CONSERVATION TILLAGE CONFERENCE
TILLAGE AND NITROGEN INFLUENCE ON COTTON

P. J. Wiatrak[1], D. L. Wright[1], F. M. Rhoads[1], S. Reed[2], and J. Pudelko[3]

AUTHORS:[1]North Florida Research and Education Center, Quincy, FL 32351-9529; [2]Florida A and M University, Tallahassee, FL; [3]Agriculture University Institute of Soil Culture and Plant Production, Mazowiecka 45/46, 60-623 Poznan, Poland. [1]Corresponding author. *REFERENCE:* J. E. Hook (ed.) *Proceedings of the 22nd Annual Southern Conservation Tillage Conference for Sustainable Agriculture*. Tifton, GA. 6-8 July 1999. Georgia Agriculture Experiment Station Special Publication 95. Athens, GA.

Abstract. The experiment was conducted during 1996 - 1998 on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL. The objectives of this study were to determine optimum N rates for cotton, the impact of fallow, small grain and legume as winter covers on N requirements of cotton, and to compare N requirements in strip tilled cotton with conventional plantings. The lint cotton yields were significantly different between years and were influenced by previous crop, N rates, and the interaction of tillage and previous crops. Significantly lower yields were obtained in 1998 due to hard-locks. Higher yields of cotton were obtained after crimson clover than wheat or fallow. There was a significant positive response to N between 0 and 60 lb N/acre and between 60 and 120 lb N/acre but no response between 120 and 180 lb N/acre. Cotton bolls were heavier after strip-till than conventional till and also heavier after fallow than wheat. There was no statistical difference for the boll weight between crimson clover and fallow and between crimson clover and wheat. Positive response of boll weight to N occurred between 0 and 60 lb N/acre but N rates higher than 60 lb/acre reduced the weight of bolls. Plant height was increased with higher N rates. Rates of N produced a range in plant height from about 2 feet with zero N to over 3 feet with 180 lb of N/acrecre. Plants were significantly higher in strip-till than conventional planting and higher after crimson clover than wheat and fallow. The interaction of previous crops and N rates shows that plants were higher after crimson clover than fallow with no N application but at the higher nitrogen rates the differences between previous crops were not significant. Height response to N application was greater after fallow than crimson clover or wheat.

INTRODUCTION

Research conducted during 1987-92 (Hutchinson et al., 1993) showed that the yields of cotton grown in minimum tillage were similar to yields obtained from conventional tillage. In many cases the yield of cotton was higher on areas, where minimum tillage was applied (no-till and ridge-till) together with previous crops (Hutchinson et al., 1993), but the cotton yield was not always higher (Stevens et al., 1992). However, cotton grown in the minimum tillage after small grains required higher N rates than cotton grown with no previous crop (Brown et al., 1985).

Experiments conducted through many years have shown that legume crops may increase the organic matter in the soil (Frye and Blevins, 1989), improve soil texture (Beale et al., 1955) and productivity (Frye et al., 1985). Using "mulch" from legume crops improves the soil capacity to hold water (Griffith et al., 1886) and infiltration (Touchton et al., 1984), and at the same time decrease the erosion and water flow (Frye et al., 1985). One of the biggest agronomic benefits from growing legume crops is their ability to distribute biologically fixed N, which may reduce nitrogen fertilization of the next crop (Brown et al., 1985). Hutchinson et al., (1994) showed that cotton grown after Vicia (Vicia Villosa. R.) didn't require application of N to get the optimum yields; however, this same plant grown after wheat required application of 40 kg/ha more N to get optimum yield compared to cotton grown after fallow.

The purpose of this work was to examine the influence of tillage, previous crop, and N rates on cotton.

MATERIALS AND METHODS

The experiment was conducted during 1996 - 1998 on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL. Following are the applied tillage, winter cover, and fertility treatments:

