ab	7833a-e	1.00ef	6.63abc	25.60a-d	1418a	1906a	
12 Tons (1)	2.63a-d	473ab	637abc	990b	7833a-e	1.17def	6.53a-d	25.70a-d	1167b-f	1507cde	
12 Tons (2)	2.80a-d	473ab	642abc	997ab	8533ab	1.17def	6.57a-d	27.47ab	1246a-d	1661bcd	
12 Tons (3)	2.60a-d	473ab	647abc	1043ab	8200a-d	1.33def	6.47bcd	27.03abc	1359ab	1936a	
24 Tons (1)	2.47d	437e	602c	1017ab	8433abc	0.67ef	6.70abc	26.80abc	1262a-d	1591cd	
24 Tons (2)	2.53bcd	440de	622bc	1043ab	8100a-d	1.00ef	6.63abc	26.40a-d	1178b-f	1548cde	
24 Tons (3)	2.53bcd	447b-e	640abc	1047ab	8767a	0.17f	6.90a	27.27ab	1035def	1510cde	
^{2/} 500 Lbs. (1)	3.00abc	470abc	688a	1023ab	8400abc	2.00cde	6.47bcd	27.83a	1116c-f	1418de	
500 Lbs. (2)	3.03ab	477a	675ab	997ab	8033a-e	1.67c-f	6.47bcd	26.77abc	1273abc	1734abc	
500 Lbs. (3)	2.90a-d	473ab	677ab	1033ab	7700a-e	2.67a-d	6.20de	27.10abc	1353ab	1928a	
Min. LSR, LSD	0.43	23.1	52.3	52.1	966.1	1.31	0.34	1.91	198.4	219.0	
Max. LSR	0.51	27.7	62.5	62.3	1156.0	1.57	0.41	2.28	237.4	262.1	
C.V. %	9.2	3.0	4.8	3.1	7.4	46.9	3.2	4.3	10.1	8.1	

LIMESTONE MEANS										
None	2.72a	450a	664a	1042a	7156a	3.56a	5.91b	26.72a	1052ab	1519a
2 Tons	2.93a	468a	637a	1007a	7367a	1.83ab	6.46ab	25.28a	962b	1420a
4 Tons	2.97a	479a	668a	1003a	7811a	1.50ab	6.46ab	26.07a	1252a	1734a
8 Tons	2.63a	470a	626a	1021a	7711a	0.83b	6.67a	25.18a	1312a	1710a
12 Tons	2.68a	473a	642a	1010a	8189a	1.22b	6.52ab	26.73a	1257a	1701a
24 Tons	2.51a	441a	621a	1036a	8433a	0.61b	6.74a	26.82a	1158ab	1549a
500 Lbs. ^{2/}	2.98a	473a	680a	1018a	8044a	2.11ab	6.38ab	27.23a	1247a	1693a
Min. LSR,LSD	0.60	47.1	68.9	110.5	2236.0	2.07	0.58	5.08	252.1	287.2
Max. LSR	0.67	52.3	76.5	122.7	2482.0	2.30	0.64	5.64	279.9	318.9
C.V. %	21.2	9.9	10.4	10.6	27.9	21.0	8.8		20.9	17.3
NITROGEN MEANS										
38+50+50 ^{3/}	2.80a	468a	650a	1012a	7795a	1.52a	6.49a	26.03a	1104b	1439c
63+50+50	2.78a	463a	645a	1020a	7790a	1.60a	6.45a	26.18a	1232a	1652b
113+50+50	2.74a	464a	650a	1027a	7862a	1.88a	6.40a	26.66a	1197a	1764a
Min. LSR,LSD	0.16	8.7	19.8	19.7	365.1	0.49	0.13	0.72	75.0	82.8
Max. LSR	0.17	9.2	20.7	20.6	382.8	0.52	0.14	0.75	78.6	86.8
C.V. %	9.2	3.0	4.8	3.1	7.4	46.9	3.2	4.3	10.1	8.1

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer N+P₂O₅+K₂O.

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

TABLE 10: SOIL TEST RESULTS IN 1970 AND EIGHT-YEAR SUMMARY OF SEED COTTON YIELDS ON PORTAGEVILLE CLAY SOIL, 1970 AND EIGHT-YEAR SUMMARY

