Field Experiments with Magnesium in Alabama - Cotton, Corn, Soybeans, Peanuts

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FIELD EXPERIMENTS with MAGNESIUM in ALABAMA - Cotton, Corn, Soybeans, Peanuts

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MAGNESIUM (Mg) is one of the major, soil-supplied plant nutrients.

Only nitrogen, potassium, and usually calcium and phosphorus are required in greater amounts. Although magnesium is a major constituent of most soils, the amount "available" depends on such things as soil composition, soil pH, liming, fertilizer practices, and crop needs. Magnesium deficiency is not a widespread problem, but instances of it are reported.

Magnesium deficiency often reveals itself by leaf discoloration, such as older corn leaves with yellow streaks between their veins, or older cotton leaves that are purplish-red between green veins. Unfortunately, leaf discolorations can be caused by many other things and, therefore, are not very useful guides to the need for magnesium.

Magnesium deficiency is sometimes a clinical problem with cattle in Alabama (grass-tetany syndrome). A connection between low magnesium content of forage plants and grass tetany in cattle is suspected, but proof of the relationship is missing. The relationship, if any, appears to be complex and may involve several growth factors in both plants and animals.

Soils contain different amounts of native Mg, which is slowly released into an available form for plants. As long as the release rate of Mg by the soil equals that needed by the crop, then there is no reason to add Mg.

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The greatest likelihood for Mg deficiency is a combination of the following conditions: (a) a highly leached sandy soil, low in Mg; (b) a crop with high Mg requirements; (c) high rates of nitrogen and potassium fertilizers; (d) liming with calcitic limestone (very low Mg content).

A major shift in fertilizer practices during the 1950's is thought to have accelerated the rate at which Mg was lost from soil. For example, high rates of ammonium and potassium fertilizers cause higher yields and more Mg to be taken up by crops and more Mg to be lost by leaching. Thus, the demand for soil-supplied Mg is greater than in earlier times. This change in Mg needs sparked renewed interest in possible Mg deficiencies, and numerous field experiments with Mg have been conducted since 1957.

Auburn University's Soil Testing Laboratory started routinely testing all soil samples for available Mg in 1963. The procedure involves extracting the soil with dilute acid ($0.05N$ HCl + $0.025N$ H_2SO_4), which removes 80 to 90 percent of the exchangeable Mg, and determining Mg by atomic absorption spectrophotometry.

COTTON

A total of 45 separate field experiments have been conducted with Mg on cotton in Alabama since 1957. They have consisted of 33 experiments with fertilizer Mg (as magnesium sulfate) and 12 with Mg-containing limestone (dolomite).

Fertilizer-Magnesium Experiments

Magnesium-potassium rate experiment, 1957-62. An experiment with three rates of Mg, two rates of K, and two rates of calcitic lime was initiated in 1957 at three locations in Alabama. Half the plots were limed with calcitic limestone, and the other half remained unlimed. Cotton was planted on all plots each year. All fertilizer, except part of the nitrogen, was broadcast prior to planting. Results for the unlimed plots are not reported because of their lower yields and because Mg deficiency was not aggravated by liming.

Only the Benndale soil was deficient in Mg, according to the cotton yields listed in Table 1. Magnesium increased yields on this soil an average of 130 pounds per acre of seed cotton, a small but significant amount. The higher rate of K fertilizer increased both the yield of cotton and the response to Mg (60 vs. 300 lb./A. of K_2O). Soil-test Mg (exchangeable Mg) at the end of the experiment on Benndale soil was 19 pounds per acre.

TABLE 1. EFFECT OF RATES OF MAGNESIUM ON YIELD OF SEED COTTON ON THREE SOIL TYPES AT TWO POTASSIUM RATES, 1957-62

Mg rate[1]	Per-acre yield of seed cotton		
	Benndale sandy loam[2] 1957-58	Lucedale sandy loam[3] 1957-62	Decatur clay loam[4] 1958-62
Lb./A.	*Lb.*	*Lb.*	*Lb.*
	60-lb. K_2O rate		
0	1,570	1,710	1,600
30	1,650	1,700	1,610
120	1,680	1,750	1,710
	300-lb. K_2O rate		
0	1,720	1,780	1,690
30	1,850	1,830	1,680
120	1,910	1,800	1,710
Av. yield increase for Mg	130*	NS[5]	NS[5]
	Soil test value at end of experiment		
Mg, lb./a.	19	38	139
Soil pH	6.0	6.1	6.4

* Yield increase significant at 0.05 probability level.
[1] Basic fertlizer rate to all plots was 500 lb. of 4-12-12 broadcast and 60 lb. N sidedressed as ammonium nitrate. Magnesium sulfate was broadcast annually prior to planting.
[2] Brewton Experiment Field.
[3] Monroeville Experiment Field.
[4] Alexandria Experiment Field.
[5] Yields were not statistically different.