I. Tillage (main plots):
   1. Strip tillage
   2. Conventional.

II. Winter cover crop (sub plots):
   1. Fallow
   2. Legume
   3. Wheat

III. Nitrogen fertilizer rates on cotton (lb/acre) (sub sub plots):
   1. 0 lb/acre
   2. 60 lb/acre
   3. 120 lb/acre

4. 180 lb/acre

Winter crops were planted in the fall of 1996 and 1997 only. Pioneer 2684 wheat was planted at 1.5 Bu/acre (90 lb/acre) only on the plots with this winter crop and crimson clover was planted at 27 lb/acre with a Great Plains No-till Drill. The study was irrigated as needed. On April the entire study was sprayed with Roundup @ 1 qt/acre in order to prepare the field to plant cotton. The conventional sections of the experiment were mowed, disc-harrowed (2x), chisel-plowed (1x), and s-tine harrowed (1x) to prepare a good seedbed for cotton seeds in May. In mid May NuCotn 33B (in 1996 and 1997) and DP 458 BR cotton (in 1998) were planted in conservation till and conventional system with a 2-row Brown Ro-till and KMC planters at 3-4 seeds/ft of 36 inch wide rows together with the application of Thimet at 3½ lb/acre. The same day cotton was side-dressed with 350 lb/acre of 3-9-18 fertilizer. Cotton was side-dressed with nitrogen (34-0-0) treatments of 60, 120, and 180 lb N/acre (the treatment with 180 lb N/acre had 120 lb N/acre applied at 40 days and 60 lb N/acre at 70 days after planting). Cotton was picked with a 782 International Cotton Spindle Picker. The lint cotton yield was calculated as 38% of seed cotton yield. Data were analyzed using SAS (1989) by analysis of a variance, and means were separated using Fisher's Least Significant Difference Test at the 5% probability level.

RESULTS

Lint cotton yields were significantly different between years and were influenced by previous crop, N rates, and the interaction of tillage and previous crops. Significantly lower yields were obtained in 1998 due to hard-locks of cotton in all plots which reduced mechanically harvested yields (Figure 1). Main effect of tillage was not significant for the lint yields (Table 1). Higher yields of cotton were obtained after crimson clover (756 lb/acre) than wheat or fallow (705 and 694, respectively). The interaction of tillage and previous crop was due to getting higher lint yields in strip-till than conventional till after fallow (712 and 677 lb/acre, respectively) while yields were higher in conventional till after crimson clover (minimum difference) and wheat (739 and 669 lb/acre, respectively) compared to strip-till. There was a significant ($P \# 0.05$) positive response to N between 0 and 60 lb N/acre and between 60 and 120 lb N/acre but no response between 120 and 180 lb N/acre (Figure 2).

The weight of cotton bolls was influenced by tillage, previous crop, N rates, the interaction of tillage and previous crop, and the interaction of previous crop and N rates (Table 2 and 3). Cotton bolls were heavier after strip-till than conventional till (4.40 and 4.29 gms, respectively). Comparing previous crops, heavier bolls were obtained after fallow than wheat (4.42 and 4.21 gms, respectively). There was not statistical difference for the boll weight between crimson clover and fallow and between crimson clover and wheat. Positive response to N occurred between 0 and 60 lb N/acre and higher than 60 lb N/acre reduced the weight of bolls . The interaction of tillage and previous crop indicated heavier bolls in strip-till than conventional after fallow and crimson clover, and heavier bolls in conventional than strip-till after wheat. The interaction of previous crop and N rates showed that after crimson clover and wheat, application of higher than 60 lb N/acre reduced the weight of bolls significantly but after fallow higher rates did not change the boll weight.

Plant height was influenced by tillage (Figure 3), previous crop, N rates, and interaction of previous crop and N rates (Table 4). Plants were significantly taller in strip-till than conventional planting (2.87 and 2.68 ft.) and taller after crimson clover than wheat and fallow (2.93, 2.73, and 2.66 ft., respectively). Plant height was increased with higher N rates. Rates of N produced a range in plant height from about 2 feet with zero N to over 3 feet with 180 lb of N/acre. The interaction of previous crops and N rates shows that plants were taller after crimson clover than fallow with no N application but at the higher nitrogen rates the differences between previous crops were not significant. Higher response to the N application occurred after fallow than crimson clover or wheat.

CONCLUSIONS

1. r yields of cotton were obtained after crimson clover than wheat or fallow.

- Nitrogen application up to 120 lb/acre significantly increased lint yield of cotton.
- Cotton bolls were heavier in strip-till than conventional till, heavier after fallow than wheat with positive response to N rate of up to 60 lb/acre.
- Plant height was greater in strip-till than conventional planting and greater after crimson clover than wheat and fallow, and increased with increasing N rates on cotton.

REFERENCES

Beale, V. W.., G. B. Nutt, and T. C. Peele. 1955. The effects of mulch tillage on runoff, erosion, soil properties, and crop yields. Soil Sci. Soc. Am. Proc., 19:244-247.

