# EFFECTS OF INCREASING NITROGEN FERTILIZER RATES IN CONSERVATION TILLAGE COTTON Charles H. Burmester Belle Mina, AL

Abstract

Conservation tillage is now the primary method of growing cotton in the Tennessee Valley of Northern Alabama. One test was conducted in 2004 to evaluate nitrogen (N) fertilizer rates under various conservation tillage systems. Another test was conducted in 2003 and 2004 to evaluate N fertilizer rates needed by irrigated cotton when planted into a small grain cover crop. Results in 2004 indicate the current N recommendation of 60 pounds per acre for conservation tillage cotton without cover crops and 90 pounds of N per acre when a small grain cover crop is used appears adequate for optimum yields. Cotton no-tilled into rotations of soybeans or double cropping of wheat with soybeans required 90 pounds of N fertilizer for optimum yields in this study. This is higher than the current recommendation of 60 pounds of N per acre. Cotton planted into corn residue also indicated a very positive trend toward higher yields with the 90 pound rate of N fertilizer. Irrigated cotton yield response to N fertilizer rates was similar each year. Cotton yields were optimized when an N fertilizer rate of 130 pounds per acre was applied following planting into a small grain cover crop.

## **Introduction**

Alabama's nitrogen fertilizer recommendations for cotton are based on long-term research conducted on the various soil regions of the state. This research has resulted in an N fertilizer recommendation of 60 pounds per acre  $\pm$  30 pounds per acre for cotton grown on the silty clay soils of the Tennessee Valley in northern Alabama (Adams et al., 1994). If cotton is grown with conservation tillage, using a small grain cover crop, an additional 30 pounds of N fertilizer is required according to Alabama research (Brown et al. 1985, Torbert and Reeves, 1981).

Cotton farmers in the Tennessee Valley of Alabama are now currently planting almost 70 percent of their cotton acreage with some form of conservation tillage. Small grain cover crops are widely used with conservation tillage. However, rotations and planting cotton into residues from corn and soybeans is increasing. There is also increased interest in planting irrigated cotton using conservation tillage. All these changes have produced a need to further research the optimum N fertilizer rates for cotton on these soils using conservation tillage practice employed by these farmers.

## **Materials and Methods**

All tests were located at the Tennessee Valley Research and Extension Center located near Belle Mina Alabama. The soil type at each site was a Decatur silt loam (clayey, kaolinitic, thermic Rhodic Paleudults) which is a dominate soil type in the area. All conservation tillage treatments were chemically killed approximately three weeks prior to planting. Plots were harvested with an IH 2055 cotton picker specifically designed for plot harvesting. Specific crop information is included in Table 1.

In 2004, a long-term rotation experiment that has been using conservation tillage since 1994 was split to evaluate two rates of N fertilizer under each conservation system. The test included eight, cotton conservation tillage cropping systems, including three one-year rotations with soybeans, corn and double crop wheat and soybeans. Each plot was 4, 30-inch rows, 50 feet long and replicated four times in a randomized complete block design. All rotations with a winter wheat cover crop received 30 pounds of N fertilizer in February to supply the additional N needed according to previous research. After planting, either 60 or 90 pounds of N was sidedressed using 32% nitrogen solution (Table 2).

Nitrogen fertilizer rates were evaluated at an irrigated conservation tillage test site in 2003 and 2004. Plots were 4, 40 inch rows, 50 feet long with rye planted as a cover crop the previous fall. All treatments were replicated 4 times in a randomized complete block design. In 2003, 70 pounds of N fertilizer as ammonium nitrate were applied preplant. In 2004, this preplant N fertilizer rate was increased to 100 pounds. Each season, sidedress N treatments of 0, 30 and 60 pounds per acre were applied using 32 % N solution in early June. A small 20 saw gin was used to

determine lint percentage in 2004. In 2004, lint samples were analyzed for micronaire, length, strength and uniformity using high volume instrument analysis.

## **Results and Discussion**

The 2003 and 2004 growing seasons produced excellent cotton yields across northern Alabama. Rainfall both seasons was well distributed during the June through August fruiting period (Table 1). In the irrigated study 5.4 and 6.2 inches of total irrigated water were applied in 2003 and 2004 respectively. Much of this irrigation each year was applied in August to maximize boll filling.

