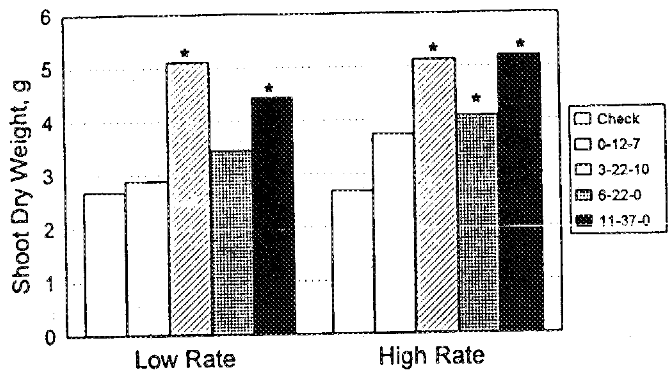

Figure 1. Effect of starter fertilizer composition and rate on cotton shoot dry weight 30 days after planting. Symbols (*) indicate values significantly ($p<0.05$) greater than that of the control treatment. Fertilizer rates are given within the text.

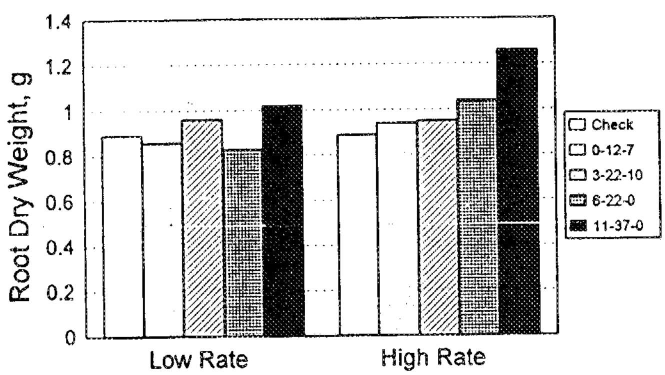

Figure 2. Effect of starter fertilizer composition and rate on cotton root dry weight 30 days after planting. No significant treatment effects were detected. Fertilizer rates are given within the text.

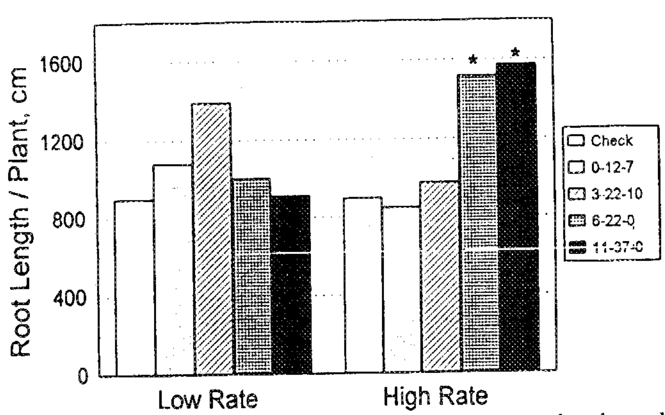

Figure 3. Effect of starter fertilizer composition and rate on root length per plant 30 days after planting. Symbols (*) indicate values significantly ($p<0.05$) greater than that of the control treatment. Fertilizer rates are given within the text.