Brown, S. M.., T. Whitwell, J. T. Touchton, and C. H. Burmester. 1985. Conservation tillage systems production for cotton production. Soil

Hutchinson, R. L., G. A. Breitenbeck, R. A. Brown, and W. J. Thomas. 1994. Effects of tillage systems and cover crops on nitrogen fertilizer requirements of cotton. pp. 70-76. In Proc. of the 1994 South. Cons. Till. Conf.

for Sust. Agric. Columbia, SC, June 7-9.
Hutchinson, R. L., R. A. Brown, B. R. Leonard, and C. W. Kennedy. 1993. Effects of tillage systems and winter cover crops on yield and maturity of cotton on a loess soil in northeast Louisiana. Pp. 85-91. Proc. 1993 South. Cons. Till. Conf. Louisiana Agric. Exp. Sta. Manuscript no. 93-86-7122.
SAS Institute Inc. 1989. SAS/STAT user's guide version 6, 4th ed., vol. 1 and 2. SAS Institute Inc., Cary, NC. 1789 pp.
Stevens, W. E., J. R. Johnson, J. J. Varco and J. Parkman. 1992. Tillage and winter cover management effects on fruiting and yield of cotton. J. Prod. Agric. 5: 570-575.
Touchton, J. T., D. H. Richerl, R. H. Walker, and C. E. Snipes. 1984. Winter legumes as a nitrogen source for no-tillage cotton. Soil Tillage Res., 4:391-401.

Table 1. Influence of Tillage and Previous Crop on Lint Cotton Yields at NFREC, Quincy, FL (3 Yr. Avg.)

Tillage	Previous crop			Avg.
	Fallow	Crimson Clover	Wheat	
	---------- lb/acre ----------			
Strip-till	712	748	669	709
Conv.	677	764	739	715
Avg.	694	756	705	712

$LSD_{(0.05)}$ for tillage NS
$LSD_{(0.05)}$ for previous crops 40.5
$LSD_{(0.05)}$ for tillage x previous crops 55.2

Table 2. Influence of Tillage and Previous Crop on Boll Weight of Cotton at NFREC, Quincy, FL (3 Yr. Avg.)

Tillage	Previous crop			Avg.
	Fallow	Crimson Clover	Wheat	
	---------- gms ----------			
Strip-till	4.50	4.46	4.09	4.40
Conv.	4.34	4.03	4.32	4.29
Avg.	4.42	4.30	4.21	4.35

$LSD_{(0.05)}$ for tillage0.13
$LSD_{(0.05)}$ for previous crops 0.17
$LSD_{(0.05)}$ for tillage x previous crops 0.22

Table 3. Influence of Previous Crop and N Rates on Boll Weight of Cotton at NFREC, Quincy, FL (3 Yr. Avg.)

N rates	Previous crop			Avg.
	Fallow	Crimson Clover	Wheat	
	---------- gms ----------			
0	4.31	4.31	3.89	4.22
60	4.48	4.61	4.55	4.52
120	4.42	4.30	4.31	4.37
180	4.45	3.96	4.08	4.27
Avg.	4.42	4.30	4.21	4.35

$LSD_{(0.05)}$ for previous crops0.17
$LSD_{(0.05)}$ for N rates0.18
$LSD_{(0.05)}$ for previous crops x N rate 0.32

Table 4. influence of Previous Crop and N Rates of Plant Height of Cotton at NFREC, Quincy, FL (3 Yr. Avg.)

N rates	Previous Crop			Avg.
	Fallow	Crimson Clover	Whear	
	----------ft----------			
0	1.88	2.53	2.06	2.14
60	2.65	2.93	2.69	2.75
120	3.02	3.13	2.89	3.01
180	3.09	3.12	3.29	3.16
Avg.	2.66	2.93	2.73	2.76+

$LSD_{(0.05)}$for previous crops 0.14
$LSD_{(0.05)}$for N rates 0.1
$LSD_{(0.05)}$ for previous crops x N rates 0.28

