POULTRY LITTER AS A NITROGEN SOURCE FOR DRYLAND COTTON ON CLAY SOIL

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Abstract

Arkansas leads all states in poultry production, with production historically being concentrated in the northwestern portion of the state. Use of poultry litter as a fertilizer in row crop production would encourage litter transport from the poultry growing regions to the Delta, thus reducing environmental problems in the northwest. A study was conducted at the University of Arkansas Northeast Research and Extension Center during 1996 and 1997 to determine the effectiveness of poultry litter as a nitrogen source for nonirrigated cotton (Gossypium hirsutum L., cv. Suregrow 125) on a Sharkey silty clay soil. Treatments consisted of preplant incorporated applications of broiler litter and conventional liquid fertilizer. In 1996, 3.2 tons/acre of broiler litter was applied on May 23. Due to differences observed in 1996, 4.1 tons/acre of broiler litter was applied on May 13, 1997. Broiler litter-treated cotton produced significantly lower seedcotton yields in 1996, even though more nitrogen was applied as litter. In 1997, yields were equivalent to conventionally fertilized treatments. In contrast to other studies, equivalent nitrogen rates did not produce equivalent seedcotton yields in this study. The study will continue in 1998.

Introduction

Arkansas leads all states in poultry production, with production historically being concentrated in the northwestern portion of the state (Arkansas Agricultural Statistics Service, 1996). With an inventory of over one billion broilers, approximately 1,000,000 tons of poultry litter is produced annually. Most of this litter is applied to nearby pastures or cropland. However, concerns have been expressed about over-application of litter to relatively small acreages, with resulting water quality problems. Use of poultry litter as a fertilizer in row crop production would encourage litter transport from the poultry growing regions to the Delta, thus reducing environmental problems in the northwest. If broiler production increases in the central and eastern parts of Arkansas, transportation costs should decrease.

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Broiler litter has been effectively used as a source of N for cotton in Alabama studies without adding weed seed (Mitchell et al., 1995). Equivalent N rates, whether applied as ammonium nitrate or broiler litter, produced the same average seedcotton yield, with the optimum broiler rate being approximately 3 tons per acre. However, litter rates as high as 4 tons per acre had no negative effects on cotton yields and the cotton did not show excessive vegetative growth. Research in south Arkansas showed poultry litter used as a soil amendment significantly increased cotton yields; however additional N fertilizer was also used (Danforth et al., 1993).

The objective of this study was to determine the effectiveness of poultry litter as a nitrogen source for cotton on a Sharkey silty clay soil. This is part of a larger study, which examines the benefits of poultry litter in combating runoff on clay soils.

Materials and Methods

Field experiments were conducted on nonirrigated cotton (Gossypium hirsutum L., cv. Suregrow 125) in 1996 and 1997 on a Sharkey silty clay (very fine, montmorillonitic, nonacid, thermic**,** Vertic Haplaquepts) at the University of Arkansas Northeast Research and Extension Center (NEREC) at Keiser. The experimental design consisted of two fertilizer treatments with three replications, with the same plots used both years. Plots were 32 rows (38 inch centers) by approximately 500 feet. Treatments consisted of preplant incorporated applications of broiler litter and conventional liquid fertilizer (URAN-32% N) applied preplant (75 lb N/acre) and at late square (50 lb N/acre). No other fertilizer was applied. In 1996, 3.2 tons/acre of broiler litter was applied on May 23. Due to differences observed in the 1996 plots and differences in litter analysis (Table 1), 4.1 tons/acre of broiler litter was applied on May 13, 1997. Planting dates were May 23, 1996 and May 21, 1997.

To investigate a possible buildup of nutrients, soil cores were taken from every plot in 6-inch increments to a 36-inch depth on May 5, prior to 1997 spring fertilization. To monitor the nutrient status of the plants, petiole samples were taken weekly starting one week before flowering in both seasons. Harvest dates were December 20, 1996 and October 20, 1997. The center 24 rows of each plot were harvested, for a harvest area of approximately 0.9 acres.

Results and Discussion

Broiler litter treatments produced significantly lower seedcotton yields in 1996 (figure 1), even though 233 lb N/acre of nitrogen was applied as litter versus 125 lb N/acre on the conventional plots. Petiole nitrate nitrogen was significantly lower over four of the seven weekly sampling periods in 1996 (figure 2), indicating the plants did not receive sufficient N. Plant color differences were also very noticeable in 1996, with the litter plots being a much lighter green.

Increased litter rates in 1997 produced a darker green plant, and yields equivalent to conventionally fertilized treatments (figure 2). Petiole nitrate nitrogen was significantly lower for the litter-treated plots only one sampling period (figure 3). In contrast to Alabama findings (Mitchell et al., 1995), equivalent nitrogen rates did not produce equivalent seedcotton yields in this study. In 1997, over twice the rate of nitrogen as broiler litter was necessary to produce yields equal to conventionally fertilized plots.

At the 0-6 inch depth, soil nitrate and phosphorus content of litter plots were significantly higher than those of conventionally fertilized plots (figures 4 and 5, respectively). Significant differences were not observed at other depths or for other nutrients. The soil test data are after only one application of litter and subsequent growing season. However, the possible buildup of nitrate and phosphorus could eventually become a concern. Continued monitoring of the soil should indicate whether the use of broiler litter could present an environmental danger.

Conclusions

Broiler litter treatments produced significantly lower seedcotton yields in 1996, and petiole nitrate nitrogen was significantly lower over four of the seven weekly sampling periods. Increased litter rates in 1997 produced yields equivalent to conventionally fertilized treatments, and petiole nitrate nitrogen was significantly lower for only one sampling period. In contrast to findings in other studies, equivalent nitrogen rates did not produce equivalent seedcotton yields in this study. In addition, at the 0-6 inch depth, soil nitrate and phosphorus content of litter plots were significantly higher than those of conventionally fertilized plots. Continued monitoring of the soil should indicate whether the use of broiler litter could present an environmental danger.