The Lucedale and Decatur soils were not deficient in Mg. They had 38 and 139 pounds per acre of soil-test Mg, respectively. The high rate of K fertilizer did not increase yield over the 60-pound rate.

Magnesium rate experiment, 1960-1971. An experiment with four rates of Mg in a 2-year rotation of cotton and corn was started in 1960 at two locations in the State. Half the plots were limed with calcitic lime to about pH 6.0; the other half remained unlimed.

Two other experiments with four rates of Mg on continuous cotton were started in 1966 on the Agronomy Farm at Auburn. One of these (on Dothan loamy sand) had half the plots limed to pH 6.0 and the other half remained unlimed. The other experiment was on limed Marvyn sandy loam. Only results for the limed plots are given in Table 2.

The experiment on the Benndale sandy loam near Brewton was divided into two periods, 1960-66 and 1967-71, because yield response to Mg was different during these periods. When the ex-

TABLE 2. EFFECT OF RATES OF MAGNESIUM SULFATE ON YIELD OF SEED COTTON ON FOUR SOIL TYPES, 1960-71

Mg rate[1]	Per-acre yield of seed cotton				
	Benndale sandy loam[2]		Marvyn sandy loam[3]	Hartsells fine sandy loam[4]	Dothan loamy sand[3]
Lb./A.	1960-66	1967-71	1966-69	1960-66	1966-69
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
60-lb. K_2O rate					
0	1,930	2,270	1,970	2,590	1,830
10	1,960	2,310	2,250	2,740	1,830
20	1,880	2,380	2,300	2,770	1,880
40	2,020	2,480	2,280	2,800	1,810
Av. yield increase for Mg	NS[3]	120*	310**	180**	NS[5]
300-lb. K_2O rate					
0	1,460	1,520	-------	2,190	1,950
40	1,850	2,100	-------	2,600	1,970
Yield increase for Mg	390*	580**	-------	410**	NS[5]
Soil test value at end of experiment					
Mg, lb./a.	-------	19	20	21	25
Soil pH	-------	5.8	6.1	5.8	6.0

* Yield increase significant at 0.05 probability level.
** Yield increase significant at 0.01 probability level.
[1] N-P-K added annually according to soil-test recommendations.
[2] Brewton Experiment Field.
[3] Auburn Agronomy Farm.
[4] Sand Mountain Substation.
[5] Yields were not statistically different.

periment started, soil-test Mg was about 25 pounds per acre, and cotton yields were unaffected by the Mg fertilizer (1960-66). After 1966, however, available Mg had decreased to an average of 19 pounds per acre, and the average seed-cotton yield was increased 120 pounds per acre for all three Mg rates.

There were also yield increases for Mg fertilizer on two of the other experiments. Seed-cotton yields were increased an average 310 pounds per acre on the Marvyn soil at Auburn (soil-test Mg = 21 lb./A.) and an average 180 pounds on the Hartsells soil of Sand Mountain (soil-test Mg = 21 lb./A.) for all three rates of Mg. Magnesium had no effect on yield on Dothan loamy sand at Auburn (soil-test Mg = 25 lb./A.).

The high rate of broadcast potassium fertilizer (300 lb./A. of K_2O) reduced seed-cotton yields by 750 and 400 pounds per acre on the Benndale and Hartsells soils, respectively, Table 2. Adding Mg at 40 pounds per acre prevented most of the yield loss caused by the high K rate. In contrast, yields were increased slightly by the high K rate on the Dothan loamy sand, where Mg was not deficient.

These data illustrate how too much of one fertilizer nutrient can aggravate the deficiency of another. The high rate of potassium was detrimental on soils that were deficient in Mg (Benndale and Hartsells) but was not detrimental on soil with adequate Mg (Dothan).