The conservation tillage treatments responded differently to the rates of N fertilizer applied in 2004 (Table 3). The conventional tillage, ridge-till without cover, and no-till without cover treatments all produced optimum yields with 60 pounds total N per acre. This is consistent with previous research on these soils. The no-till and ridge-till treatments with wheat cover crop produced optimum yields with 90 pounds total N per acre. This is also consistent with previous research and current recommendations by Auburn University. However, cotton yields following one year rotation with soybeans or a double cropping of wheat and soybeans produced optimum yields with the 90 pounds of N fertilizer. Although not statistically significant, cotton yields following corn were also increased 270 pounds of seedcotton per acre when N fertilizer rates were increased from 60 to 90 pounds per acre. The current N fertilizer rate recommended for these three treatments is 60 pounds per acre. The fall tillage treatment (chisel plowing) and planting a wheat cover crop required 120 pounds of N fertilizer for optimum yields in 2004. The current N fertilizer rate recommended for this treatment is 90 pounds per acre.

The cotton yield response to higher N fertilizer rates appears surprising especially following rotations including soybeans. Previously, Mitchell has reported erratic cotton yields responses to N rates following soybeans in another long-term experiment at this site (Mitchell, 2000) However, both systems, especially the double cropping of wheat and soybeans produce high amounts of residue which may be increasing microbial N fixation during the growing season. This may also be true for the cotton following corn rotation, which had a trend toward higher yields as N fertilizer rates were increased to 90 pounds per acre. It appears that cotton following these rotations with high soil residue may require more N fertilizer than currently recommended. The fall tillage and cover crop planting system may also require additional N fertilizer.

Irrigated cotton yield response to N fertilizer rates was similar in 2003 and 2004, even though cotton yield variability was much higher in 2004 (Table 4). In both years 130 pounds total N per acre produced optimum cotton yields when planted into a winter cover crop of wheat. There is currently very little research on N rates when cotton is planted into cover crops with irrigation on these soils. Fiber data from 2004 found no differences in turnout, micronaire, strength or uniformity due to N fertilizer rates. Staple length, however, was significantly shorter with the 100 pounds rate of N fertilizer treatment compared to N rates of 130 and 160 pounds per acre (Table 5). It appears that 130 pounds total N per acre would be a good starting point for further N research on this irrigated, conservation cropping system on this soil type.

# **References**

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Mitchell, C.C. 2000. Nitrogen rates for cotton in Alabama's long-term experiments. Proc. Beltwide Cotton Conf. 2:1388-1392 (2000). National Cotton Council. Memphis, TN.

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	Cons. Systems Site	Irrigation Site			
	2004	2003	2004		
Planting Date	4/29	5/1	4/21		
Cultivar	DP444 BG/RR	DP444 BG/RR	DP444 BG/RR		
Irrigation (total inches)		5.4	6.2		
Harvest Date	10/6	10/8	10/5		
Rainfall Inches *	5.0, 4.6, 3.0	5.1, 7.8, 2.6	5.0, 4.6, 3.0		
DD60's (April-Sept.)	2298	2281	2298		

Table 1. Specific crop information for 2003 and 2004 TVREC nitrogen test sites.

\*June, July and August

Table 2. Nitrogen fertilizer rates applied to conservation tillage treatments, TVREC 2004.

	Total N Rates Ibs./A		
<b>Conservation Treatments</b>			
Conv. Cotton	60	90	
Cotton/Soybeans	60	90	
Cotton/Wheat-Soybeans	60	90	
Cotton/Corn	60	90	
Ridge- No Cover	60	90	
No-Till No Cover	60	90	
No-Till Wheat	90	120	
Ridge-Wheat	90	120	
Chisel-Wheat	90	120	

Table 3.	Effect	of nitrogen	fertilizer	rates	on seed	-cotton	yields,
TVREC.	2004.	-					•

	Ν	Rates (lbs./	A)
<b>Conservation Treatments</b>	60	90	120
Conv. Cotton	2740	2780	
Cotton/Soybeans	2910	3630	
Cotton/Wheat-Soybeans	2650	3070	
Cotton/Corn	2980	3250	
Ridge-No Cover	2720	2840	
No-Till No Cover	2990	3050	
No-Till Wheat		3040	3180
Ridge-Wheat		3130	3270
Chisel-Wheat		2740	3290
L.S.D. P< 0.10=370			
CVI 10 50/			

CV=10.5%

Table 4. Irrigated seed-cotton yields with conservation tillage, TVREC

		N Rate	s lbs./A	
Year	70	100	130	160
2003*	3730	3850	4110	
2004**		3200	3650	3770

\* L.S.D. P<0.10=170

\*\* L.S.D. P<0.10=443

treatments in 2	004.				
N Treatment	Turnout				
lbs./A	%	Micronaire	Staple	Strength	Uniformity
100	0.447a	3.47a	35.8b	30.55a	82.8a
130	0.439a	3.60a	37.0a	29.75a	84.0a
160	0.445a	3.55a	36.8a	29.25a	83.5a

Table 5. Cotton lint turnout and cotton fiber properties for irrigated nitrogen treatments in 2004.

Numbers followed by the same letter in each column are not significantly different at the 10% level according to Duncan's NMRT.