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USE OF POULTRY LITTER AS A FERTILIZER SOURCE IN NO-TILLAGE COTTON PRODUCTION

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Abstract

Research was conducted to evaluate the use of poultry litter as a fertilizer source in no-tillage cotton on an Atwood silt loam soil. Litter treatments were surfaced applied immediately prior to planting at 1.2, 2.8, 4.3, and 5.9 tons/ac. Treatment combinations included litter followed by a side-dress application of UAN (32%) solution. A treatment of UAN at 90 lbs N/ac side-dressed was included as the industry standard. Lint yield was at least 915 lb/ac with 2.8, 4.3, and 5.9 ton/ac of litter, equivalent to 70, 110, and 150 lbs/ac of plant-available N, respectively. Lint yield with all treatments that included litter was greater than the untreated check except for the 1.2 ton/ac litter alone and in combination with a side-dress application of 60 lbs N/ac UAN solution. Fiber length and uniformity was not different among treatments. Fiber strength was higher with higher litter rates. Micronaire was in the base range for all treatments. Leaf tissue N, P, and K increased with an increase in litter rate.

Introduction

The poultry industry is thriving in Mississippi and so is the abundance of litter, which must be utilized in an environmentally friendly manner. We have realized the benefits of poultry litter to our traditional grass type forage crops for some time, but little is known about how soil amendments of poultry litter will affect no-tillage cotton. The addition of poultry litter (a combination of poultry manure and bedding material) as a soil amendment should increase cotton yield and improve soil structure, tilth, and other physical and chemical soil properties. Research indicates that cotton seedling emergence and vigor was enhanced with a cover crop, surfaced applied litter, no-tillage system compared to a winter fallow, no litter, conventionally tilled system (Nyakatawa and Reddy, 2000). In addition, litter at 2 tons/ac improved the mean yield of cotton grown in a strip-tilled environment over a 4 year period (Gascho et al., 2001). Therefore, the objectives of this study is to determine if litter should be applied alone or in combination with an inorganic fertilizer source and the appropriate litter rate for a no-tillage system.

Materials and Methods

The soil type was an Atwood silt loam (fine-silty, mixed, thermic Typic Paleududalfs). The experimental design was a randomized complete block with 4 replications. Plot size was 20 x 45 ft. Total N content of the litter used in this study was determined by nutrient analyses conducted at the USDA laboratory in Starkville, Mississippi. Litter rates were based on 50% of the litter N being available. Treatments were made with litter alone and in combination with 32%-N urea-ammonium nitrate solution (UAN). Litter treatments included 1.2, 2.8, 4.3, and 5.9 tons litter/ac. Combination treatments of preplant litter followed by sidedressed (32% UAN) included 1.2 ton/ac litter with 60 lb N/ac (32% UAN) sidedressed and 2.4 tons litter/ac with 30 lb N/ac (32% UAN) sidedressed. A no litter/no fertilizer check and a standard fertility program of 80 lbs P_2O_5 and 60 lbs K_2O prior to planting with 90 lbs N/ac sidedressed were included (P and K rates were determined by state soil test recommendations). The P and K levels in all plots receiving litter were considered sufficient based on litter P and K levels. Lime was applied in the spring according to soil test recommendations. Litter treatments were applied to the soil surface immediately prior to planting.

A preplant burndown application of 1.0 lb ai/ac glyphosate was applied two weeks before planting. Deltapine 451 BR cotton was planted in 40-inch rows with a seeding rate of 55,000 seed/ac. At planting, 0.6 lb ai/ac Temik 15G (aldicarb) was applied in a t-band. Weed management was conducted as necessary to maintain a weed free environment. Cotton was defoliated and harvested with a plot picker equipped with an electronic scale. Samples were collected from each treatment for fiber property analyses (staple, fiber length, fiber strength, and micronaire).

Yield was recorded as pounds of lint per acre. Analysis of variance was conducted and means were separated using Fishers protected LSD (α=0.05).

Results and Discussion

The highest lint yield was 1255 lb/ac in 2003 compared to 940 lb/ac in 2004. Record yields were expected in 2004, but hail damage caused premature defoliation and minimized further crop growth. Average lint yield for 2003-04 was at least 915 lb/ac with 2.8, 4.3, and 5.9 ton/ac of litter, equivalent to 70, 110, and 150 lb N/ac, respectively (Figure 1). Lint yield with all treatments that included litter was greater than the untreated check except for the 1.2 ton/ac litter alone and in combination with a side-dress application of 60lbN/ac UAN solution. In addition, yield with the 90 lbN/ac of UAN fertilizer alone applied at side-dress was not different from the untreated check.

Fiber quality was evaluated for cotton receiving poultry litter (Table 1). Fiber length (32nds ranged from 35 to 36) and uniformity (Average and High) was not different among treatments. Fiber strength was considered Average (26-28) and Intermediate (24-25) for all treatments. However, the strength category was approaching Weak (23 & below) for the untreated check. The micronaire was in the base range "no-discount" (4.3 to 4.9) for all treatments.