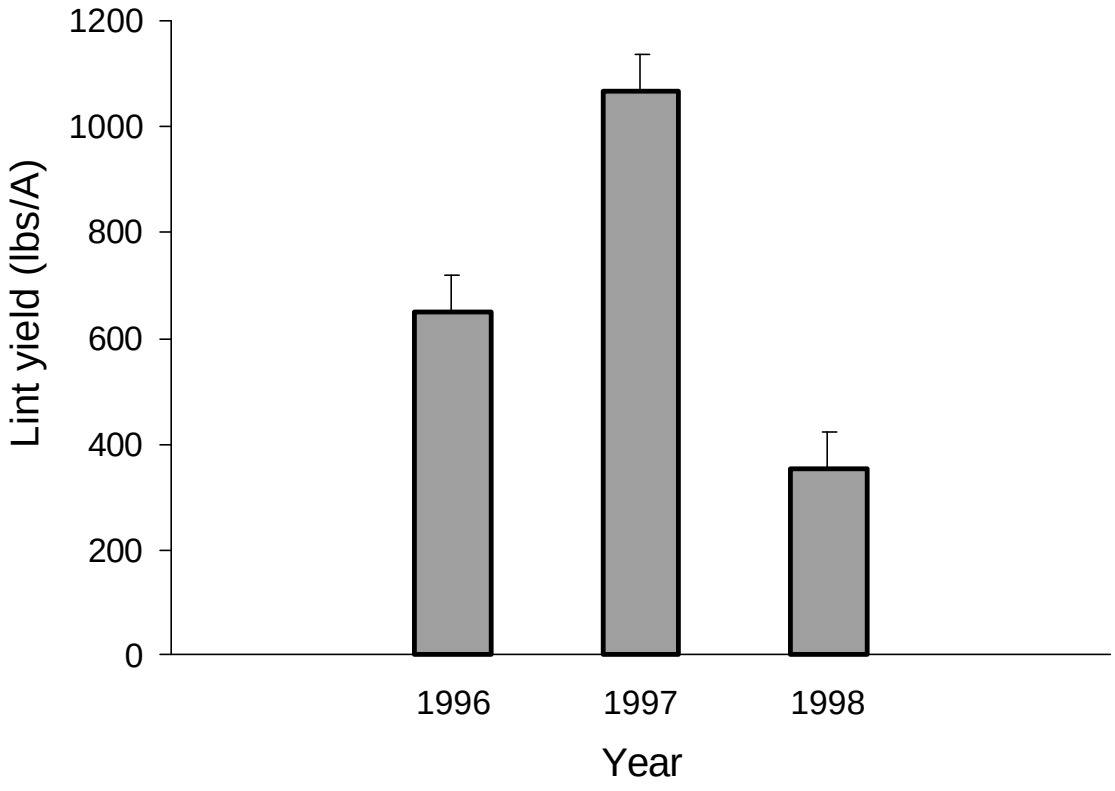

Fig. 1. Average lint cotton yields (lb/acre) over three years at NFREC, Quincy, FL.

