COTTON RESEARCH ANNUAL REPORT
Alabama Cotton Commission

PROJECT TITLE: "NITROGEN FERTILIZER SOURCE, RATES, AND TIMING FOR A COVER CROP AND SUBSEQUENT COTTON CROP"

AGREEMENT NUMBER: ALCTNCOM-NITROGEN FERTILIZER

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PROJECT OBJECTIVE:
1 - Compare N fertilizer sources, rates, and time of application for a rye winter cover crop to determine optimal biomass production for conservation tillage production.
2 – Compare recommended and no additional N fertilizer rates across different biomass levels for cotton.
3 – Determine the effect of residual N applied to the cover crop across two N fertilizer rates for cotton.

PLAN OF WORK:
Nitrogen sources, rates, and time of application were implemented at the Wiregrass Research and Extension Center (WREC) in Headland, AL. Biomass cover treatments were arranged in a split-split-plot design with 4 replications. At cotton planting, the eight row plots were split with one side receiving 90 lb N ac^{-1} at sidedress and the other side receiving no additional N.

Time of application
1. Fall
2. Spring

Nitrogen Source
1. Commercial fertilizer
2. Poultry litter

Nitrogen Rates

Commercial fertilizer	Poultry litter
1. 0 lb ac^{-1}	1. 0 ton ac^{-1}
2. 30 lb ac^{-1}	2. 1 ton ac^{-1}
3. 60 lb ac^{-1}	3. 2 tons ac^{-1}
4. 90 lb ac^{-1}	4. 3 tons ac^{-1}

REPORT:

A rye cover crop was drilled across the experimental area on Nov. 9, 2006 at the WREC. Rye was seeded at 90 lb ac^{-1}. Plot size was 24 ft. (8-36 inch rows) wide and 40 ft. long. Fall poultry litter treatments were applied on the same day the cover crop was planted. Commercial fertilizer was applied on Dec. 4, 2006 after stand establishment. The spring applications of commercial fertilizer and poultry litter were applied on Feb. 7, 2007. Poultry litter application rates were designed to approximate commercial fertilizer rates based on total and estimated available N supplied in the litter (Table 1). Biomass samples were collected on April 16, 2007 by collecting all aboveground plant biomass from two 2.7 ft^2 areas within each plot. Immediately prior to cotton planting, all plots, were in-row subsoiled with a KMC Ripper Stripper® equipped with rubber pneumatic tires to minimize surface disruption. DPL 555® BG/RR was planted on May 2, 2007. The eight row plots were split and corresponding cotton plots were sidedressed on June 20, 2007 with 90 lb N ac^{-1}, while other plots were not fertilized, in order to estimate any residual effects from the poultry litter.

Table 1. Total and available N applied in the fall and spring from poultry litter on a dry weight basis at the Wiregrass Research and Extension Center in Headland, AL during the 2006-2007 growing season.

	Rate (tons ac^{-1})				Rate (tons ac^{-1})			
Time of application	0	1	2	3	0	1	2	3
	Total N				Available N†			
	----------lb ac^{-1}----------							
Fall	0	53	106	159	0	27	53	80
Spring	0	69	138	207	0	35	69	104

† Available N based on an estimate of 50% total N available during the first year of application.

Nitrogen uptake at mid-bloom was determined by collecting whole plant biomass from the aboveground portion of all plants within a 3.28 ft. section of a non-harvest row from each plot. The plant material collected was dried at 55 degrees Celsius for 72 hours and weighed to estimate plant biomass of each plot. A subsample from each plot was analyzed for total N by dry combustion on a LECO CHN-600 analyzer (LecoCorp.; St. Joseph, MI). Corresponding N contents and biomass were used to calculate N uptake at mid-bloom.

The plot area was defoliated with 1.5 pt/ac. of Finish® and Ginstar® at 5 oz/ac on Sept. 26, 2007. All plots were harvested with a spindle picker equipped with a bagging attachment on Oct. 3, 2007. A sub-sample 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.

Rye biomass production

Biomass levels measured in 2007 produced a timing X rate interaction ($Pr > F = 0.0440$), which indicates that biomass levels increased with fall application of N (Fig. 1). Timing of N fertilizer had no effect on measured biomass levels during the previous year of this study, but biomass levels following fall applied N averaged over sources and rates for both crop years indicate 25% higher biomass levels compared to spring applied N. This would indicate that if growers choose to maximize biomass production by utilizing some form of N fertilizer that fertilizer would be more beneficial to the cover crop if applied in the fall.

