Strip-Till Versus Conventional Tillage on Yield and Petiole-Sap Nitrate of Cotton and Soil Nitrate

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INTRODUCTION

A conservation compliance plan must exist on highly erodible land if a producer wishes to receive USDA benefits. This requirement was stated in the Food Security Act of the 1985 Farm Bill and must have been fully emplemented by I January 1995 (Bogusch and Supak,1995). There has been a rapid growth of interest and acreage of cotton *(Gossypium hirsutum* L.) in conservation tillage in the Southeast (York, 1995). About 10% of the cotton acreage in the Southeast was either in no-till or strip-till systems in 1995 and further increases are expected. There are benefits of omsewation tillage, even where conservation compliance is not a concern. Examples include reduced number of trips over the field, and more efficient use of time, labor, and equipment in the overall farm operation. Furthermore, cover crop residue has value in conserving soil moisture and improving water quality. Sand blasting of seedling cotton on sandy soils can be avoided by planting into cover crop mulch. Since climate, growing conditions, and soils are different in each cotton growing region, research must be conducted in each region to measure cotton response to different types of conservation tillage. The objective of this research was to determine yield, N requirements, and N movement in soil for strip-tilled versus conventional-tilled cotton

MATERIALS AND METHODS

A cotton production test with 'NuCotn 33B' was initiated in the spring of 1996 on Dothan sandy loam (fine, loamy, siliceous, thermic, Plinthic Kandiudult) located on the University of Florida, North Florida Research and Education Center near Quincy, Florida. Tillage treatments were strip-till and conventional-till. Nitrogen rates were 0, 60, 120, and 180 lb/a. After harvesting, three winter cropping systems were superimposed over tillage and N treatments as follows: fallow, legume cover crop, and wheat *(Triticum aestivum* L.) cover crop. The experimental design was a split-split plot with four replications. Main plots were tillage treatments, subplots were winter cropping systems, and sub-sub plots were N application rates. Cotton plots consisted of six rows 3 ft wide and 25 ft long. Cotton fiber yield was determined as 38% of seed plus fiber yield.

Petiole-sap nitrate was monitored weekly, starting at first bloom appearance, by collecting 15 petioles at the fourth leafposition from the top. Nitrate concentration was determined with a portable nitrate meter (Cardy Nutrient Meters).

All plots were sampled to a depth of 4 ft to determine soil nitrate levels at different depths (0 to 1, 1 to 2, 2 to 3, and 3 to 4 ft) before fertilizer was applied in the spring and the influence of fertilizer on nitrate after harvest. Soil sample extracts were analyzed for nitrate after shaking soil with calcium sulfate solution, filtering, adding powder containing Cd to a 5 mL aliquot and measuring transmittance at 425 microns. All data were analyzed for statistical significance using a desk-top computer with a MSTAT-C statistics package (Freed et al., 1989).

RESULTS AND DISCUSSION

Tillage main effect did not influence yield of cotton in 1996. Fiber yield was 1139 lb/a with ship-till and 1027 lb/a with conventional-till, which were not significantly different at (P=0.26). However, strip-till produced a significantly (alpha=0.05) greater yield than conventional-till with 180 lb of fertilizer N/a (Table 1.). There were no differences in yield between tillage treatments at other fertilizer N rates. Equal or better yields with strip-till compared to conventional-till would allow cotton producers in North Florida to comply with conservation rules of the USDA without incurring costly yield losses. Also, the benefits of conservation tillage such as increased efficiency in farm operations and water use, along with seedling protection with cover crop mulch, could make conservation tillage more economical than conventional tillage.

Tillage did not influence nitrate-N concentration of cotton-petiole sap (Table 2); petiole-sap nitrate-N levels were proportional to fertilizer N rates for the first

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three wk of blooming. After three wk, there were no differences in petiole-sap nitrate-N levels between the rates of 0 and 60 lb N/a. The petiole-sap nitrate-N level of the 180 lb N rate remained significantly higher than other treatments during the 7-wk sampling period. Petiole-sap nitrate-N levels for the 120 lb N/a rate were not significant from the *zero* rate at the 6- and 7- wk sample dates. Since there was no significant difference in yield between the 60 and 120 lb N rates, data in Table 2 suggest that petiole-sap nitrate-N level of cotton is important only during the first and second wk of blooming and that critical values were 1500 ppm the first wk and 500 ppm the second wk.