Magnesium experiments on farmers' fields, 1965-71. The need for an improved soil testing program for Mg led to the establishment of numerous experiments on farmers' fields from 1965 to 1971. They were simple experiments, with two treatments and four replications. Magnesium sulfate was topdressed over the row soon after seedlings had emerged to a stand at a rate of 25 pounds of Mg per acre. Otherwise, the plots were handled by the farmer as a part of a larger field. Twenty-six of these cooperative experiments were harvested, Table 3.

The biggest yield response to Mg fertilizer was on Sand Mountain, typified by the Hartsells and Albertville sandy loams. Of the 14 experiments on these soil types, six responded to Mg. The maximum response was 450 pounds of seed cotton per acre on a soil with 25 pounds per acre of soil-test Mg (Green farm, Jackson County, 1966). Soil-test Mg ranged between 21 and 90 pounds per acre. The highest value for which fertilizer Mg caused a yield increase was 42 pounds per acre (Tinker farm, Jackson County, 1970). The lowest value at which there was no response to Mg was 36 (Jones farm, DeKalb County, 1970), possibly because of its low pH. For the soils of the Sand Mountain area, the dividing line between enough soil Mg and a deficiency of it appears to be about 40 pounds per acre of soil-test Mg.

Two of the other five experiments on sandy loam soils in the State with soil-test Mg values below 30 pounds per acre showed a yield response to Mg. Seed-cotton yields were increased about 200 pounds per acre, and each had a soil-test Mg value of about 20 pounds per acre.

The data in tables 1, 2, and 3 show that the dividing line between enough Mg and a deficiency of it on sandy Coastal Plains soils (central and southern Alabama) is about 25 pounds per acre of soil-test Mg.

A few cooperative experiments were conducted on silt loam soils of northern Alabama. In general, these soils have a higher level of Mg than sandy soils. Only one showed a yield response

TABLE 3. EFFECT OF 25 POUNDS PER ACRE OF Mg AS MAGNESIUM SULFATE ON YIELD OF SEED COTTON ON FARMERS' FIELDS IN ALABAMA, 1966-71

County	Farmer	Year	Soil pH	Soil-test Mg	Per-acre yield of cotton: Without Mg	With Mg	Increase for Mg
				Lb./A.	*Lb.*	*Lb.*	*Lb.*
	Hartsells-Albertville sandy loams						
Jackson	K. Green	1966	6.0	25	1,190	1,640	450*
Jackson	J. M. Presley	1969	5.5	25	1,530	1,970	440**
Jackson	B. T. Tinker	1970	5.7	42	1,740	2,100	360**
Jackson	B. T. Tinker	1970	5.8	25	1,900	2,240	340**
Cherokee	N. C. Davis	1970	4.6	30	1,090	1,390	300*
Marshall	R. Mason	1971	5.2	21	1,110	1,330	220***
DeKalb	B. R. Jones	1970	5.1	36	1,670	1,850	NS[1]
DeKalb	H. Raines	1969	5.7	57	1,610	1,630	NS
Morgan	S. Moore	1969	6.6	60	1,230	1,200	NS
Cherokee	C. Stubbs	1970	6.0	78	1,900	1,850	NS
Cherokee	G. Abernathy	1969	6.6	84	2,480	2,360	NS
Jackson	B. T. Tinker	1971	6.6	72	2,550	2,400	NS
Morgan	O. Z. Davis	1970	6.7	90	2,330	2,170	NS
Cherokee	N. C. Davis	1970	5.0	48	2,270	2,080	NS
	Dothan-Ruston sandy loams						
Sumter	W. C. McDonald	1965	5.6	20	1,950	2,200	250*
Houston	L. Scott	1965	5.3	12	780	870	NS
	Holston-McQueen sandy loams						
Cherokee	R. Sentell	1969	5.3	30	1,670	1,640	NS
Cherokee	J. F. Ray	1971	5.1	28	2,960	2,930	NS
	Abernathy sandy loam						
Colbert	D. T. Brumler	1966	6.1	20	1,310	1,540	230**
	Dewey-Decatur silt loam						
Lauderdale	W. King	1969	5.6	84	920	910	NS
	Dickson-Fullerton silt loams						
Lauderdale	W. V. McDougal	1966	5.4	25	1,070	1,260	190***
Lauderdale	A. Bailey	1970	6.8	90	2,310	2,500	NS
Limestone	R. Malone	1970	5.0	60	1,160	1,300	NS
Lauderdale	A. Newton	1971	5.1	40	2,450	2,510	NS
Lauderdale	A. Bailey	1970	6.8	90	2,580	2,620	NS
Limestone	K. L. Looney	1969	6.4	72	1,690	1,710	NS

