

SIDEDRESS NITROGEN RATES AND COSTS FOR SOUTHEASTERN COTTON PRODUCTION &**Kipling S. Balkcom****Leah M. Duzy &****USDA-ARS - National Soil Dynamics Laboratory &****Auburn, AL &****Abstract &**

Nitrogen (N) is typically the most important fertilizer input for cotton (*Gossypium hirsutum* L.), and usually ranks in the top five production expenses for cotton. Previous N recommendations have been based on conventional tillage practices that do not include cover crops. Our objective was to determine cotton response to N following non-fertilized and fertilized cover crops. This experiment was conducted at the Wiregrass Research and Extension Center in Headland, AL during the 2006-2008 growing seasons. A traditional cotton N response trial was conducted following a non-fertilized cover crop with three additional treatments consisting of split applications for the 90 lb N ac⁻¹ rate. This trial was embedded on the 0 N plots, and examined time of application, N source, and N rate for a cover crop. All corresponding eight row cotton plots that received N fertilizer on the cover crop were split with four rows receiving 90 lb N ac⁻¹ at sidedress, while the other four rows were not fertilized. Nitrogen rates for cotton following the non-fertilized cover crop indicated that 30 lb N ac⁻¹ applied at planting followed by 60 lb N ac⁻¹ at sidedress was consistently effective for maximum lint yield across all three growing seasons. Cotton grown following a cover crop fertilized with 30 lb N ac⁻¹ or 1 ton poultry litter ac⁻¹ consistently produced maximum yields with 90 lb N ac⁻¹ applied at sidedress across all three years of the study. These data represent multiple growing seasons but only one variety and one soil type; however, the results indicate that cotton following high residue cover crops may not always require N fertilizer above currently recommended rates to maximize yields.

Introduction

Nitrogen is typically the most important fertilizer input for cotton, and usually ranks in the top five production expenses for cotton. Under application of N can result in low yields, while over application of N can create excessive vegetative growth that reduces yields, promotes disease pressure, and may result in unnecessary environmental risks. Sampling for residual N is typically not done in the Southeast due to the warm, humid climate. As a result, careful consideration of rates, including costs, is required to optimize productivity and profits. These decisions can be further complicated by tillage systems that include cover crops. Beneficial effects from cover crops are usually enhanced by applying fertilizer to promote maximum biomass production. The fertilizer N sources can be inorganic or organic, but it is not clear how the fertilizer applied to the cover crop affects the cotton fertilizer N requirements. Therefore, our objective was to determine cotton response to N following non-fertilized and fertilized cover crops.

Methods

This experiment was conducted at the Wiregrass Research and Extension Center in Headland, AL on a Fuquay sand (loamy, kaolinitic, thermic Arenic Plinthic Kandiudults) during crop years 2006-2008 with DPL 555 as the variety. Cotton plots following a cover crop that received no additional N were used to conduct a traditional cotton response trial consisting of 5 N rates (0, 30, 60, 90, and 120 lb N ac⁻¹) with three additional treatments consisting of split applications for the 90 lb N ac⁻¹ rate. The split applications consisted of 30 lb N ac⁻¹ at planting followed by 60 lb N ac⁻¹ at sidedress, 45 lb N ac⁻¹ at planting followed by 45 lb N ac⁻¹ at sidedress, and 90 lb N ac⁻¹ at planting. This trial was embedded on the 0 N plots in a trial that examined time of application (fall and spring), N source (commercial fertilizer, and poultry litter), and N rate (0, 30, 60, and 90 lb N ac⁻¹ as commercial fertilizer and 0, 1, 2, and 3 tons ac⁻¹ as poultry litter on an as-sampled basis) for a cover crop. The eight row plots where N was applied to the cover crop were split in half, with four rows receiving 90 lb N ac⁻¹ at sidedress, while the other four rows were not fertilized. This was done to detect any residual N applied to the cover crop that might have been available to the cotton crop. Each four row plot was 12 ft. wide and 45 ft. long.

