Effect of rye (*Secale cereale* L.) residue removal and interaction with nitrogen fertilization on cotton productivity

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ABSTRACT

Optimum nitrogen (N) rates for cotton depend on many variables including winter cover crop residue management (WCCRM). An experiment, in central Alabama, examined the effect of WCCRM and cotton N rates on cotton productivity in 2006. The WCCRM treatments were no cover crop, rye residue removed and rye residue retained. Cotton N rates were 0, 50, 100 and 140 kg ha^{-1}. First year data shows higher cotton biomass yield, N uptake and higher plant and leaf N concentration at first square when rye residue was retained. Rye residue retained had the lowest leaf N concentration at mid-bloom, and the highest cotton biomass yield and N uptake at cutout. Higher N rates increased leaf N concentration at mid-bloom and cotton biomass yield and N uptake at cutout. The soil N mineralized/immobilized between first square and cutout was not significantly affected by residue management levels. Seed cotton yield response to N varied across residue management levels with higher N rates required when residue was removed or retained with respect to no cover crop. Preliminary results suggest residue management levels affected cotton plant growth parameters and seed cotton yield response to N rates.

INTRODUCTION

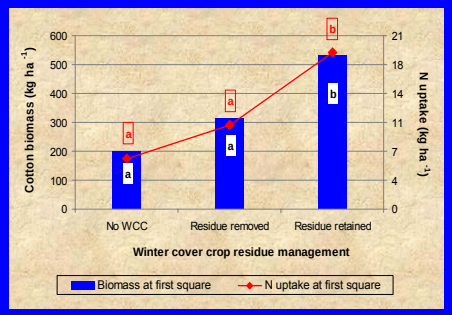
Winter cover crop residue removal could change cotton N fertilization requirements in conservation systems. A reduction in the amount of high C/N residue left on the soil surface could decrease soil N immobilization. In this situation, optimum N rates for cotton should be lower compared to when high levels of residue are retained on the soil surface.

OBJECTIVES

Examine how cotton growth and yield are affected by winter cover crop residue management and N rates.

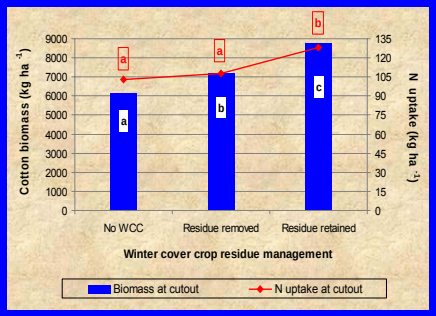
MATERIALS AND METHODS

The experiment was conducted on a Marvyn fine-loamy, kaolinitic, thermic Typic Kanhapludult at the E.V. Smith Research Center, in central Alabama. The experiment was started in the Fall of 2005 with rye planting. Three WCCRM schemes (no WCC, WCC residue removed in the Spring and WCC residue retained) and four N rates for cotton (0, 50, 100 and 140 kg ha^{-1}) were evaluated. Measured variables for the 2006 year included cotton biomass yield, N uptake and leaf N concentration at first square, leaf N concentration at mid-bloom, cotton biomass yield and N uptake at cutout, soil N mineralized/immobilized and seed cotton yield. Statistical analysis was performed using the PROC MIXED procedure of SAS, considering effects as significant when P≤0.05.



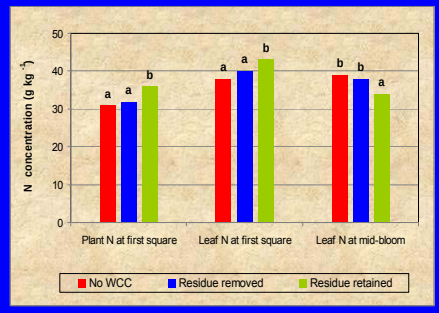
Columns with different letters (for each variable) are significantly different at P≤ 0.05.

Figure 1. Cotton biomass yield and N uptake measured at first square for each residue management treatment.



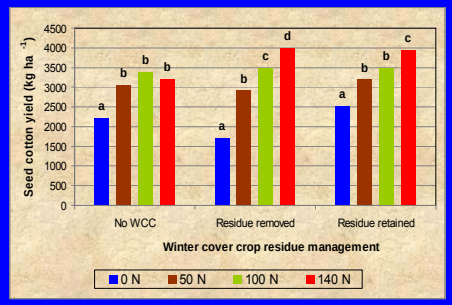
Columns with different letters (for each variable) are significantly different at P≤ 0.05.

Figure 2. Cotton biomass yield and N uptake measured at cutout for each residue management treatment.



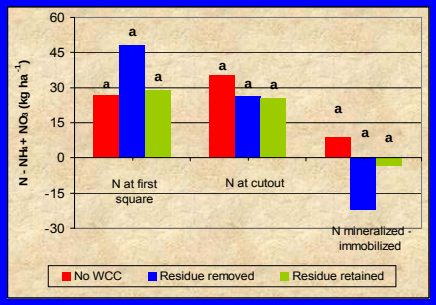
Columns with different letters (for each variable) are significantly different at P≤ 0.05.

Figure 3. Nitrogen concentration in cotton for each residue management treatment.



Columns with different letters (for each WCC residue management) are significantly different at P≤ 0.05.

Figure 4. Seed cotton yield measured across N rates within each residue management treatment.



Columns with different letters (for each variable) are significantly different at P≤ 0.05.

Figure 5. Nitrogen mineralized/immobilized between first square and cutout for each residue management treatment.

Nitrogen treatments	Leaf N at mid-bloom (g kg^{-1})	Cotton biomass at cutout (kg ha^{-1})	N uptake at cutout (kg ha^{-1})
0 N	26 a	4928 a	55 a
50 N	36 b	7451 b	102 b
100 N	42 c	8425 c	137 c
140 N	43 c	8743 c	158 d

Values followed by different letters (inside of columns) are significantly different at P≤ 0.05.

Table 1. Leaf N concentration at mid-bloom, and cotton biomass yield and N uptake at cutout for each cotton N rate.

RESULTS

- WCC residue retained had the highest cotton biomass yield, N uptake and plant and leaf N concentration at first square (Figures 1 and 3).
- No WCC and WCC residue removed had the highest leaf N concentration at mid-bloom (Figure 3).
- WCC residue retained had the highest cotton biomass yield and N uptake at cutout (Figure 2).
- Leaf N concentration at mid-bloom and cotton biomass yield at cutout responded to N fertilizer up to 100 kg N ha^{-1}, but N uptake response at cutout was up to 140 kg N ha^{-1} (Table 1).
- Seed cotton yield response to N was up to 140 kg ha^{-1} for WCC residue removed and retained treatments, but only up to 50 kg N ha^{-1} for the no WCC treatment (Figure 4).
- There was no difference among WCC residue management treatments in the amount of soil N mineralized/immobilized between first square and cutout (Figure 5).

CONCLUSIONS

- WCC residue removal decreased cotton biomass yield and N uptake at first square and cutout, when compared to residue retained
- Nitrogen concentration in cotton plants and leaves was affected by residue management treatments.
- Higher leaf N concentration at mid-bloom and cotton biomass yield and N uptake at cutout were observed with higher rates of N fertilization.
- WCC residue removal did not affect cotton yield response to N, when compared to residue retained.
- WCC residue treatments did not influence the amount of N mineralized/immobilized between first square and cutout.