Soil nitrate-N levels were significantly higher with conventional-till at 120 and 180 lb of N/a than with strip-till (Table 3). However, tillage did not influence soil nitrate-N levels with soil depth. Soil samples taken in the spring before fertilizer was applied contained between 43 and 51 lb of nitrate-N/a in the top four ft of the profile (Table 4), while fall samples contained between 115 and 154 lb of nitrate -N/a. The 0 and 60 lb fertilizer N rates each contained 115 lb of nitrate-N/a in the soil profile, while there was about a 20 lb/a increase of *soil* nitrate-N per 60 lb of fertilizer N between the 60 and 180 lb N rates. This suggests that the 120 and 180 lb N rates were excessive, supplying more N than the plants could utilize. The absence of a significant yield increase between the 60 and 120 lb N rates support the possibility of excessive N. Excessive nitrate-N in the 120 and 180 lb N plots accumulated in the 2- to 4- ft depth range, with peak levels between the 2- and 3-ft depths (Table 4).

CONCLUSIONS

Strip-till did not reduce yield or influence mole-sap nitrate-N levels of cotton. Petiole-sap nitrate-N levels of cotton appeared to be most critical during the first two wk of blooming. Conventional-till plots appeared to accumulate more soil nitrate-N at the 120 and 180 lb N rates than strip-till plots. The 120 and 180 lb N rates appeared to be excessive in this experiment as shown by nitrate-N accumulation below the 2-ft soil depth.

LITERATURE CITED

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Table 1. Yield of cotton fiber with two tillage systems and four N rates.

Fertilizer-N Rate	Tillage	
	strip-till	Conventional-till
	lb/a	
0	766	758
60	1188	998
120	1156	1183
180	1445	1170
$LSD_{0.05}$	192	

Table 2. Nitrate-N concentration in petiole sap of cotton at seven sample dates with four fertilizer-N rates and two tillage systems.

Week of Bloom	Fertilizer-N Rate (lb/a)				Tillage		
	0	60	120	180	strip	Conv.	$LSD_{0.05}$
	ppm						
1	140	1626	2021	2264	1497	1529	277
2	130	570	1440	1569	916	939	177
3	151	318	1349	1790	945	859	197
4	165	194	1039	1596	752	746	223
5	201	207	734	1575	642	717	319
6	245	237	361	1315	426	654	424
7	282	305	305	852	435	428	161

Table 3. Soil nitrate-N levels at four fertilizer-N rates and four soil depths with two tillage systems.

Fertilizer-N Rate	Tillage		Soil Depth	Tillage	
	strip	Conventional		strip	Conventional
lb/a	----------------ppm--------------------		-- ft --	----------------ppm---------------------	
0	7.3	7.0	0-1	8.1	8.9
60	6.8	7.6	1-2	7.7	8.1
120	7.8	9.0	2-3	7.7	8.6
180	9.0	10.1	3-4	1.4	8.1
$LSD_{0.05}$	1.04			1.04	

Table 4. Soil nitrate-N levels at spring and fall sample dates, with four fertilizer-N rates and four sample depths.

Fertilizer N-rate	Sample Date		Soil Depth	Fertilizer-N Rate (lb/a)			
	Spring	Fall		0	60	120	180
---------------lb/a------------------------			--ft--	-------------------------ppm------------------------------------			
0	51†	115†	0-1	8.1‡	8.3‡	8.4‡	9.2‡
60	46	115	1-2	7.0	7.3	8.0	9.2
120	50	134	2-3	6.7	6.5	8.8	10.7
180	43	154	3-4	7.0	6.7	8.2	9.1
$LSD_{0.05}$	7.2	13			1.5		

†Multiply lb/a by 0.0625 to convert to ppm in top four ft of soil.
#Multiply ppm by 4 to convert to lb/a in a one A layer of soil.