*** Yield response was significant at 0.01 probability level.
** Yield response was significant at 0.05 probability level.
* Yield response was significant at 0.10 probability level.
[1] Yields were not statistically different.

to Mg (McDougal farm, Lauderdale County, 1966), and it had only 25 pounds per acre of soil-test Mg. Soil-test Mg values for the others ranged between 40 and 90 pounds per acre. From these few experiments, it seems that soil-test Mg must be less than 40 or 50 pounds per acre before Mg is likely to be deficient on these silt loams.

Dolomitic versus Calcitic Limestone

The most economical method of adding Mg to acid soils in Alabama is through dolomitic limestone. Alabama has vast deposits of this high-grade limestone, containing more than 10 percent Mg. Each ton of such dolomitic limestone contains at least 200 pounds of Mg. In contrast, most calcitic limestone in Alabama contains less than 1 percent Mg, or less than 20 pounds per ton.

Experiments comparing dolomitic and calcitic limestones for cotton were established as early as 1930 by the Alabama Agricultural Experiment Station. However, none of these early experiments showed any yield advantage for the Mg-containing dolomite (unpublished data).

The change to ammonium fertilizers and the adoption of higher N and K rates during the 1950's accelerated the removal of soil Mg by crops and by leaching. New liming experiments were thus initiated in 1957 to determine if the use of dolomitic limestone was necessary to prevent the occurrence of Mg deficiency.

Lime rate experiments, 1957-1973. Five locations were chosen, representing a wide range in soil-test Mg levels. Only selected yields of the experimental results are reported here, i.e., only the comparison between dolomitic and calcitic limestones, Table 4. The results show that Mg-containing dolomite was slightly superior in two experiments. In both cases, initial soil-test Mg was about 25 pounds per acre. Because the calcitic limestone contained 0.2 to 0.6 percent Mg, the final soil-test Mg equalled or exceeded the initial Mg level, Table 4.

The average yield increase for Mg-containing dolomite was 170 pounds per acre of seed cotton on Hartsells fine sandy loam and 120 pounds on Lucedale sandy loam near Monroeville. The high potassium rate (220 lb./A. of K_2O) may have been partially responsible for the response on the Lucedale soil. However, recommended K rates (60 lb./A. of K_2O) were used in the experiment on the Hartsells soil.

Two-year rotation, 1959-1967. A 2-year rotation of cotton and corn, consisting of 17 treatments, had one treatment in which soil pH was maintained near 6.0 with dolomitic limestone and another maintained with calcitic limestone. The experiment was located at seven different sites, representing the major row-cropping areas of the State.

The results in Table 5 show that soil-test Mg ranged from a

TABLE 4. THE EFFECT OF LIME SOURCE (DOLOMITIC VERSUS CALCITIC) ON YIELD OF SEED COTTON

Lime rate	N rate	Final soil-test values		Per-acre yield of cotton		
		pH	Mg	Calcitic lime	Dolomitic lime	Increase for dolomitic
Ton/A.	*Lb./A.*		*Lb./A.*	*Lb.*	*Lb.*	*Lb.*
Benndale sandy loam, Brewton Experiment Field, 1957-61[1]						
1	60	5.9	28	1,740	1,810	
1	240	5.6	27	1,870	1,770	
4	240	6.3	32	1,700	1,910	
	Average		**29**	**1,770**	**1,830**	**60***
Hartsells fine sandy loam, Sand Mountain Substation, 1970-72[2]						
2	100	6.0	42	2,390	2,520	
2	200	5.4	22	2,390	2,550	
4	100	6.6	65	2,140	2,270	
4	200	6.3	46	2,160	2,420	
	Average		**44**	**2,270**	**2,440**	**170****
Lucedale sandy loam, Monroeville Experiment Field, 1957-61[1]						
1	60	5.7	39	1,780	1,850	
1	240	5.5	27	1,610	1,710	
4	240	6.2	34	1,760	1,940	
	Average		**33**	**1,720**	**1,830**	**110*****
Lucedale sandy clay loam, Prattville Experiment Field, 1958-64[1]						
1	60	5.9	500	1,990	1,960	
1	240	5.5	350	2,030	2,030	
4	240	6.4	420	2,010	2,090	
	Average		**420**	**2,010**	**2,030**	NS[4]
Decatur clay loam, Tennessee Valley Substation, 1966-73[3]						
1	90	6.1	128	2,540	2,590	
4	90	6.6	132	2,550	2,530	
	Average		**130**	**2,550**	**2,560**	NS[4]