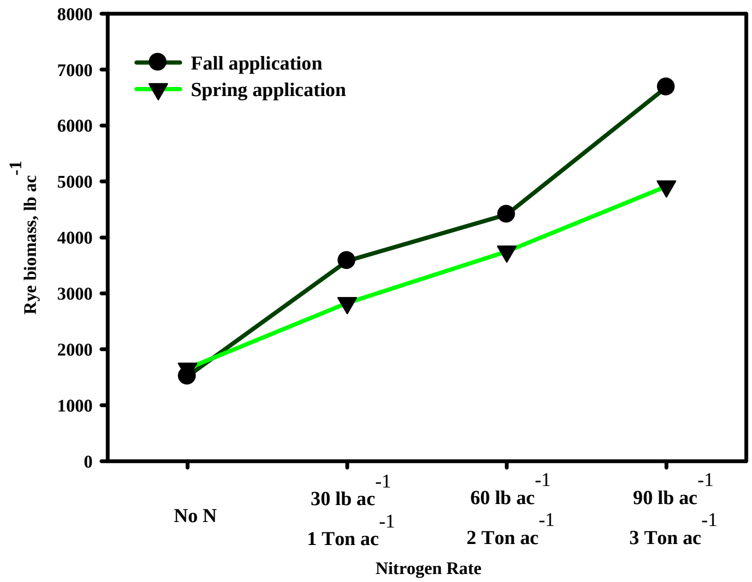

Figure 1. Rye biomass production measured between N rates, regardless of source and time of application during the 2006-2007 winter growing season at the Wiregrass Research and Extension Center in Headland, AL.

Lint yields

In 2007, time of application and cover crop N rate influenced measured cover crop biomass levels (Table 2). Based on this information and an effort to simplify the analysis of cotton lint, timing of cover crop N application was the main plot, cover crop N rate was the subplot, and the two sidedress N rates were the sub-subplots. Significant interactions between time of application and sidedress N rates, as well as, cover crop N rates and sidedress N rates were observed in 2007 and are illustrated in the following figures. As expected, regardless of cover crop N timing, lint yields were increased with 90 lb N ac^{-1} compared to 0 lb N ac^{-1}, however, spring applied N to the cover crop produced superior yields compared to fall applied N at the 0 lb N ac^{-1} sidedress rate (Fig. 2). Nitrogen applied in the spring to the cover crop would be less susceptible to loss, prior to cotton uptake, which could explain this difference. Depending on how quickly the poultry litter is mineralized, spring applications could also synchronize better with cotton uptake.

Figure 3 illustrates the interaction between cover crop N rate and sidedress N rate observed during the 2007 growing season. By examining only N applied to the cover crop (0 lb N ac^{-1} sidedress), the residual effects of the poultry litter are apparent. Regardless of N source, lint yields increased as cover crop N rate increased, but poultry litter improved lint yields compared to commercial fertilizer (Fig. 3). At the recommended 90 lb N ac^{-1} sidedress rate, the difference between sources was not as great, but lint yields following poultry litter were higher (Fig. 3). This data indicates there is no advantage to cover crop N rates greater than 30 lb N ac^{-1} as commercial fertilizer or 1 ton ac^{-1} as poultry litter when 90 lb N ac^{-1} is supplied at sidedress to the cotton. However, due to the organic fraction of poultry litter, utilizing higher poultry litter rates to the cover crop with lower sidedress N rates could provide some cost savings to growers without sacrificing yields.

Table 2. Cotton lint yields and N uptake measured at mid-bloom across cover crop fertilizer timing, cover

crop N rates and sidedress cotton N rates during the 2007 cotton growing seasons at the Wiregrass Research and Extension Center in Headland, AL.

Treatment		2007	
		Lint yields	N uptake
		------------------lb ac-1------------------	
Timing Cover Crop Fertilizer			
Fall		1192	47.1
Spring		1233	48.9
Cover Crop N Rate			
Poultry litter (tons ac-1)	Commercial fertilizer (lb ac-1)		
0	0	1011	46.2
1	0	1267	48.7
2	0	1288	54.9
3	0	1393	57.4
0	30	1136	41.7
0	60	1182	45.7
0	90	1211	41.5
Sidedress Cotton N rate (lb ac-1)			
0		912	36.0
90		1513	60.0

Figure 2. Cotton lint yields measured following fall and spring applied N to the cover crop and two cotton sidedress N rates (0 and 90 lb N ac^{-1}) during the 2007 growing season at the Wiregrass Research and Extension Center in Headland, AL.