EFFICACY OF MANGANESE APPLICATION TO COTTON AS A FUNCTION OF SOIL PH AND DRAINAGE

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Abstract

Manganese deficiency symptoms include reduced internodal growth, reduced square development, interveinal chlorosis on young leaves, and necrotic spots on young leaves under severe conditions. Previous studies have found that the leaf blades were the best indicator of Mn deficiency by tissue analysis, and the critical level is about 10-15 mg Mn/ kg leaf. The current recommendation for Mn on cotton in Georgia is that if the soil pH is above 5.6, then 2.5 lb Mn/A should be applied in the fertilizer mix in order to avoid Mn deficiency. The objective of this study was to evaluate recommendation of soil applied Mn. Two locations were used in 1993-1994: a well drained soil, Tifton loamy sand (Plinthic Kandiudult)and a poorly drained soil, Leefield loamy sand (Arenic Plinthaquic Kandiudult). A split plot design was used with soil pH levels, established by application of dolomitic limestone, as the main plots, with pH levels ranging from 5.0 to 6.7. The sub-plots were Mn application rates (0, 2.5, 5.0, and 25 lb/A), which were soil applied, broadcast, and tillivated in pre-plant. Liming increased yield on the Tifton soil in 1993 and on the Leefield soil in both years, but Mn application had no significant yield effect or interaction with soil pH levels. Liming also reduced blade Mn levels and increased the blade Mg:Mn ratio, but Mn application did not alter these measurements in the leaf blades, regardless of soil pH. In no case was blade Mn below the critical level, and no Mn deficiency symptoms were detected. After proper diagnosis of Mn deficiency in cotton, foliar treatment is preferable to soil treatment.

NO-TILL COTTON RESPONSE TO COVER CROP SYSTEM AND STARTER FERTILIZER PLACEMENT IN NORTHERN ALABAMA

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Abstract

A field study (1991-1993) in northern Alabama was conducted to determine possible limiting factors affecting cotton (*Gossypium hirsutum* L.) growth and yield when cotton is planted no-till in old cotton residue or a wheat (*Triticum aestivum* L.)cover crop. Two starter fertilizers placed in a 4 inch band over the seed furrow or in a 2X2 placement were also evaluated. All cotton was planted flat with a burn-down herbicide applied to kill any vegetation in the no-till treatments at least two weeks prior to planting. A conventional tillage treatment included fall moldboard plowing with smoothing and leveling in the spring. The soil type was a Decatur silt loam (Rhodic Paleudult).

Only in 1991 was there a significant cotton growth difference caused by tillage. The cotton no-tilled into old residue produced a shorter compact plant compared to cotton no-tilled into old cotton residue or grown with conventional tillage. However, no significant yield differences due to tillage were found during the 3 year study. This lack of growth and yield differences is contrary to results of previous studies, and may be in a large part due to severe droughts in 2 of the 3 years of the study.

Cotton growth and yield response to starter fertilizer was erratic between years and tillage systems. However, a more consistent response to starter fertilizer was measured in the no-till systems compared to conventional tillage. A more consistent response to the 15-50 starter fertilizer was also found compared to a starter with N alone (15-0). In this study no differences were found between the 15-50 starter applied as a band treatment or placed 2X2.

Surface soil compaction was found to be a possible yield limiting factor for both no-till systems on this soil. Growing a wheat cover crop reduced surface soil compaction slightly compared to soil compaction in old cotton residue. When cotton is no-tilled on these soils, cotton growth and yields may largely depend upon whether cotton roots can penetrate this surface compaction and reach deeper into the subsoil for nutrients and water.

Introduction

Alabama's most intense cotton production area is located on the silty clay Limestone Valley soils located in the northern part of the state. In the past most of these soils have been moldboard plowed in the fall allowing winter freezes and thaws to break up the soil. But many of these soils are now considered highly erodible and therefore must have approved soil conservation plans to meet requirements of the 1985 Farm Bill. Research into conservation-tillage systems for cotton grown on these soils has been conducted since the early 1980's. However, only in recent years have many acres of conservation tillage cotton been grown in this region.

Two conservation tillage cover systems used by most north Alabama cotton farmers are: 1) planting no-till into old cotton residue, or 2) planting no-till into a wheat cover killed at least two weeks prior to planting. Essentially all cotton is planted flat with very little cotton planted on raised beds.

Planting into old cotton residue is preferred by most farmers because of the ease of stand establishment and time and costs involved in planting wheat in the fall. Research by Brown et al. (1985), however, indicated possible weed control and cotton growth problems when cotton was planted into old cotton residue. More recent research has also found reduced cotton stalk height and reduced yields when cotton is planted into old cotton residue compared to cotton planted into a small grain cover or in conventionally tilled soils (Burmester, et al., 1993). The reasons for these reductions have not been explained.