References

Arkansas Agricultural Statistics Service. 1996. Arkansas Agricultural Statistics for 1995. University of Arkansas AES Report Series 334.

Mitchell, C.C., C.H. Burmester, J.A. Hattey and C.W. Wood. 1995. Broiler Litter on Cotton. Proceedings Beltwide Cotton Conferences. 1338-1340.

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Table 1. Total nutrient application to broiler litter-fertilized plots*

Component	Litter Content (lb/ton)		Total Application (lb/acre)	
	1996	1997	1996	1997
N	72.9	62.7	233	257
P_2O_5	54.0	64.7	173	265
K_2O	55.2	57.3	177	235

* Conventionally fertilized plots received only nitrogen at 125 lb N/acre.

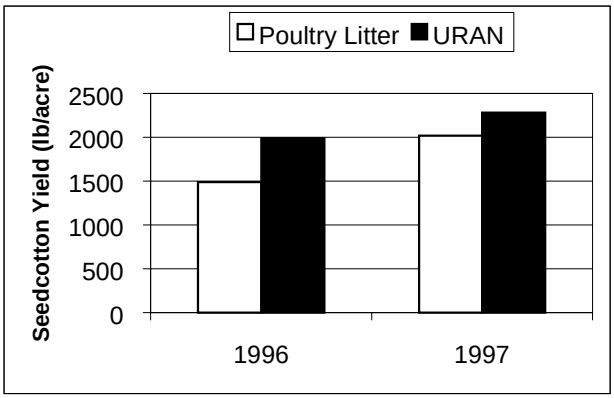

Figure 1. Seedcotton yields from 1996 and 1997 poultry litter study at NEREC, Keiser AR.

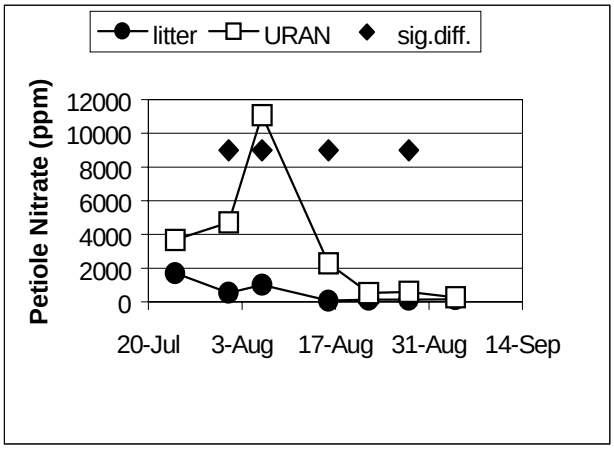

Figure 2. Petiole nitrate nitrogen from 1996 poultry litter study at NEREC, Keiser AR.

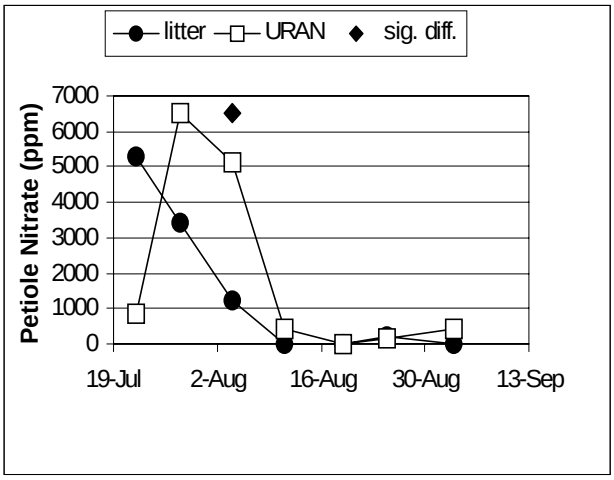

Figure 3. Petiole nitrate nitrogen from 1997 chicken litter study at NEREC, Keiser AR.

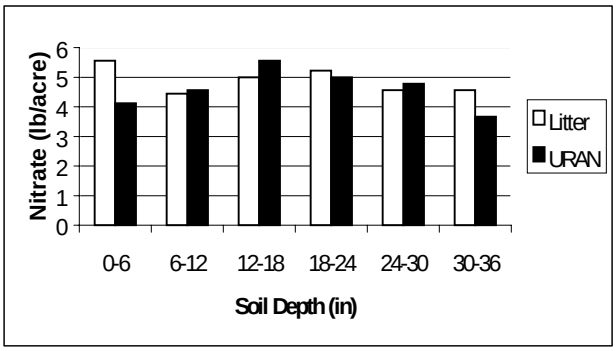

Figure 4. Soil nitrate nitrogen analysis from 1997 chicken litter study at NEREC, Keiser AR.

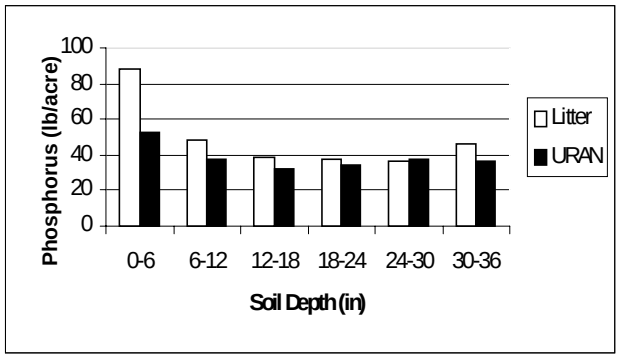

Figure 5. Soil phosphorus analysis from 1997 chicken litter study at NEREC, Keiser AR.