Cover crop biomass samples were collected immediately preceding chemical termination from each plot by cutting all aboveground material from two, 2.69 ft² areas within each plot, drying, and weighing approximately 3 weeks before the anticipated cotton planting date. The two center rows of all cotton plots were harvested with a mechanical harvester equipped with a bagging attachment. A subsample of seed cotton from each plot was ginned

in a 20-saw tabletop micro-gin to determine ginning percentage. Lint yields were determined by weighing lint and seed collected from each plot and multiplying corresponding seed cotton by the ginning percentage of each plot. Lint yield was analyzed based on a general linear mixed model procedure using SAS software (Littell et al., 2006) (release 9.2, SAS Institute Inc., Cary, NC) with differences between treatment means considered significant if $P \leq 0.05$.

Results

Fertilizer rate had the most significant impact on cover crop biomass, but 30 lb N ac⁻¹ or 1 ton ac⁻¹ of poultry litter was adequate to produce sufficient biomass when averaged over all three growing seasons (Fig. 1). Reiter et al. (2008) established a minimum biomass threshold (4000 lb ac⁻¹) to qualify as high residue production in the Southeast to maximize cover crop benefits. As expected, additional N produced additional biomass, but the lowest N rate was sufficient to produce an adequate level of cover crop biomass.

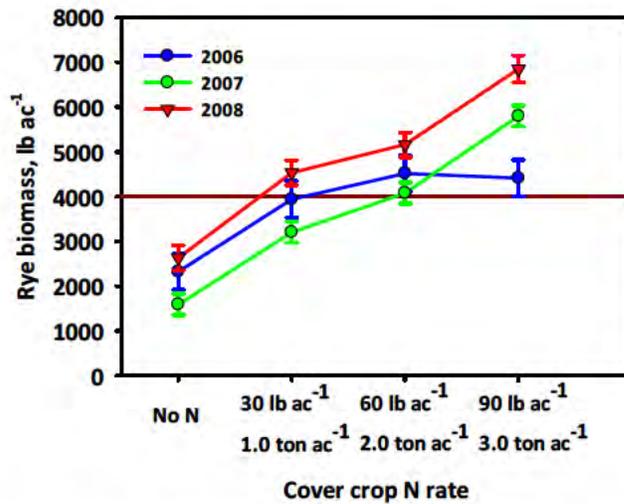
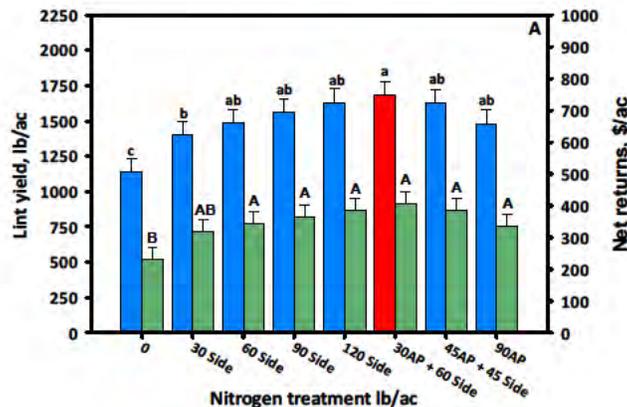


Figure 1. Rye biomass production measured across commercial fertilizer and poultry litter rates during the 2006-2008 growing seasons at the Wiregrass Research and Extension Center in Headland, AL. Solid horizontal line represents a minimum threshold for biomass production in the Southeast (Reiter et al., 2008).

Nitrogen rates for cotton following the non-fertilized cover crop indicated that 30 lb N ac⁻¹ applied at planting followed by 60 lb N ac⁻¹ at sidedress was consistently effective for maximum lint yield across all three growing seasons (Fig. 2).