The beneficial effects of using starter fertilizers placed 2X2 in no-till cotton has also been demonstrated in Alabama field studies by Touchton, et al. (1986). However, due to the additional equipment needed for 2X2 placement, few Alabama growers use starter fertilizers on their no-till cotton. Placement of starter fertilizer in a 4-inch band over the cotton seed furrow at planting has produced similar yield increases as 2X2 placement in Mississippi studies (Funderburg, 1988). If similar results are found on no-till cotton in Alabama, growers may use more starter fertilizers since they could adapt their planter much easier to this surface placement.

The objectives of this study were 1) to determine what limiting factor is affecting growth and yield with the two most commonly used no-till cotton systems in North Alabama, and 2) determine if starter fertilizers surfaced banded are as effective as starter fertilizers placed 2X2.

Materials and Methods

A replicated field study located on the Alabama Agricultural Experiment Station, Belle Mina, AL was used to evaluate conservation tillage systems for this area of northern Alabama. The soil type was a Decatur silt loam (Rhodic Paleudult) and is the predominate soil type on which cotton is grown in northern Alabama. Tillage systems included conventional tillage and no-tillage into a wheat cover or old cotton residue. Conventional tillage included fall moldboard plowing with smoothing and leveling in the spring, while both no-till systems received a 1 quart burndown application of glyphosate herbicide to kill all vegetation at least 2 weeks before planting. All cotton planting was done with a John Deere Maxi-Emerge planter equipped with a cutting coulter to cut through residue in the no-till systems. Since soil test rating for P and K at this site was "High," no P or K fertilizer was applied. Nitrogen fertilizer as ammonium nitrate was applied to supply 60 lb. N/A preplant and 30 lb. N/A at early squaring.

In each tillage system liquid starter fertilizer source and placement was evaluated. Liquid fertilizers 11-0-0 and 11-37-0 were applied to supply N and P_2O_5 rates of 0-0, 15-0 and 15-50 lb/A. These rates were applied in a 4-inch band over the seed furrow or placed 2X2 at planting. The experimental design was a split plot with 3 replications with tillage system as main plots and factorial arrangement of starter source and placement as subplots.

In 1991 and 1992 the cotton variety DPL 50 was used while DPL 51 was planted in 1993. In all years cotton stand counts and cotton height measurements were taken approximately 4 and 10 weeks after planting, respectively. In 1992 and 1993, six plants from each plot were harvested, dried and weighed for dry matter accumulation approximately 8 weeks after planting. Cotton leaf samples from each plot at first bloom were also collected, dried and analyzed for nutrient accumulation in both 1992 and 1993.

To measure soil compaction in each tillage system, soil penetrometer readings were made 2 to 4 weeks after cotton emergence in the non-traffic middles of the no-starter check treatment in each tillage system. Ten soil penetrometer readings were made per plot in 1992 and 1993. Measurements were made using a hand held Bush recording soil penetrometer (Mark I Model 1979, Findlay, Irvine Ltd., Penicuik, Scotland.

Cotton yields were determined each year by mechanically picking the two center rows from each plot.

Results and Discussion

Rainfall and (DD) 60 accumulation differed greatly during the 1991, 1992, and 1993 growing seasons (Table 1). In 1991 and 1993 droughts in June and July greatly reduced cotton growth and yields. In 1992, low (DD) 60 accumulation delayed cotton maturity but produced excellent yields. Similar planting dates were used each year, but first harvest was September 16th in 1991, October 23rd in 1992, and September 28th in 1993.

Cotton stands in all years were not affected by starter fertilizer treatments, however, in 1992 and 1993 tillage treatments did affect final stands (Table 2). In 1992 wetter soils in the no-till system produced soil crusting after planting that reduced stands compared to conventional tillage. In 1993 the cotton no-till into wheat produced the best stand due to wind protection from the wheat residue. In all years final stands in all tillage systems were adequate and should not have affected cotton yields.