1970 Soil Treatment	Final Soil Test Results (1970)								Eight-Year Avg. (1961-70)	
	%	Lb/A	Exchangeable Lbs/A			N.A.	pHs	C.E.C.	Seed Cotton Yield-Lb/A	
	O.M.	P ₂ O ₅	K	Mg.	Ca				1st Pick	Total
Limestone ^{1/}										
None (1)	2.27de	465d	595a-d	1010b-f	5300e	3.17ab	5.93ghi	21.40f	11251	1310i
None (2)	2.03e	490abc	630a	1010b-f	6367de	3.83a	5.67i	24.77c-f	1233h-1	1483gh
None (3)	2.57a-e	475cd	622ab	1017b-f	6600de	4.00a	6.10fgh	25.53cde	1279d-i	1587d-g
2 Tons (1)	2.80a-d	497ab	520cde	1090a	6367de	3.17ab	5.97ghi	24.30c-f	1030m	1214j
2 Tons (2)	2.90a	497ab	542b-e	1060abc	6633de	2.50bc	5.97ghi	24.20c-f	1237g-k	1488gh
2 Tons (3)	3.00a	482a-d	500e	1067ab	6467de	2.83abc	6.10fgh	24.10c-f	1266e-j	1599c-f
4 Tons (1)	2.67a-d	482a-d	527cde	1037a-d	6700de	2.17b-e	6.13e-h	23.90c-f	1178jk1	1392hi
4 Tons (2)	2.63a-d	487abc	570a-e	1037a-d	7033d	1.67c-g	6.40c-f	24.30c-f	1402abc	1676a-d
4 Tons (3)	2.63a-d	487abc	520cde	1013b-f	6433de	2.83abc	5.87hi	23.80c-f	1340b-f	1676a-d
8 Tons (1)	2.57a-e	477bcd	540b-e	973def	7133cd	0.67f-i	6.67abc	23.23ef	1311c-h	1529efg
8 Tons (2)	2.47a-e	483a-d	532cde	960ef	7500bcd	0.50ghi	6.77abc	23.97c-f	1442a	1704abc
8 Tons (3)	2.70a-d	473cd	562a-e	960ef	6700de	1.33d-h	6.50b-e	22.80ef	1431ab	1771a
12 Tons (1)	2.87ab	483a-d	540b-e	1007b-f	6933d	1.17e-i	6.47b-f	23.40def	1204i-1	1391hi
12 Tons (2)	3.00a	493abc	545a-e	1040a-d	8500bc	1.17e-i	6.53bc	27.43abc	1337b-g	1586d-g
12 Tons (3)	2.90a	487abc	570a-e	1047abc	7133cd	1.67c-g	6.40c-f	24.60c-f	1378a-d	1732ab
24 Tons (1)	2.10e	498a	505e	953f	9900a	0.00i	6.93a	29.37ab	1347a-f	1538efg
24 Tons (2)	2.30cde	500a	535b-e	977c-f	9967a	0.17hi	6.83ab	29.87a	1377a-d	1636b-e
24 Tons (3)	2.50a-e	497ab	545a-e	1000b-f	8600b	0.67f-i	6.77abc	27.03a-d	1328c-h	1621cde
^{2/} 500 Lbs. (1)	2.33b-e	490abc	607abc	1023b-e	7167cd	1.67c-g	6.47b-f	24.63c-f	1147k1	1342i
500 Lbs. (2)	2.83abc	490abc	517de	1007b-f	7100cd	1.83c-f	6.27d-g	24.43c-f	1255f-g	1511fg
500 Lbs. (3)	2.33b-e	487abc	585a-e	997c-f	7567bcd	2.50bc	6.23d-h	26.33b-e	1364a-e	1702abc
Min. LSR, LSD	0.46	17.8	75.5	57.5	1275.0	1.11	0.34	3.16	86.9	94.0
Max. LSR	0.55	21.3	90.3	68.8	1526.0	1.33	0.41	3.78	108.8	117.8
C.V. %	10.6	2.2	8.2	3.4	10.5	35.4	3.2	7.6	11.9	10.8

LIMESTONE MEANS

None	2.29a	477a	616a	1012a	6089b	3.67a	5.90d	23.90b	1212cd	1460cd
2 Tons	2.90a	492a	521a	1072a	6489b	2.83ab	6.01d	24.20b	1178d	1434d
4 Tons	2.64a	485a	539a	1029a	6722b	2.22abc	6.13cd	24.00b	1307abc	1581abc
8 Tons	2.58a	478a	544a	964a	7111b	0.83cd	6.64ab	23.33b	1395a	1668a
12 Tons	2.92a	488a	552a	1031a	7522b	1.33bcd	6.47abc	25.14ab	1306abc	1570abc
24 Tons	2.30a	498a	528a	977a	9489a	0.28d	6.84a	28.76a	1351ab	1598ab
500 Lbs. ^{2/}	2.50a	489a	569a	1009a	7278b	2.00abc	6.32bcd	25.13ab	1255bcd	1519bcd
Min. LSR,LSD	0.94	32.4	99.1	108.2	1788.0	1.57	0.42	3.89	110.2	120.6
Max. LSR	1.05	35.9	110.0	121.1	1986.0	1.74	0.46	4.31	125.7	137.5
C.V. %	35.5	6.5	17.5	10.4	24.1	81.1	6.4	15.2	25.5	23.1

NITROGEN MEANS

38+50+50 ^{3/}	2.51a	485b	548a	1013a	7071b	1.71b	6.37a	24.32a	1192b	1388c
63+50+50	2.60a	491a	553a	1013a	7586a	1.67b	6.35a	25.57a	1326a	1584b
113+50+50	2.66a	484b	558a	1014a	7071b	2.26a	6.28a	24.89a	1341a	1670a
Min. LSR,LSD	0.17	6.7	28.5	21.7	482.0	0.42	0.13	1.20	32.8	35.5
Max. LSR	0.18	7.0	29.9	22.8	505.3	0.44	0.14	1.25	34.6	37.5
C.V. %	10.6	2.2	8.2	3.4	10.5	35.4	3.2	7.6	11.9	10.8

1/ Agricultural limestone (calcium carbonate) applied April 1961.

