SULFUR NUTRITION FOR COTTON IN THE SOUTHEAST

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Introduction

The current University of Georgia (UGA) extension recommendation for sulfur (S) fertilization of cotton is 10 lb S/a. Recent research conducted by Dr. Greg Mullins on Coastal Plain soils in Alabama showed that a cotton yield response could be obtained up to 20 lb S/a. This same research indicated that timing of application was not entirely critical, i.e. sulfur could be applied at preplant or with sidedress nitrogen (between first square and first bloom).

Objectives

The objectives of this research are to determine the optimum S application rate, timing and source for high-yielding cotton in Georgia.

Materials and Methods

Research was conducted at two locations in Georgia in 2003: 1) the Sunbelt Expo site in Moultrie which is center pivot irrigated an on a Dothan loamy sand and 2) the UGA Southeast Experiment Station in Midville on a Fuquay sand; and two different locations both located near Tifton in 2004: 3) a center-pivot irrigated site on a Tifton loamy sand and 4) a dryland location on a Tifton loamy sand. Both sites each year were limed and fertilized with P and K according to soil test results. Cotton (DP 555 B/RR was planted the first week of May at all sites except Midville in 2003 where planting was delayed until the first week of June due to wet weather. The experimental treatments at all site-years were:

1) 0 S/a
2) 10 lb S/A using AS at planting
3) 20 lb S/A using AS at planting
4) 30 lb S/A using AS at planting
5) 20 lb S/A using 5-10-15 at planting
6) 10 lb S/A using AS at sidedressing
7) 20 lb S/A using AS at sidedressing
8) 30 lb S/A using AS at sidedressing
9) 20 lb S/A using ammonium thiosulfate at sidedressing,

All plots received the equivalent of 26 lb nitrogen (N) /A at planting. Any N not provided by the ammonium sulfate treatments at planting was made up with ammonium nitrate. Sidedressing S treatments (6-9) were made using an 8-0-0-9(S) liquid made with AS and urea-ammonium nitrate (UAN) solution. The balance of N on these treatments was made up by using 32 % UAN. All treatments were applied by hand to plots measuring 4

rows wide (38 inch row spacing) by 40 feet long.

The cotton in all plots was managed in regards to weed control, insect control, growth regulation, etc. according to UGA Extension recommendations. The experimental design was a randomized complete block with 4 replications. Leaf tissue samples were taken from all plots just prior to sidedress and again at approximately 4th week of bloom (except at Midville in 2003, sidedress time only). All plots were machine harvested in the Fall and weighed for yield. Lint percentage or turnout was estimated at 40 % for all plots.

Results and Discussion

Sunbelt Expo/Irrigated/2003: There were no statistical yield differences between sulfur treatments at the Sunbelt Expo in 2003 where yields averaged 1230 lb lint/a (Table 1). The general trend numerically was higher yield with increasing S rates for either at-planting or sidedress applications. Yields were similar between at-planting and sidedress application timing when the same rates were compared. Ammonium sulfate appeared to increase yield compared to the 5-10-15 treatment when both were applied at 20 lb S/A at planting. There did not appear to be any difference in yield between ammonium sulfate and ammonium thiosulfate treatments (20 lb/A S level) applied at sidedress.

Leaf tissue S on June 27 showed a statistical increase with increasing rate of S applied at planting. Leaf tissue S was also greater for all rates above the 0 lb S/A treatment. The leaf tissue S of the 0 lb S/a treatment was 0.71 which is on the upper side of the reported sufficiency range of 0.25 to 0.8 %. This explains the lack of yield response. Some possible explanations for this result include scavenging of S by deep cotton roots from the S accumulated in subsoil, S mineralized from organic matter and/or S from atmospheric deposition. Of these 3 sources, S accumulated in subsoil is thought to be the main factor. The later tissue sampling on August 23 however showed lower S concentrations compared to the earlier sampling as expected due to increasing plant biomass. The leaf tissue S was very similar between the 10, 20 and 30 lb S/A rates which were only slightly higher than the 0 lb S/A rate.

Table 1. Effect of sulfur rate, timing and source on cotton yield and leaf tissue S concentration: Sunbelt Expo/Irrigated/2003.