Early season cotton growth was affected by tillage system in 1992 and by starter fertilizer treatments in 1992 and 1993 (Table 3). In 1992 cotton no-tilled in the wheat cover grew much faster than cotton no-tilled into cotton residue of cotton grown with conventionally tillage. No significant early season growth difference due to tillage was seen in 1993. Starter fertilizers improved early season growth in all tillage systems both years, but results were inconsistent. In the no-till systems 15-50 banded or placed 2X2 consistently increased early season growth in 1992 while all starters and placements increased growth in the no-till systems in 1993. Banding starter fertilizer did not improve early cotton growth with conventional tillage either year. Only the 15-50 starter place 2X2 improved early season cotton growth both years with conventional tillage.

At early bloom each year, cotton grown no-till into old cotton residue was consistently shorter than cotton planted in conventional tillage or cotton planted no-tilled into wheat (Table 4). However, this difference was only significant in 1991. Nutrient concentrations in the cotton leaves at first bloom were not affected by starter treatments either year, but P and K concentrations were affected by tillage (Table 5). Cotton no-till into old cotton residue had lower leaf P concentrations compared to cotton in the other two tillage systems. This difference was significant in 1992. Both no-till systems also had significantly lower leaf K concentrations than cotton grown with conventional tillage in 1992. In 1993 cotton leaf K concentrations were again significantly lower where cotton was grown no-till in old cotton residue compared to conventional tillage and no-till into wheat.

Soil penetrometer measurements in 1992 and 1993 (Fig. 1 and Fig. 2) indicated both no-till systems had much higher resistance to penetration than conventionally tilled cotton down to about 12 inches. Below 12 inches resistance was similar in each tillage system. Data both years also indicates the no-tilled areas with wheat cover were slightly less compacted compared to no-till areas of old cotton residue. This difference was greatest at about 2 to 4 inches deep. Soil compaction was much greater in both no-till systems in 1993 compared to 1992. This was largely due to drier soil conditions in 1993 compared to 1992.

Surprisingly, no significant yield differences due to tillage were found during the three years of this study (Table 6). In 1993 cotton planted into old cotton residue had numerically lower yields of 600-900 pounds of seed cotton per acre compared to the other tillage systems; however, wide variability in the plot area due to the severe drought cause this not to be significant.

Starter fertilizer treatments affected cotton yields in each tillage system in 1991 and 1992, but not in 1993 (Table 6). Yield response to starter fertilizer was very erratic in conventional tillage, but more consistent in both no-till systems. In this study the 15-50 fertilizer banded or placed 2X2 significantly increased cotton yields compared to no starter in both no-till systems in 1991 and 1992. Yield increases due to the starter fertilizer 15-0 were more erratic which indicates a possible response to P in the starter.

Although this study did measure some reduced stalk growth in cotton no-till into old residue compared to conventional tillage or cotton no-tilled into a wheat cover, differences were not as great as had been seen in previous studies. Significant yield differences due to tillage were also not measured any year of the study. The lack of response may be in a large part due to the severe drought condition 2 of the 3 years of the study.

Surface soil compaction, however, was determined to be a possible yield limiting factor in both no-till cotton systems, but especially in the cotton no-tilled into old residue. Growing a wheat cover reduced soil compaction, especially in the upper 4 inches of the soil, compared to soil compaction in old cotton residue. On these soils, cotton growth and yields in the no-till systems may depend largely upon whether cotton roots can penetrate this surface compaction and reach deeper into the subsoil for water and nutrients.

Starter fertilizer response was erratic between years and tillage systems. However, a more consistent response to starter fertilizer was measured in the no-till systems compared to conventional tillage. Also a more consistent response to the 15-50 starter fertilizer was found compared to 15-0 starter fertilizer. In this study no differences were found between the 15-50 starter fertilizer applied as a band treatment or placed 2X2.

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Table 1. Rainfall and DD 60 accumulation by months for 1991, 1992, and 1993 growing seasons.