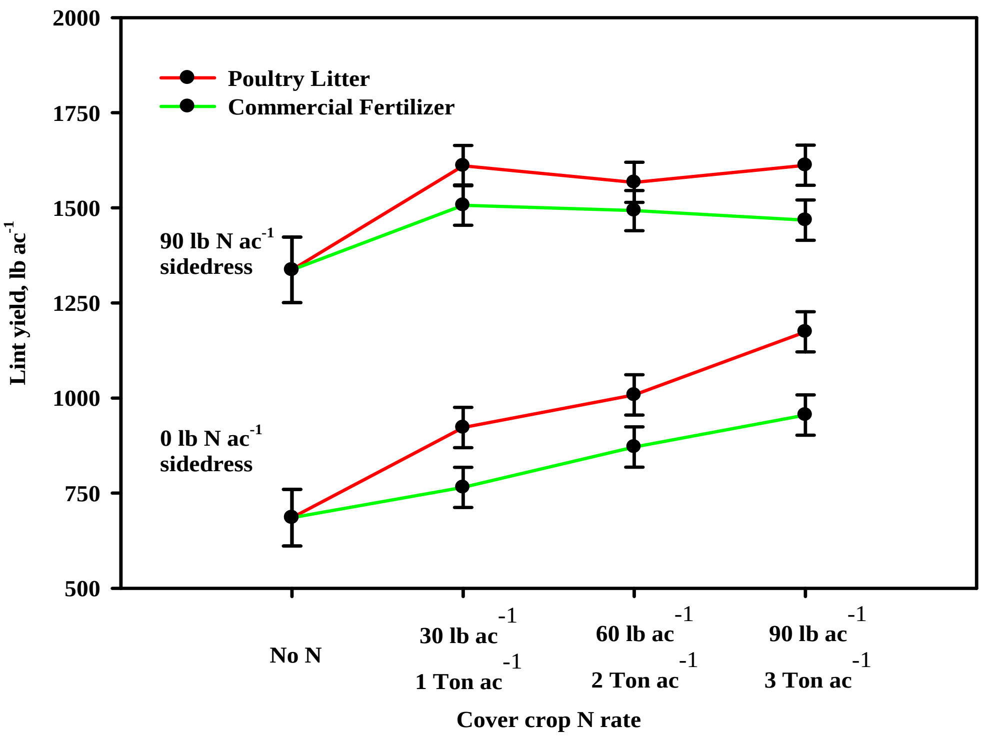

Figure 3. Cotton lint yields measured across two sources of N (commercial fertilizer and poultry litter) applied to the cover crop and two cotton sidedress N rates (0 and 90 lb N ac^{-1}) during the 2007 growing season at the Wiregrass Research and Extension Center in Headland, AL.

N uptake

In 2007, only cover crop N rate and sidedress cotton N rate influenced uptakes at mid-bloom (Table 3). Measured uptakes at mid-bloom were lowest from plots receiving 90 lb N ac^{-1} to the cover crop, while the highest observed uptakes were measured from plots receiving 3 tons ac^{-1} of poultry litter (Table 3). Generally, higher measured uptakes were observed from plots receiving poultry litter compared to plots receiving commercial fertilizer (Table 4). As in 2006, measured uptakes at mid-bloom in 2007 were greater following plots that received the recommended 90 lb N ac^{-1} at sidedress compared to no additional N at sidedress (Table 3).

Conclusions

Poultry litter can be considered a slow release fertilizer and preliminary results indicate that when applied in the fall it benefits the cover crop and the cotton crop. Cover crop biomass is maximized and cotton N rates could be at least partially reduced by using poultry litter. Future work in this area should focus on comparing poultry litter supplied to the cover crop combined with lower cotton N sidedress rates to the current cotton conservation tillage systems that utilize approximately 30 lb N ac^{-1} to the cover crop and maintain recommended sidedress N rates may be warranted. These scenarios could maximize biomass, maintain yields, and decrease costly commercial N use.