[1] Annual rate of P_2O_5-K_2O = 120-220.
[2] Annual rate of P_2O_5-K_2O = 60-60.
[3] Annual rate of P_2O_5-K_2O = 100-80.
* Yield increase of dolomitic over calcitic was significant at 0.10 probability level.
** Yield increase of dolomitic over calcitic was significant at 0.05 probability level.
*** Yield increase of dolomitic over calcitic was significant at 0.01 probability level.
[4] Yields were not statistically different.

low of 11 pounds per acre to a high of 135 pounds per acre. In all cases, the lime sources were equal in their effects on cotton yields. There was no yield advantage for the Mg-containing dolomite.

Liming acid soils is an essential practice for most Alabama cotton growers. These experiments have shown that the source of lime is not important on many soils. Magnesium-containing dolomitic lime is needed only on soils with "low" available Mg. Calcitic lime is equally good on other soils.

TABLE 5. THE EFFECT OF LIME SOURCE (DOLOMITIC VERSUS CALCITIC) ON YIELD OF SEED COTTON IN A 2-YEAR ROTATION WITH CORN, 1959-67[1]

Location	Soil type	Final soil-test Mg	Per-acre yield of cotton	
			Calcitic lime	Dolomitic lime
		Lb./A.	*Lb.*	*Lb.*
Brewton Exp. Field	Benndale sandy loam	11	2,120	2,210
Wiregrass Substation	Dothan sandy loam	21	2,560	2,400
Monroeville Exp. Field	Lucedale sandy loam	62	2,050	2,170
Prattville Exp. Field	Lucedale sandy loam	85	2,400	2,390
Sand Mt. Substation	Hartsells fine sandy loam	30	2,520	2,610
Alexandria Exp. Field	Decatur clay loam	135	2,260	2,210
Tenn. Valley Substation	Decatur clay loam	135	2,550	2,400

[1] N-P_2O_5-K_2O added at recommended rates.

CORN

Corn occupies significant acreage in Alabama, and field experiments were designed to establish whether Mg should be added to the soil to produce maximum yields. Corn is somewhat deceptive in its Mg needs because it tends to exhibit leaf symptoms of Mg deficiency without a corresponding loss in yield.

Magnesium rate experiment, 1960-71. An experiment with four rates of Mg and two lime levels was initiated in 1960 on a 2-year

TABLE 6. EFFECT OF RATES OF MAGNESIUM SULFATE ON YIELD OF CORN GROWN IN ROTATION WITH COTTON ON TWO SOIL TYPES, 1960-71 (SEE TABLE 2 FOR RESULTS WITH COTTON)

Mg rate[1]	Per-acre yield of corn	
	Benndale[2] sandy loam 1960-71	Hartsells[3] fine sandy loam 1960-66
Lb./A.	*Bu.*	*Bu.*
0	71	100
10	68	104
20	68	101
40	70	101
	Final soil-test values	
Mg, lb./a.	19	21
pH	5.8	5.8

[1] N-P_2O_5-K_2O rate = 100-60-80.
[2] Brewton Experiment Field, Brewton, Alabama.
[3] Sand Mountain Substation, Crossville, Alabama.

rotation of corn and cotton on Benndale sandy loam (Brewton Experiment Field) and Hartsells fine sandy loam (Sand Mountain Substation). The experiment continued for 7 years on the Hartsells soil and for 12 years on the Benndale soil. The yields of the limed plots showed that Mg had no effect on corn yields at either location, Table 6. These are the same plots on which yield of cotton in the rotation was increased by Mg fertilizer, see Table 2. Soil-test Mg was about 20 pounds per acre at each location.

Dolomitic versus calcitic limestone, 1962-1969. Four liming experiments were conducted with corn during the 1960's in which dolomitic and calcitic limestones were compared. Only that portion of each experiment that compares the effect of Mg in the lime is reported here, Table 7.