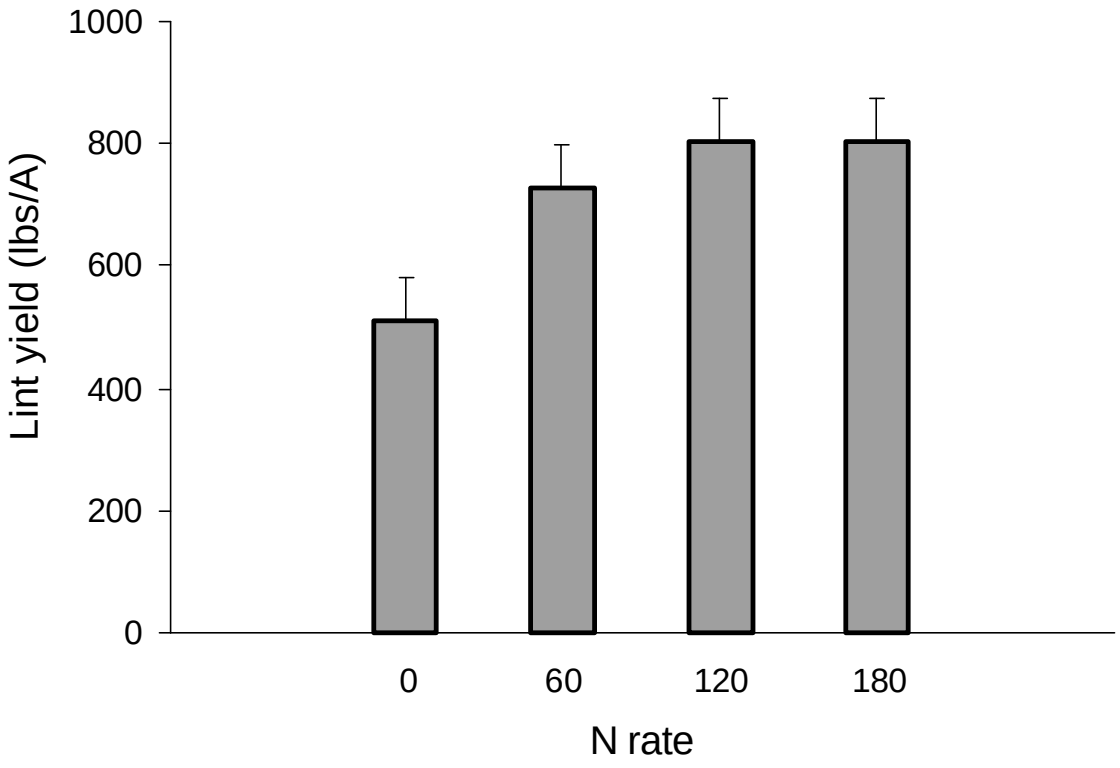

Fig. 2. Influence of N rates on lint cotton yields (3 yr. avg.)

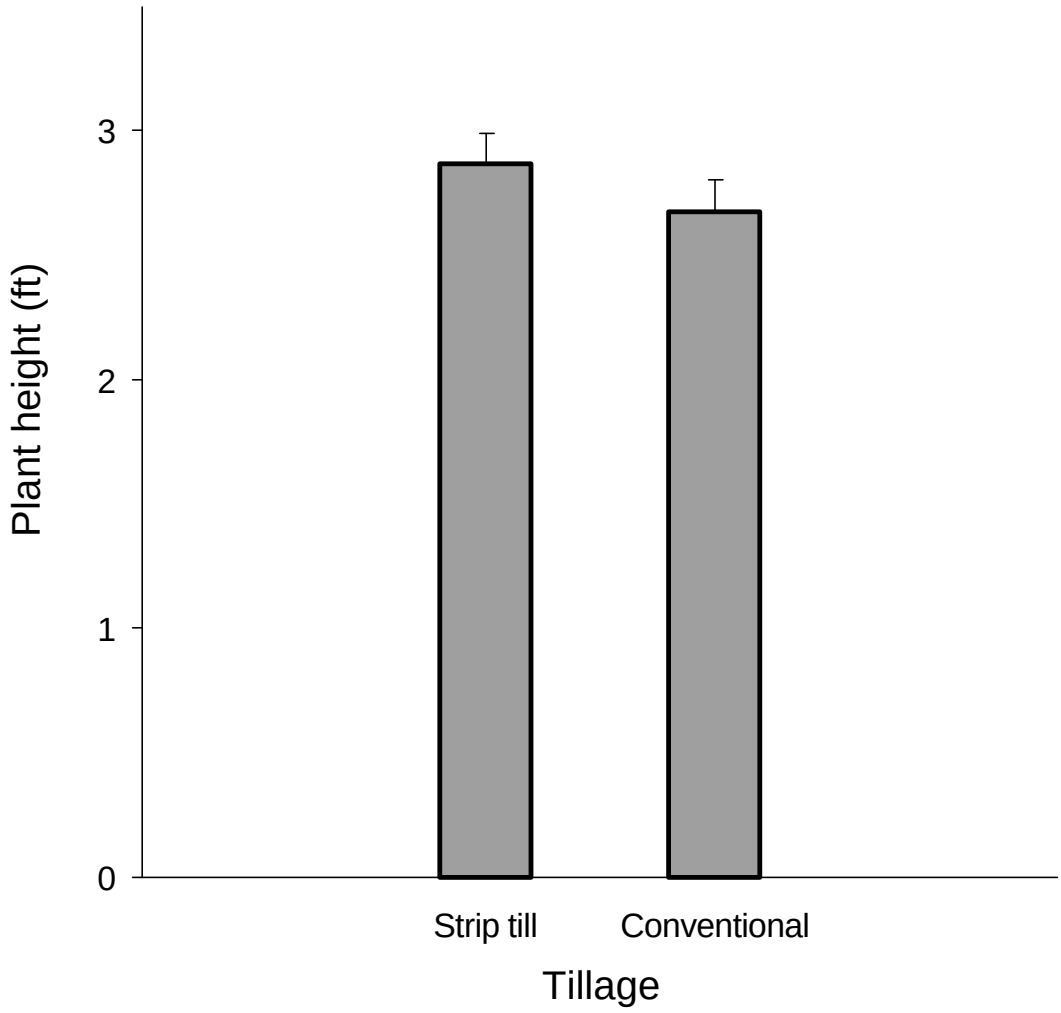

Fig 3. Influence of tillage on plant height of cotton at NFREC, Quincy, FL (3 yr. avg.)