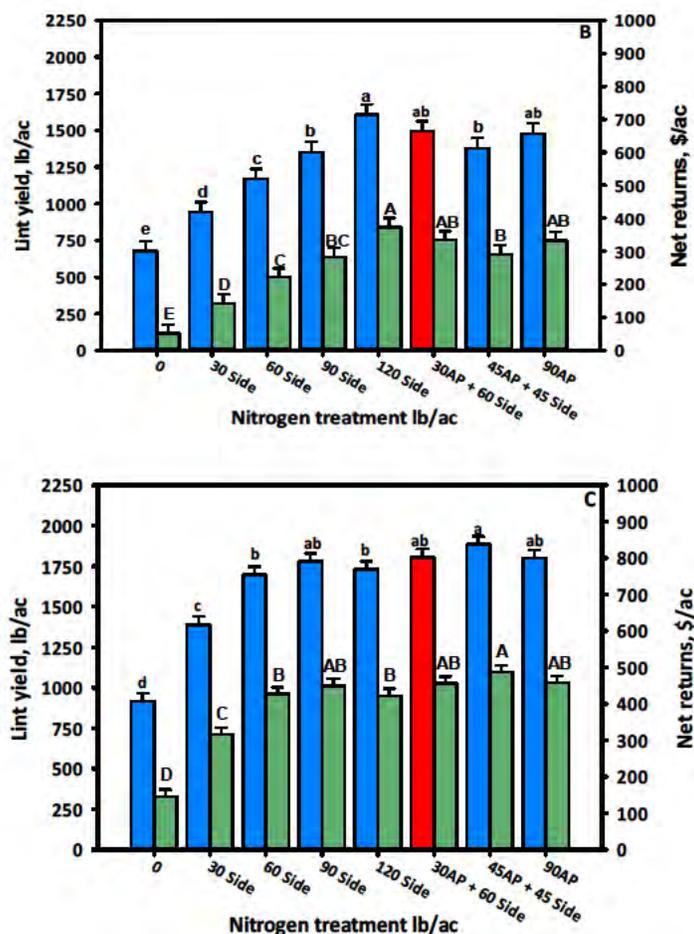


Figure 2. Cotton lint yields (blue bars) and net returns (green bars) for different N sidedress rates and times of application during the 2006 (A), 2007 (B), and 2008 (C) growing seasons at the Wiregrass Research and Extension Center in Headland, AL. The red bar denotes a standard recommendation of 30 lb N ac⁻¹ at planting followed by 60 lb N ac⁻¹ at sidedress.

This N rate and time of application combination corresponds to current N fertilizer recommendations for cotton grown with conventional tillage practices. In 2006, cotton lint yields were very high when no N was applied, which indicates that some residual N may have been present from a previous crop rotation or fertilization practice (Fig. 2A). A blanket cost of production was estimated with only the cost of N different among treatments. As a result, net returns were directly related to the amount of lint produced among treatments (Fig. 2).

Due to plot space limitations, it was only possible to evaluate two N rates on the cotton (0 lb N ac⁻¹ and 90 lb N ac⁻¹) following a cover crop. Cotton grown following a cover crop fertilized with 30 lb N ac⁻¹ or 1 ton poultry litter ac⁻¹ consistently produced maximum yields with 90 lb N ac⁻¹ applied at sidedress across all three years of the study (Fig. 3).

In 2008, additional N applied to the cover crop decreased lint yields when the cotton received 90 lb N ac⁻¹ at sidedress (Fig. 3C). Cover crop N rates above 30 lb N ac⁻¹ or 1 ton poultry litter ac⁻¹ increased cotton yields only when no additional N was applied to the cotton crop (Fig. 3). It is surprising to compare the cotton response to N following a cover crop that was not fertilized, which is highlighted by the red line in each figure, particularly the 90 lb N ac⁻¹ sidedress rate with and without 30 lb N ac⁻¹ or 1 ton ac⁻¹ of poultry litter applied to the cover crop (Fig. 3). In 2006 and 2008, the differences were minimal between observed yields (Fig. 3A, 3C), but in 2007, lint yields were superior when the cover crop was fertilized indicating a benefit associated with high residue (Fig. 3B). Previous

research has indicated possible benefits, including weed suppression that reduces competition with the crop and/or increased water infiltration that leads to increased plant available water (Lascano et al., 1994; Reeves et al., 2005).