The average soil-test Mg values (of plots receiving calcite) ranged from a low of 18 pounds per acre on Benndale sandy loam to a high of 420 on Lucedale sandy clay loam. Yields were not affected by lime source, i.e., yields were as high on plots limed with calcitic limestone as on plots limed with dolomite. Three

TABLE 7. THE EFFECT OF LIME SOURCE (DOLOMITIC VERSUS CALCITIC) ON YIELD OF CORN, 1962-1969[1]

Lime application		Final soil-test values		Per-acre yield of corn	
Rate	Year	pH	Mg	Calcitic lime	Dolomitic lime
Ton/A.			*Lb./A.*	*Bu.*	*Bu.*
Benndale sandy loam, Brewton Experiment Field, 1962-66					
1	1957	5.7	15	67	69
1	1957	5.4	18	65	64
4	1957	5.8	22	72	72
	Average		**18**	**68**	**68**
Lucedale sandy loam, Monroeville Experiment Field, 1962-66					
1	1957	5.3	38	66	65
1	1957	5.1	14	59	54
4	1957	5.5	28	63	66
	Average		**27**	**63**	**62**
Lucedale sandy clay loam, Prattville Experiment Field, 1967-69					
1	1958	6.0	500	81	79
1	1958	5.5	350	85	77
4	1958	5.9	420	85	89
	Average		**420**	**84**	**82**
Malbis sandy loam, Gulf Coast Substation, 1966-69					
1	1966	5.3	116	67	72
4	1966	6.2	77	74	76
8	1966	6.8	88	77	73
	Average		**94**	**73**	**74**

[1] Fertilized as recommended by Auburn's Soil Testing Laboratory.

TABLE 8. THE EFFECT OF LIME SOURCE (DOLOMITIC VERSUS CALCITIC) ON YIELD OF CORN IN A 2-YEAR ROTATION WITH COTTON, 1959-67[1]

Location	Soil type	Final soil-test Mg	Per-acre corn yield	
			Calcitic lime	Dolomitic lime
		Lb./A.	*Bu.*	*Bu.*
Brewton Exp. Field	Benndale sandy loam	11	74	69
Wiregrass Substation	Dothan sandy loam	21	62	61
Monroeville Exp. Field	Lucedale sandy loam	62	71	72
Prattville Exp. Field	Lucedale sandy loam	85	91	89
Sand Mountain Substation	Hartsells fine sandy loam	30	104	102
Alexandria Exp. Field	Decatur clay loam	135	94	89
Tenn. Valley Substation	Decatur clay loam	135	82	79

[1] N-P_2O_5-K_2O added at recommended rates.

of these experiments were limed initially for a cotton experiment, see Table 4 for results with cotton. Two of those showed a slight increase in cotton yield in favor of dolomite.

Two-year rotation, 1959-1967. A 2-year rotation of cotton and corn in which one treatment maintained soil pH near 6.0 with dolomitic lime and another with calcitic lime showed no differences in yield of corn at any of the seven locations, Table 8. Soil-test Mg ranged between 11 and 135 pounds per acre, but in no case was it deficient for corn.

The data in Tables 6, 7, and 8 show that adding Mg had no effect on corn yields, not even on soils that were quite low in Mg and slightly deficient in Mg for cotton. It appears that soil-test Mg must be very low before corn can be expected to respond to Mg, whether as lime or as fertilizer.

SOYBEANS

Soybeans became a major crop in Alabama during the 1960's. Because it is a legume, as well as an oil crop, it has been considered to be more susceptible to Mg deficiency than many other crops grown in the State. However, only recently have field experiments been conducted in Alabama to determine if Mg needs to be added to soils for maximum soybean yields.

Magnesium rate experiment, 1963-66. At the conclusion of a 5-year experiment with Mg rates on continuous cotton at the

TABLE 9. EFFECT OF RATES OF MAGNESIUM SULFATE BROADCAST ANNUALLY ON YIELD OF SOYBEANS FOLLOWING 6 YEARS OF CONTINUOUS COTTON ON LUCEDALE SANDY LOAM, MONROEVILLE EXPERIMENT FIELD, 1963-66 (SEE TABLE 1 FOR COTTON DATA)

Mg rate[1]	Final soil-test values		Per-acre yield[2]
	pH	Mg	
Lb./A.		*Lb./A.*	*Bu.*
0	6.0	31	17.9
30	6.0	54	18.2
120	6.0	100	17.5

[1] Limed with calcitic limestone in 1963. Annual fertilizer rate was 0-60-60.
[2] Average of eight plots.