	Rainfall (in.)			DD 60		
Month	91	92	93	91	92	93
May	6.07	2.19	4.73	450	218	266
June	1.57	8.34	2.50	527	389	504
July	1.98	5.64	2.57	607	569	660
August	3.69	3.80	5.13	597	421	537
September	3.41	4.52	5.01	407	328	319
Total	22.7	26.1	19.94	2,588	1,925	2,286

Table 2. Cotton stand as affected by tillage systems.

	Cotton Stand (plants/ft.)		
Tillage System	1991	1992	1993
Conventional	3.9	5.3	4.6
No-Till cotton residue	4.0	4.7	4.4
No-till wheat	3.8	4.3	5.6
LSD (0.10)	NS	0.3	0.3

Table 3. Cotton dry weight eight weeks after planting as affected by tillage system and starter fertilizer, 1992 and 1993.

Starter Fertilizer (lb/A)				Cotton dry weight (grams/6 plants)	
N	P_2O_5	Placement	Tillage	1992	1993
0	0	-	Conv.	5.7	9.6
15	0	Band	Conv.	5.3	9.3
15	0	2X2	Conv.	5.5	14.0
15	50	Band	Conv.	5.5	10.6
15	50	2X2	Conv.	6.2	11.3
			Tillage Mean	5.6	11.0
0	0	-	Cot. Residue	5.3	7.7
15	0	Band	Cot. Residue	5.5	9.4
15	0	2X2	Cot. Residue	5.5	9.1
15	50	Band	Cot. Residue	5.7	9.6
15	50	2X2	Cot. Residue	6.0	9.3
			Tillage Mean	5.6	9.0
0	0	-	Wheat	6.2	7.9
15	0	Band	Wheat	6.0	9.9
15	0	2X2	Wheat	7.2	11.0
15	50	Band	Wheat	7.1	10.7
15	50	2X2	Wheat	6.9	12.5
			Tillage Mean	6.7	10.4
LSD tillage (0.10)				0.7	NS
LSD starter (0.10)				0.3	1.2

Table 4. Cotton height at first bloom as affected by tillage system.

	Cotton height (in.)		
Tillage System	1991	1992	1993
Conventional	25.2	31.9	35.3
No-Till Cotton Residue	21.6	29.8	34.7
No-Till Wheat	25.6	32.8	37.4
LSD (0.10)	0.9	NS	NS

Table 5. Cotton leaf nutrient consentration at early bloom as affected by tillage system.

	Cotton Leaf Nutrient Concentration (%)					
	1992			1993		
Tillage System	N	P	K	N	P	K
Convention	4.4	0.38	1.04	4.1	0.32	2.01
No-Till Cotton Residue	4.4	0.33	0.88	4.1	0.29	1.83
No-Till Wheat	3.9	0.38	0.87	3.9	0.32	2.08
LSD (0.10)	NS	0.04	0.08	NS	NS	0.21

Table 6. Seed cotton yields as affected by starter fertilizer treatments.

Starter Fertilizer (lb/A)				Seed Cotton Yield (lb/A)		
N	P_2O_5	Placement	Tillage	91	92	[illegible]
0	0	-	Conv.	1433	3307	[illegible]
15	0	Band	Conv.	1550	3376	[illegible]
15	0	2X2	Conv.	1452	3550	[illegible]
15	50	Band	Conv.	1434	3717	[illegible]
15	50	2X2	Conv.	1583	3318	[illegible]
			Tillage Mean	1490	3454	[illegible]
0	0	-	Cot. Residue	1354	3129	[illegible]
15	0	Band	Cot. Residue	1463	3314	[illegible]
15	0	2X2	Cot. Residue	1550	3267	[illegible]
15	50	Band	Cot. Residue	1524	3314	[illegible]
15	50	2X2	Cot. Residue	1648	3387	[illegible]
			Tillage Mean	1508	3282	[illegible]
0	0	-	Wheat	1452	3176	[illegible]
15	0	Band	Wheat	1492	2842	[illegible]
15	0	2X2	Wheat	1670	3187	[illegible]
15	50	Band	Wheat	1622	3398	[illegible]
15	50	2X2	Wheat	1775	3423	[illegible]
			Tillage Mean	1602	3205	[illegible]
LSD tillage (0.10)				NS	NS	[illegible]
LSD starter (0.10)				67	165	[illegible]

