NITROGEN AND POTASSIUM FERTILIZATION OF COTTON ON ATLANTIC COAST FLATWOODS SOILS

Glen Harris
University of Georgia, Cooperative Extension Service
Tifton, GA

Abstract

Cotton acreage in Georgia has recently expanded, including into a new growing region known as the Flatwoods soil region. Little or no data is available concerning proper fertilization of cotton on these unique soil types with a high water table and high yield potential. Therefore, the objective of this study was determine the proper nitrogen (N) and potassium (K) fertilizer rates for cotton grown in this area. Five on-farm research sites were established in 1996 and three were repeated in 1997. Three levels of N and three levels of K, in all combinations, were applied to plots measuring 4 rows wide by 50 feet long. Rates were mainly adjusted at sidedress between first square and first bloom. All plots were mechanically harvested and a sample was ginned for turnout. A positive cotton lint yield response to increasing N rates was measured for 5 out of 8 site-years. Both high water table and deep sand soil types responded to N rates above current UGA recommendations, especially in 1996 with adequate rainfall. There was little response to increasing K rates and excessive rates tended to decrease yields. There was also very little n x K interaction in terms of yield response. Based on this research, it appears that cotton grown in this soil region can benefit from between 80 and 120 lb N/a and current K rates are sufficient.

Introduction

Cotton acreage has recently expanded in Georgia, including into new growing areas. One of these areas is known as the Atlantic Coast Flatwoods soil region. Located in the southeast corner of the state, this region contains sandy soils traditionally cropped to tobacco, corn, soybeans and pine trees. A distinguishing characteristic of this region that separates it from the Coastal Plain region is the presence of a seasonally high water table on most soil types. This feature is thought to contribute to a higher cotton yield potential, much like irrigation on Coastal Plain soils. Also like the Coastal Plain soil region, the Flatwoods soil region also contains soil types that are classified as deep sands (more than 18 inches to subsoil clay). These soils traditionally have a history of producing inadequate growth. Therefore, new cotton growers in the Flatwoods region questioned whether both the high water table/high yield potential and deep sand/inadequate growth situations may require higher rates of nitrogen and potassium fertilizer compared to the standard UGA recommendation for a Coastal Plain soil with a 750 lb/a lint yield goal. Since there was apparently no research data available concerning proper fertilizer rates for cotton in this region, a preliminary study was conducted in 1995 on-farm in Bacon County, Georgia. The results indicated that nitrogen rates of up to 120 lb/a may be required for cotton grown on Sapelo and Rigdon (high water table) soil series of the Flatwood region (unpublished data). Therefore, in 1996, a more comprehensive 2-year study was initiated with the objective of determining the optimum nitrogen and potassium fertilizer rates for cotton grown in the Flatwoods soil region of Georgia.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:652-654 (1998)
National Cotton Council, Memphis TN

Materials and Methods

On-farm research trials were established in Spring 1996 on five sites located in three Flatwoods region counties. Counties, soil series and a classification as either “high water table” or “deep sand” for each of the sites is listed in Table 1. Note that three of the five sites were classified as deep sands. Both Jeff Davis County sites were irrigated while the other sites were not. The previous crop at all sites was cotton. In 1997, the trials were re-established at all five sites. However, only three of the sites were harvested (both Jeff Davis County sites were lost).

After the grower established a stand, plots measuring 4 rows wide by 50 feet long were laid off that included 5-foot alleys to facilitate fertilizer treatment applications and harvest. Treatments including 3 rates of both nitrogen and potassium sidedress fertilizer (in all combinations for a total of 9 treatments) were applied by hand. Half of the potassium fertilizer treatment was applied at planting and half at sidedress for Sites 2 and 3. All nitrogen treatments were applied at sidedress between somewhere between first square and first bloom. Treatments were applied in addition to farmer- applied preplant fertilizer in some cases and total N and K_2O rates, alongside the recommended rates of N and K_2O, appear in Table 2. Ammonium nitrate and muriate of potash were used as the nitrogen and potassium sources, respectively. A portion of the potassium treatments at Sites 1, 2 and 3 was supplied by potassium magnesium sulfate. Besides the sidedress fertilizer treatments, all other farming operations were determined by and conducted by the grower at each site but were the same for all research plots at a given site

All plots were mechanically harvested using farm scale equipment. Cotton was harvested either from all 4 or the center 2 rows of each plot depending on the availability of harvest equipment at each site each year. Seed cotton was gathered from the picker baskets and placed in nylon bags, which were labeled, weighed then sampled. Approximately 1 pound of seed cotton was sampled from each plot and ginned for turnout. The experimental design for all sites was a randomized complete block, (3 x 3) 2-factor factorial with

4 replications. An analysis of variance was performed on lint yields for each site/year.