2/ Fine lime (calcium carbonate less than 100 mesh) applied annually.

3/ Annual fertilizer $N+P_2O_5+K_2O$.

4/ Eight year summary.

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

TABLE 11: CHANGE IN SOIL TEST VALUES FROM INITIAL SOIL TEST TO FINAL SOIL TEST 1961-70
(Portageville Clay Soil - Portageville Field)

Soil Treatment ^{1/}	% O.M.	Lbs/A P ₂ O ₅	Exchangeable Lbs/A			N.A.	pHs ^{3/}	C.E.C.
			K	Mg	Ca			
<u>Limestone Summary</u>								
None	- .44	+278	+178	+121	- 442	+ .79	+ .12	+ .40
2 Tons	- .17	+249	+ 40	+197	+ 150	- .40	+ .19	+ .76
4 Tons	- .22	+257	+ 53	+156	+ 115	- .55	+ .29	+ .66
8 Tons	- .32	+239	+ 45	+ 55	+ 593	- 2.17	+ .92	- .39
12 Tons	+ .13	+268	+ 85	+189	+1018	-1.55	+ .61	+1.97
24 Tons	- .47	+250	+ 64	+130	+2995	-2.39	+ .96	+5.82
500 Lbs Fine ^{2/} Lime (Annually)	- .58	+254	+ 95	+128	+ 640	-1.00	+ .48	+1.53
<u>Nitrogen Summary</u>								
38 (lbs)	- .24	+259	+ 57	+142	+ 570	-1.22	+ .57	+ .92
63 (lbs)	- .37	+250	+127	+133	+ 934	-1.35	+ .59	+1.97
113 (lbs)	- .28	+262	+ 74	+133	+ 630	- .54	+ .37	+1.77

1/ All plots 13N+50 P₂O₅ + 50 K₂O applied annually as a starter plus additional nitrogen sidedressed. Limestone applied broadcast and plowed down after obtaining initial soil samples.

2/ Fine lime (calcium carbonate less than 100 mesh) from Ste. Genevieve banded near row annually.

3/ Refers to salt pH (pHs) as measured in 1:1 soil: 0.01M CaCl₂ suspension.

TABLE 12: EIGHT-YEAR SUMMARY OF LIMESTONE AND NITROGEN EXPERIMENT ON THE PORTAGEVILLE CLAY SOIL AT THE PORTAGEVILLE FIELD

Limestone Per Acre ^{1/}	Eight Year Average Seed Cotton Yield (Pounds Per Acre)		pHs ^{3/}		
	First Picking	Total	Initial (1961)	5 Years (1965)	10 Years (1970)
<u>Limestone Summary</u>					
None	1212 cd	1460 cd	5.8 a	6.0 d	5.9 d
2 Tons	1178 d	1434 d	5.8 a	6.4 cd	6.0 d
4 Tons	1307 abc	1581 abc	5.8 a	6.6 bc	6.1 cd
8 Tons	1395 a	1668 a	5.7 a	6.9 ab	6.6 ab
12 Tons	1306 abc	1570 abc	5.9 a	6.9 ab	6.5 abc
24 Tons	1351 ab	1598 ab	5.9 a	7.1 a	6.8 a
500 Lbs Fine Lime ^{2/}	1255 bcd	1519 bcd	5.8 a	6.5 c	6.3 bcd
Min. L.S.R. (L.S.D. .05)	110	121	0.31	0.39	0.42
Max. L.S.R.	126	138	0.34	0.44	0.46
C.V. %	25.5	23.1	5.1	5.8	6.4
<u>Nitrogen Summary</u>					
38+50+50	1192 b	1388 c	5.8 b	6.7 a	6.4 a
63+50+50	1326 a	1584 b	5.8 b	6.6 a	6.4 a
113+50+50	1341 a	1670 a	5.9 a	6.6 a	6.3 a
Min. L.S.R. (L.S.D. .05)	33	36	0.11	.08	0.13
Max. L.S.R.	35	38	0.11	.08	0.14
C.V. %	11.9	10.8	2.9	1.9	3.2

1/ Agricultural limestone (Calcium Carbonate) applied April 1961. 13 N + 50 P₂O₅ + 50 K₂O applied annually as starter plus additional nitrogen sidedressed.

2/ Fine lime (Calcium Carbonate less than 100 mesh) applied annually.

3/ Refers to salt pH (pHs) as measured in 1:1 soil: 0.01M CaCl₂ suspension.