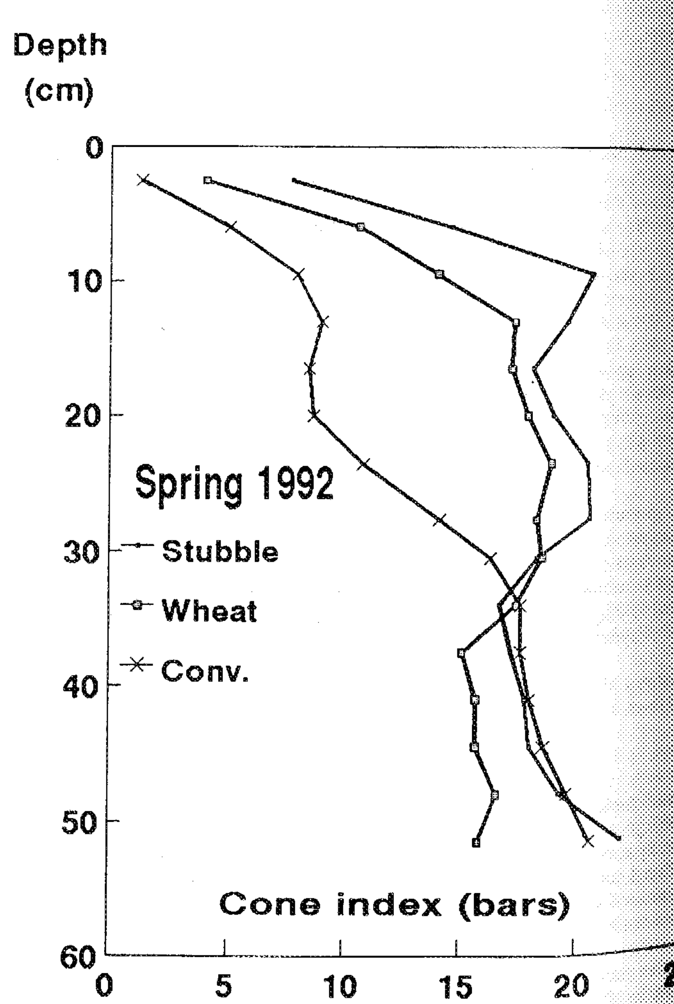

Figure 1. Penetrometer readings in spring 1992 for no-starter treatments in each tillage system.