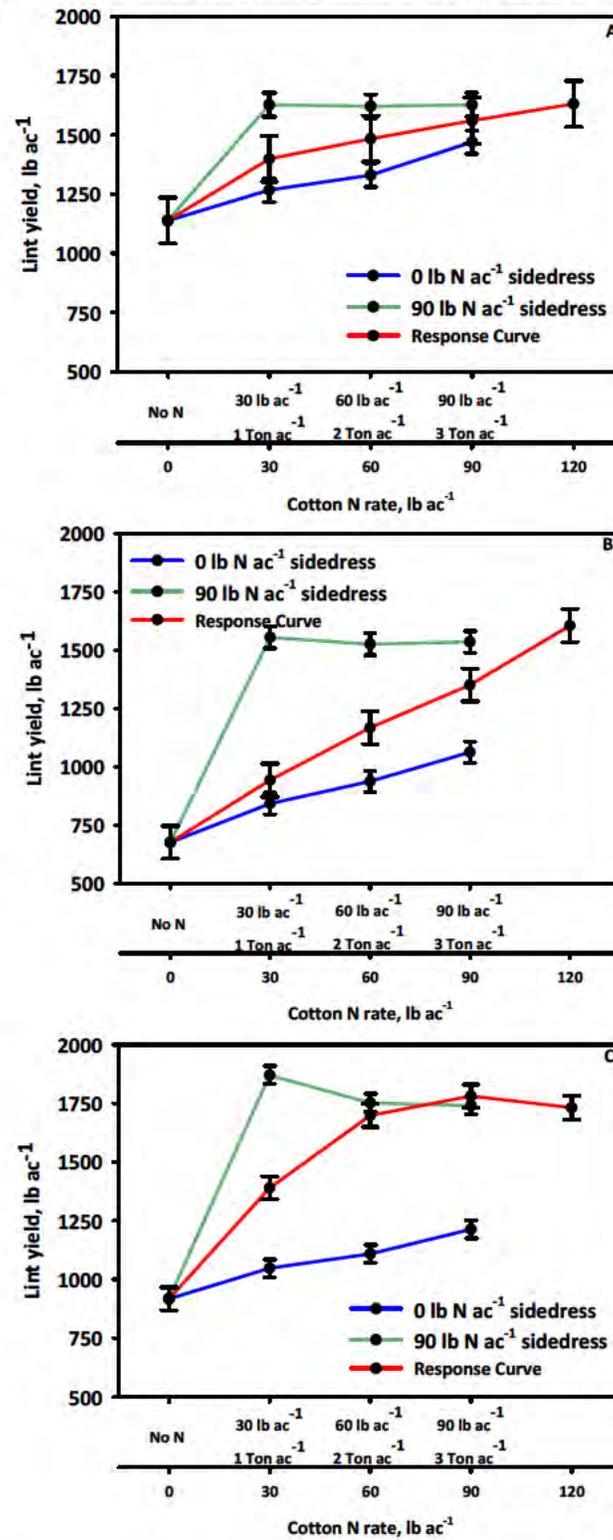


Figure 3. Cotton lint yields observed for two sidedress N rates following a cover crop fertilized with four different N rates during the 2006 (A), 2007 (B), and 2008 (C) growing seasons at the Wiregrass Research and Extension

Center in Headland, AL. The red line illustrates the cotton lint yield response to five different sidedress N rates ! conducted simultaneously where no N was applied to the cover crop (cotton N rates are shown in the lower x-axis).

Summary

These results indicate that N fertilizer applied to a cover crop preceding cotton contributes minimal amounts of fertilizer to the total N cotton requirements. Current sidedress N recommendations (90 lb N ac⁻¹) for cotton following a non-fertilized rye cover crop appear sufficient, and no evidence exists from these results for reducing the recommended cotton sidedress N rate following a cover crop fertilized with 30 lb N ac⁻¹. These data represent multiple growing seasons but only one variety and one soil type; however, the results indicate that cotton following high residue cover crops may not always require N fertilizer above currently recommended cotton N rates to maximize lint yields.

References

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