Tissue analyses were conducted to determine nitrogen (N), phosphorous (P) and potassium (K) concentration in leaf tissue (Table 2). The N, P, and K content was higher with then 5.9 ton/ac rate of litter compared to all other treatments. Among treatments, N ranged from 2.0 to 2.5 %, P ranged from 2.3 to 4.1 g/kg, and K range from 17.2 to 21.6 g/kg.

These preliminary results indicate that lint yield with a surface application of 2.8 tons/ac of litter prior to planting is comparable to a standard commercial inorganic fertilizer source. This project shows significant promise of minimizing the use of inorganic fertilizer sources and promoting chicken litter as value added component of poultry production.

Table 1. Fiber quality for no-tillage cotton treated with poultry litter at Pontotoc, MS in 2003.

Treatment			Fiber Quality			
Litter		UAN (32%)	Length	Uniformity	Strength	Micronaire
--tons/ac--	--lb N/ac--	--lb N/ac--	--inches--	-----%-----	-grams/tex-	µg/25.4mm
0	0	0	1.08	83	23.7	4.6
1.2	30	0	1.09	82	24.5	4.6
2.8	70	0	1.09	83	24.8	4.6
4.3	110	0	1.10	83	**25.5**	4.6
5.9	150	0	1.10	83	25.0	4.5
0	0	90	1.09	83	23.7	**4.3**
1.2	30	60	1.10	83	24.4	4.4
2.4	60	30	1.11	83	**25.2**	4.5
LSD (0.05)			Nd	nd	1.5	0.2

Table 2. Concentration of N, P, and K in leaf tissue of no-tillage cotton treated with poultry litter at Pontotoc, MS in 2003.

Treatment			Leaf Tissue		
Litter		UAN (32%)	Nitrogen	Phosphorous	Potassium
--tons/ac--	--lb N/ac--	--lb N/ac--	----%----	----------g/kg----------	
0	0	0	2.0	2.6	17.2
1.2	30	0	2.0	2.9	19.2
2.8	70	0	2.1	2.9	19.6
4.3	110	0	2.3	**3.4**	18.9
5.9	150	0	**2.5**	**4.1**	**21.6**

0	0	90	**2.4**	2.3	19.4
1.2	30	60	2.3	2.4	**19.8**
2.4	60	30	2.3	2.5	17.9
LSD (0.05)			0.3	0.8	2.5

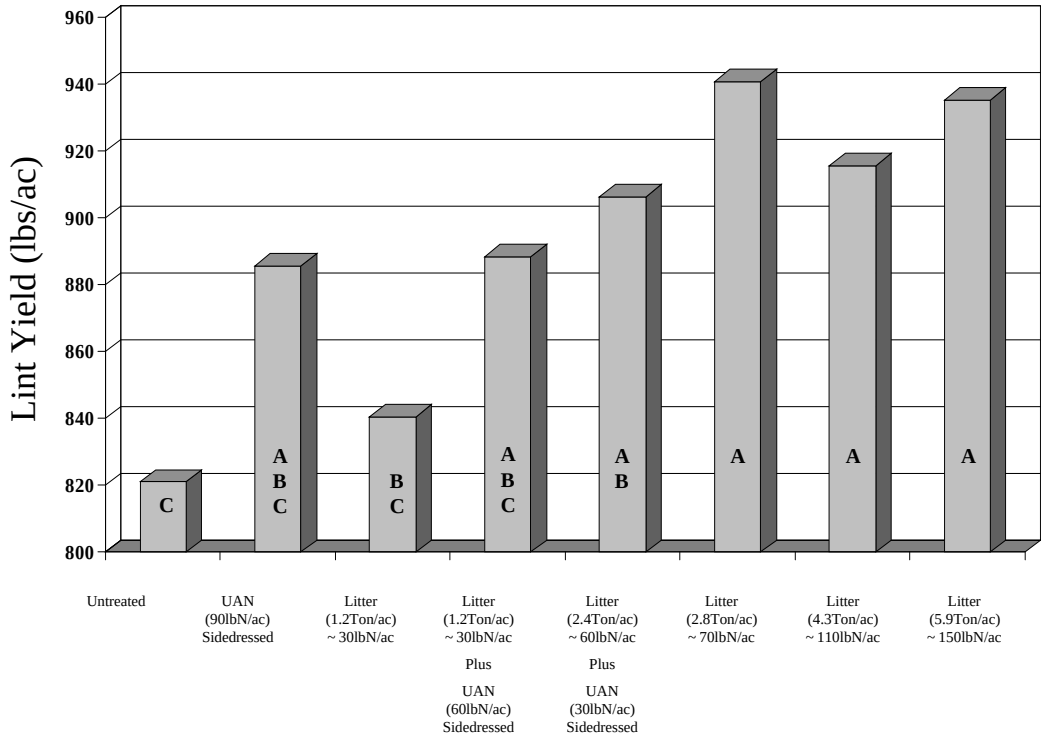

Figure 1. Effect of poultry litter rate on no-tillage cotton lint yield for 2003 and 2004 in Pontotoc, MS.

References

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