Treatment	Yield (lb/a)	Tissue S (%)	
		27-June	23-August
1	1269	0.71 a	0.57
2	1216	0.91 ab	0.66
3	1332	1.05 b	0.66
4	1227	1.20 c	0.71
5	1098	1.08 d	0.66
6	1285	0.68 d	0.66
7	1156	0.74 d	0.61
8	1304	0.63 d	0.66
9	1185	0.73 d	0.64
Stat Signif	NS	0.0000	NS
CV (%)	17	10	17
EMS		0.008	
LSD (0.05)		0.1305	

Midville/Dryland/2003: Planting at the dryland site in Midville was delayed in 2003 from early May to early June due to wet weather. The experiment then received above average rainfall during the growing season, especially during the month of June. As a result of excessive rain, cotton yields were well below normal yield potential averaging 601 lb/A lint (Table 2). Numerically, there appeared to be increasing yields with increasing S rates for both application times. The 5-10-15 at planting and ATS at sidedress treatments appeared to out yield the corresponding AS treatments.

Leaf tissue S on July 9 showed a statistical increase with increasing rate of S applied at planting. Leaf tissue S for the at planting rates were also greater for all rates above the 0 lb S/A treatment. The leaf tissue S of the 0 lb S/A treatment was 0.80 which is on the upper side of the reported sufficiency range and explains the lack of yield response. The leaf tissue S treatments for the S sidedressing treatments were all similar as expected since sidedressing had not occurred yet.

Table 2. Effect of sulfur rate, timing and source on cotton yield and leaf tissue S concentration: Midville/Dryland/2003.

Treatment	Yield (lb/a)	Tissue S (%)
		9-July
1	578	0.80 cd
2	633	0.92 bc
3	542	1.10 ab
4	738	1.16 a
5	607	0.96 bc
6	556	0.64 d
7	576	0.63 d
8	582	0.64 d
9	600	0.61 d
Stat Signif	0.29	0.0000
CV (%)	16	16
LSD (0.05)		0.1903

Tifton/Irrigated/2004: There were no statistical differences in yield between S rate, timing or source at the Tifton location in 2004 where yields averaged 1508 lb lint/A (Table 3). There were also no clear numerical trends for yield. There were no statistically significant differences in leaf tissue S for S rate, timing or source at either sampling periods. The leaf tissue S levels for the 0 lb S/A rate leaf tissue were in the sufficiency range explaining the lack of yield response once again. Unlike at both locations in 2003, the leaf tissue S concentrations for the later sampling were higher than the earlier sampling.

Table 3. Effect of sulfur rate, timing and source on cotton yield and leaf tissue S concentration: Tifton/Irrigated/2004.

Treatment	Yield (lb/A)	Tissue S (%)	
		17-June	9-August
1	1477	0.56	1.07
2	1503	0.62	1.00
3	1523	0.64	1.05
4	1492	0.67	1.23
5	1495	0.63	0.98
6	1530	0.55	1.00
7	1519	0.55	1.06
8	1570	0.57	0.94
9	1464	0.60	0.96
Stat Signif	NS	0.0742	0.3857
CV (%)	5	10	11
LSD (0.05)			

Tifton/Dryland/2004: Yield and tissue results for this site were similar to the irrigated site, i.e. no significant differences in yield or leaf tissue S for different s rates, timing of

application or sources. Yields averaged 1766 lb lint/A which was even higher than the irrigated site. The reason for this could be the previous crop at the dryland site was 30 years of pearl millet creating positive rotation effect. Leaf tissue S concentrations were higher at the earlier sampling compared to the late sampling as was observed at both sites in 2003. And once again, the leaf tissue S of the 0 lb S/A rate was in the sufficiency range which explains the lack of yield response.

Table 4. Effect of sulfur rate, timing and source on cotton yield and leaf tissue S concentration: Tifton/Dryland/2004.

Treatment	Yield (lb/a)	Tissue S (%)	
		17-June	10-August
1	1753	1.06	0.56 cd
2	1831	1.09	0.62 bc
3	1774	1.15	0.65 b
4	1726	1.27	0.72 a
5	1684	1.27	0.68 ab
6	1729	1.22	0.56 cd
7	1780	1.14	0.54 d
8	1808	1.31	0.58 cd
9	1816	1.08	0.54 d
Stat Signif	0.0789	0.1591	0.0000
CV (%)	4	10	7
EMS			0.002
LSD (0.05)			0.065

Conclusions

Results from this study indicate that the current UGA recommendation of 10 lb S/A is sufficient for making high-yield cotton on Coastal Plain soils in the Southeast. Apparently there is enough additional S from atmospheric deposition, from mineralized organic matter and/or from accumulation in the subsoil to fulfill the S requirement of even high-yield cotton on these soils in this geographic region.

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