Monroeville Experiment Field, see Table 1 for cotton data, the appropriate plots were relimed with calcitic limestone, and the experiment planted to soybeans.

Only yields from limed plots are reported, Table 9. The data show no yield response to Mg on this Lucedale sandy loam, which had a soil-test Mg value of 31 pounds per acre. However, neither did the preceding cotton crop show a need for Mg.

Dolomitic versus calcitic limestone, 1967-74. Five experiments with lime rates have been conducted with soybeans since 1967. In each case, a comparison of dolomitic and calcitic limestone was also made at two or three lime rates.

Soybean yields were increased by the Mg in dolomite in only one of the experiments, Table 10. A 2-bushel yield increase was obtained in favor of dolomitic limestone on Benndale sandy loam that was low in available Mg. Although the yield increase was small, it was significant.

Cotton was an earlier crop on all these plots, except on the Malbis soil. Three of those (Brewton, Monroeville, and Sand Mountain Substation) had shown cotton-yield increases for dolomite over calcite. With soybeans, however, a difference could be measured in only one experiment.

The results of seven other field experiments in Alabama were recently reported in which dolomitic and calcitic limestone were compared as lime sources for soybeans. The report showed yield advantages for dolomite in two of the experiments. Both were on soils with low soil-test Mg levels—Benndale sandy loam at the Brewton Experiment Field and Hartsells fine sandy loam at the Sand Mountain Substation. See Auburn University Agricultural Experiment Station Bulletin 452 (1973) for details.

TABLE 10. EFFECT OF LIME SOURCE (DOLOMITIC VERSUS CALCITIC) ON YIELD OF SOYBEANS[1]

Lime application		Final soil-test values		Per-acre yield of soybeans		
Rate	Date	pH	Mg	Calcitic lime	Dolomitic lime	Increase for dolomite
Ton/A.			*Lb./A.*	*Bu.*	*Bu.*	*Bu.*
Benndale sandy loam, Brewton Experiment Field, 1967-69						
1	1957	5.4	34	31.4	33.8	
1	1957	5.2	21	29.5	31.2	
4	1957	5.5	36	33.2	35.3	
		Average		**31.4**	**33.4**	**2.0****
Lucedale sandy loam, Monroeville Experiment Field, 1967-69						
1	1957	5.3	50	32.0	31.6	
1	1957	5.1	22	25.0	28.8	
4	1957	5.4	48	32.3	30.1	
		Average		**29.8**	**30.2**	NS[2]
Lucedale sandy clay loam, Prattville Experiment Field, 1970-74						
1	1958	5.7	96	26.0	27.0	
1	1958	5.5	84	27.5	25.8	
4	1958	5.8	88	28.1	26.6	
		Average		**27.2**	**26.5**	NS[2]
Malbis sandy loam, Gulf Coast Substation, 1970-72						
1	1966	5.5	120	44.4	46.2	
4	1966	6.0	83	44.6	45.1	
8	1966	6.7	94	45.7	45.6	
		Average		**44.9**	**45.6**	NS[2]
Hartsells fine sandy loam, Sand Mountain Substation, 1973-74						
2	1970	6.3	42	30.2	34.4	
2	1970	5.8	22	30.6	31.6	
4	1970	6.5	65	32.6	33.7	
4	1970	6.2	46	32.6	33.2	
		Average		**31.5**	**33.2**	NS[2]

** Yield increase of dolomitic over calcitic was significant at 0.01 probability level.
[1] Fertilized at rates recommended by Auburn's Soil Testing Laboratory.
[2] Yields were not statistically different.

Soybeans, like corn, tend to show visual symptoms of Mg deficiency on leaves without a corresponding loss in bean yield. These experiments showed that Mg should sometimes be added for soybeans, but that soybeans do not require as high a level of available soil Mg as cotton.