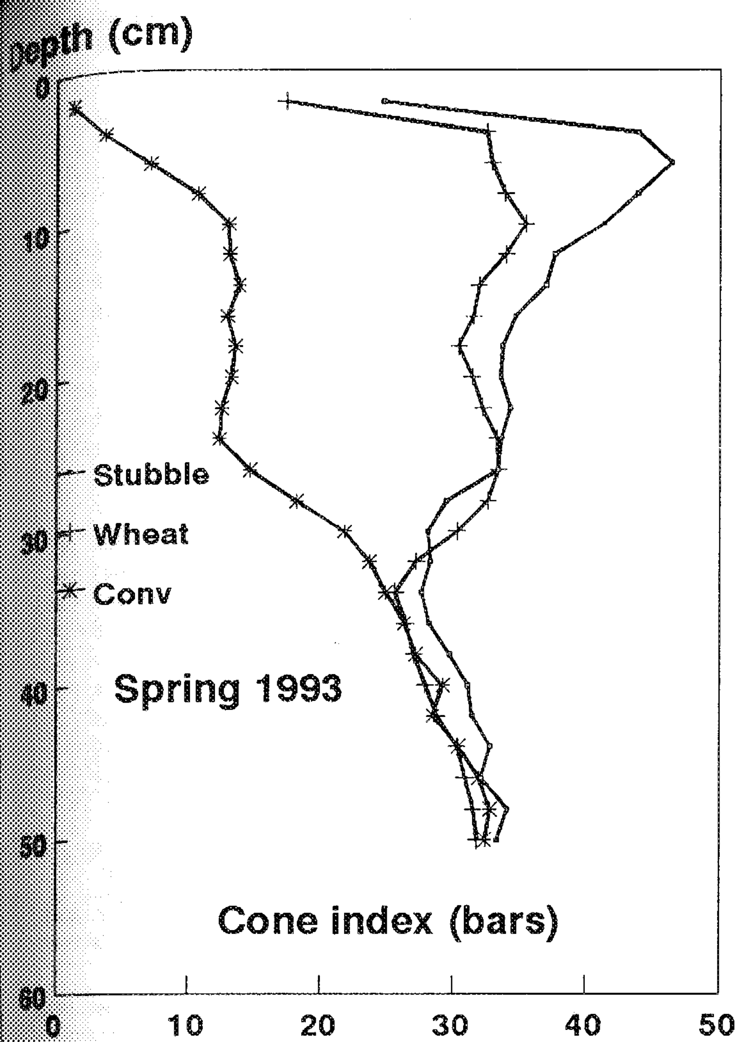

Figure 2. Penetrometer readings in spring 1993 for no-starter treatments in each tillage system.

RESPONSE OF COTTON TO THE SOURCE OF FOLIAR POTASSIUM

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Abstract

A three year field test (1992-94) was conducted on a Lucedale sandy clay loam (Rhodic Paleudults) in central Alabama with a medium soil test rating for K. The primary objective of the study was to evaluate cotton (*Gossypium hirsutum* L.) response to the rate of soil applied K and the source of foliar K. Treatments consisted of rates of soil applied K with and without foliar applications of K. Soil K was applied preplant at rates of 0, 30 and 60 lb K_2O A^{-1}. Sources of foliar K in 1992 included K nitrate (KNO_3: 14-0-44), K chloride (KCl: 0-0-62) and K thiosulfate ($K_2S_2O_3$: 0-0-25-17S, liquid). In 1993, K sulfate (K_2SO_4: 0-0-49-17S) was included as an additional source. A S check was included which received S as Mg sulfate ($MgSO_4$: 12.9% S) at a rate (3.1 lb A^{-1}) equivalent to the S applied as K thiosulfate. The test was revised further in 1994 by applying KNO_3 and K_2SO_4 at their normal solution pH and at an adjusted pH of 4.0. Foliar N was applied to all treatments at a rate of 1.38 lb A^{-1} as urea or KNO_3. For all treatments, the respective fertilizer sources were dissolved in water and diluted to give a total application rate of 10 gal A^{-1}. The rate of foliar K was 4.4 lb K_2O A^{-1} per application. Foliar K treatments were initiated at ~ 2 weeks after first white flower and repeated at 10-14 day intervals for a total of 4 applications. All treatments received a total of 5.12 lb of foliar N A^{-1} and all of the foliar K treatments received a total of 17.6 lb of foliar K_2O A^{-1}. In 1992 and 1994, a yield response was obtained to the rate of soil K. A preplant soil application of 60 lb K_2O A^{-1} increased lint yields by 187 and 260 lb A^{-1}, respectively. Foliar treatments consistently increased yields but the differences were not significant. There were no differences among the foliar K sources tested. Lint quality as measured by HVI was not affected by any of the foliar treatments during either year of the test. Micronaire was increased and strength decreased in 1994 by the application of soil K.

Introduction

Research conducted in Arkansas indicates that K deficiencies can be corrected by foliar applications of K as KNO_3 (Oosterhuis et al., 1990, 1991). Initial results showed that a combination of soil and foliar applied K resulted in an increase in yield and quality of cotton lint. In most trials, KNO_3 was applied 4 times beginning 1-2 weeks after first white flower at a rate of 10 lb A^{-1} in 10 gallons of water.