Results and Discussion

In 1996, a significant cotton yield response to N rates was measured at 3 out of 5 of the sites (Table 3). Two of these sites which showed an increasing lint yield with increasing N rates were deep sand soils and one was a "high water table" soil. Averaged across potassium rates, the low, medium and high N rates resulted in lint yields of 914, 1063 and 1082 at Site 2, 993, 1277 and 1461 at Site 4, and 1469, 1580 and 1620 at Site 5. Yield levels at all sites in 1996 were good, due to adequate rainfall during the season. There was no cotton lint yield response to K rates at any of the sites. One site showed a significant N x K interaction, and appeared to decrease in yield with increasing potassium rates within the medium level N rate. At this particular site, a large amount of preplant K was applied by the grower (100 lb K2O/a) and additional sidedress K up to a total of 170 lb K2O was applied. These rates should be considered excessive since no K was recommended by soil test. The yield decrease with increasing K rates could be due a number of factors including excessive vegetative growth, a magnesium imbalance/deficiency or possibly salt injury. The possibility of excessive vegetative growth, especially early in the season, is considered the most likely explanation.

In 1997, a late season drought decreased yields compared to 1996 at the 3 sites that were harvested. Two out of the three sites still had a trend toward increasing yields with increasing N rates. Both sites were deep sand soils and this result may be due to producing adequate stalk growth and fruit set before the drought period. There was trend toward a yield response to increasing K rates at one of the sites in 1997 and a N x K interaction at another. Again, these sites were deep sands and these results may be related to late-season regrowth after cut-out due to drought.

Conclusions

A positive cotton lint yield response to increasing N rates was measured in 5 out of 8 site-years of this study (Tables 3 and 4). Yield increases were measured on both deep sand and "high water table" type soils. This indicates that the grower's intuition that higher N rates on deep sands to push early season vegetative growth, and on high water table soils to take advantage of high yield potential were basically correct. There was a greater response to N in 1996, a year of adequate rainfall compared to 1997 where a significant late-season drought ocurred. This suggests that higher N rates may not be utilized in dry years and more emphasis may need to be placed on making in-season N rate adjustments such as lower sidedress N rates with some foliar fertilization. Based on results of this study, it appears that N rates in the range of 80 to 120 may be justified on these Flatwoods soils.

There was little cotton yield response to increasing K rates for any of the 8 site-years of this study. Therefore, current potassium recommendations for these soils appears sufficient. Where K rates well in excess of the recommendation were applied, a negative yield response seem to occur. There were also 2 instances of a N x K interaction, indicating that the combination of both high N rates and excessive K rates may decrease yield due to excessive early-season vegetative growth.

Overall, whether due to higher yield potential or inadequate growth history, nitrogen rates above the current UGA recommendation seem justified for cotton grown in the Flatwoods region. Current potassium recommendations, on the other hand, seem sufficient, and excessive rates may actually decrease yields

Acknowledgements

Thanks are given to the cooperating growers and county extension agents for their assistance with this study, without which, it would not have been possible. Thanks are also given to the Georgia Plant Food and Educational Society and the Georgia Cotton Commission for helping fund this study.

Table 1. Site Characteristics

Site #	County	Soil Series	Classification
1	Coffee	Pelham	High Water Table
2	Coffee	Fuquay	Deep Sand
3	Lanier	Fuquay	Deep Sand
4	Jeff Davis	Fuquay	Deep Sand
5	Jeff Davis	Leefield	High Water Table

Table 2. UGA soil test fertilizer recommendations and total N and K2O rates applied.

		Treatments (Total Rates)	
	Rec.	N	K_2O
Site/Year	N/ K2O	Low /Med/High	Low/Med/High
	------------------------ lb/a --------------------------		
1/96	60/20	60/90/120	20/40/80
1/97	60/30	60/90/120	20/40/80
2/96	60/60	45/65/95	60/90/120
2/97	60/60	60/90/120	60/90/120
3/96	60/80	60/90/120	80/120/160
3/97	60/40	90/120/150	100/135/170
4/96	60/0	70/100/130	110/140/170
5/96	60/0	60/90/120	100/130/160

Table 3. Effect of nitrogen and potassium fertilizer rates on cotton lint yield - 1996

N/K Treatment		Site # 1	2	3	4	5
		------------------------ lb lint/a --------------------------- -				
Low	Low	1183	972	954	995	1487
Low	Med	1206	873	1084	1077	1464
Low	High	1273	898	1008	908	1458
Med	Low	1259	973	1047	1367	1616
Med	Med	1282	1177	947	1305	1562
Med	High	1267	1041	1142	1159	1562
High	Low	1269	1179	1041	1457	1617
High	Med	1269	1116	1061	1395	1617
High	High	1308	951	1036	1532	1627
Stat. Prob. (0.05)						
N		.123	.077	NS	.000	.004
K		NS	NS	NS	.165	NS
N x K		NS	.369	.413	.012	NS
CV (%)		8	18	15	8	6

Table 4. Effect of nitrogen and potassium fertilizer rates on cotton lint yield - 1997.

N/K Treatment	Site # 1	2	3
	---------------- lb lint/a ------------		
LowLow	802	773	1022
Low/Med	769	742	908
Low/High	798	663	977
Med/Low	777	629	1062
Med/Med	832	712	985
Med/High	742	711	1101
High/Low	810	711	1109
High/Med	798	757	1025
High/High	780	736	1086
Stat. Prob. (0.05)			
N	NS	.095	.070
K	NS	.295	.099
N x K	.410	.043	NS
CV (%)	9	8	11