PEANUTS

Unless dolomitic limestone has been added in the recent past, the sandy soils of southeastern Alabama tend to be low in available Mg. However, there have been no reported instances of Mg deficiency on peanuts in the area. This may be because peanuts

TABLE 11. EFFECT OF MAGNESIUM SULFATE ON YIELD OF PEANUTS ON FARMERS' FIELDS IN SOUTHEASTERN ALABAMA

County	Farmer	Year	Soil-test values		Per-acre yield of peanuts	
			pH	Mg	No Mg	Added Mg
				Lb./A.	*Lb.*	*Lb.*
Coffee	B. Deloney	1974	5.1	7	2,310	2,340
Bullock	J. R. Mitchell	1967	5.7	18	2,860	2,740
Bullock	B. East	1967	5.9	42	2,750	2,850
Henry	J. Hardwick	1968	5.8	54	1,590	1,660

have unusually low Mg requirements or because too few field experiments have been conducted in the area.

Four experiments with Mg on peanuts have been conducted recently on farmers' fields in the Wiregrass area. Available Mg ranged from a low of 7 pounds per acre to a high of 54 pounds per acre, Table 11. Magnesium sulfate was top-dressed in the row at the rate of 25 pounds per acre of Mg soon after seedlings had emerged to a stand.

Peanut yields were not affected by Mg in any experiment, not even at the unusually low level of 7 pounds per acre of soil-test Mg. Although these preliminary results suggest that peanuts need not be fertilized directly with Mg, more experiments are needed before a definite conclusion can be reached. The data do show, however, that peanuts can thrive at a lower soil-Mg level than cotton.

SUMMARY

Field experiments since 1957 with magnesium sulfate and magnesium-containing dolomitic limestone have totaled 45 with cotton, 13 with corn, 13 with soybeans, and 4 with peanuts.

The number one soil fertility problem in Alabama is low soil pH. The need for lime is widespread, and its use exceeds 1 million tons annually in Alabama.

The primary reason for liming is to neutralize soil acidity (raise soil pH). A secondary reason is to supply Ca and Mg, **if a soil is low in either.**

Alabama has abundant sources of liming materials, some containing more than 10 percent Mg and some containing only traces of Mg.

Magnesium (Mg) is a major constituent of soils and a major plant nutrient. The amount of Mg that crops need varies. The amount of Mg in soils varies.

Cotton responded to magnesium (Mg) as magnesium sulfate or as dolomitic limestone on sandy soils with low values of available Mg. Seed-cotton yields were generally increased about 200 pounds per acre on Mg-deficient soils. Soybean yields were increased 2 bushels or less.

Neither corn nor peanuts responded to magnesium (Mg) in any experiment.

Most soils in Alabama are not deficient in magnesium. On soils containing adequate Mg, calcitic lime and dolomitic lime are equally good for raising soil pH and increasing yields.

The results of the experiments reported in this bulletin show that soil magnesium is adequate if soil-test Mg is 25 pounds per acre or more on sandy Coastal Plains soils. Other soils in Alabama are adequate in available magnesium if soil-test Mg is 50 pounds per acre or more.

The amount and kind of lime needed for crops in Alabama can be determined only by a reliable soil test. Unless dolomitic limestone is specifically recommended by Auburn's Soil Testing Laboratory, calcitic limestone is just as good.

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Special recognition is given to the work of J. G. Link, Extension Agronomist, and S. M. Eich, Extension Cotton Specialist, for making the experiments on farmers' fields possible and for collecting yield data from them.

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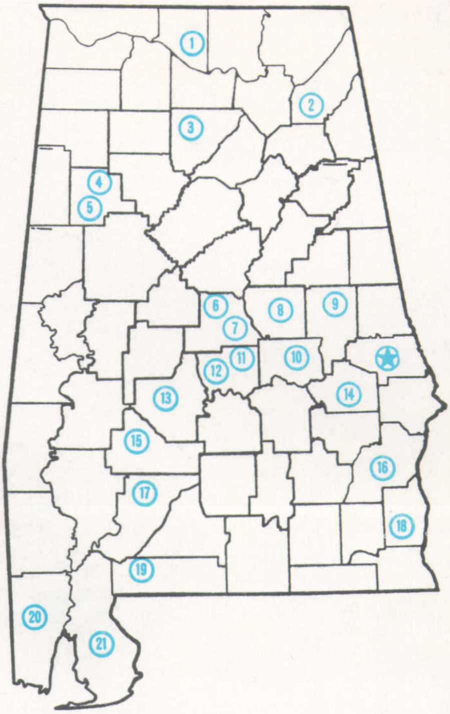
With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.