These initial positive results have led to a great deal of interest in foliar feeding of cotton with K throughout the Cotton Belt. Initial results of a cooperative Beltwide study being conducted in 10 states show that a positive response to foliar K was obtained at 3 of 12 locations in 1991 and 6 of 10 locations in 1992 (Oosterhuis et al., 1993). In 1992, foliar K tests were conducted at 5 locations in Alabama with each site having a wide range in residual soil test K levels. Initial results showed that a response to foliar K was obtained at 2 of the 5 locations, and that the response to foliar K as KNO_3 was not predictable based on the level of soil test K (Mitchell and Mullins, 1993).

Since KNO_3 is not the only source of water-soluble K available, a producer might want to consider other sources. To date, we do not know how cotton will respond to different sources of foliar applied K. Miley et al. (1992) in Arkansas made 4 bi-weekly foliar applications of potassium nitrate, potassium sulfate, potassium thiosulfate, potassium chloride, potassium carbonate and a combination of potassium nitrate and magnesium sulfate. In 1991, cotton yield, boll size and petiole contents of nitrate N and K were not affected by the source of K. During 1992, KNO_3 significantly increased lint yields as compared to a no K check while potassium carbonate decreased yield as compared to the check.

A field study was conducted for three years in central Alabama to evaluate cotton response to foliar fertilization with K. Objectives of this test were: 1) determine cotton response to soil and foliar applied K, 2) evaluate cotton response to various sources of foliar applied K, and 3) evaluate the effect of foliar applied K on cotton fiber quality.

Materials and Methods

Field studies were initiated in 1992 on a Lucedale sandy clay loam (Rhodic Paleudults) in central Alabama. The site had a pH of 6.2. Mehlich I (Mehlich, 1953) extractable K was 104 lb/acre which corresponded to a 'medium' soil test rating for K (Cope et al., 1981).

Treatments (Table 1) consisted of rates of soil applied K with and without foliar applications of K. Rates of preplant, soil applied K were 0, 30 and 60 lb K_2O A^{-1}. Sources of foliar K in 1992 included K nitrate (KNO_3: 14-0-44), K chloride (KCl: 0-0-62) and K thiosulfate ($K_2S_2O_3$: 0-0-25-17S, liquid). During the 1993 cropping season, K sulfate (K_2SO_4: 0-0-49-17S) was added as a foliar source. Since S was applied in the K thiosulfate (3.1 lb S A^{-1}) and K sulfate (1.53 lb S A^{-1}) treatments, a S check was included which received S as Mg sulfate ($MgSO_4$: 12.9% S) at a rate equivalent to the S applied as K thiosulfate. The test was further revised in 1994 by applying KNO_3 and K_2SO_4 at their normal solution pH and at an adjusted pH of 4.0. A buffer (Helena's Buffer Xtra Strength) and HCl were used in adjusting the pH to 4.0.

In order to ensure that an observed response would be due to K, all treatments that did not receive KNO_3 received a foliar application of urea (45-0-0, feed grade) each time foliar K was applied. Foliar N as urea was applied at a rate of 1.38 lb A^{-1} at each application which is equal to the N applied in KNO_3. Treatments were arranged in a randomized complete block design with 5 replications. In 1992, only 4 replications were included in the statistical analysis of the yield data.

Foliar treatments were applied at 10-14 day intervals beginning just after the first white flower for a total of 4 applications. Each application of foliar K supplied 4.4 lb K_2O A^{-1} for each foliar source. This K rate was based on a rate of 10 lb KNO_3 A^{-1} (14-0-44). Thus, all treatments received a total of 5.12 lb of foliar N A^{-1} as KNO_3 or urea. All of the foliar K treatments received a total (sum of 4 applications) of 17.6 lb of foliar K_2O A^{-1}.

Nitrogen at a rate of 90 lb A^{-1} as NH_4NO_3 was applied preplant during both years of the study. Deltapine 50 was grown each year. Plots consisted of 6