USING POULTRY LITTER IN COTTON PRODUCTION AND EFFECTS ON WATER QUALITY

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Introduction

Crop production has been identified as a major source of nonpoint source pollution which causes impairment in many stream segments within the Red River Basin of Louisiana. The suspected causes of this impairment include suspended solids, nutrients, organic enrichment, low dissolved oxygen, and pesticides. Conventional tillage of cotton and inorganic fertilizer application have been identified as nonpoint sources of pollution within the state's water bodies. Furthermore, large quantities of organic wastes generated by the poultry industry have been recognized as a potential source of nutrients and organic matter for crop production. This is an attractive source of nutrients because it provides an avenue for the disposal of poultry litter and would increase the soil organic matter content over time. Addition of poultry litter to soils can reduce the rate of nutrient runoff from cotton fields and, when combined with conservation tillage, can reduce the rate of sediment addition to water bodies. The purpose of this study was to determine if using organic waste with a best management practice (BMP) will provide a feasible method of disposal for poultry litter while improving water quality.

Materials and Methods

This study consists of the following five treatments:

1. Conventional tillage (control): Cotton plots are conventionally tilled and grown continuously. Tillage practices employed include disking, chisel plowing, hipping, etc. to prepare a seedbed. Inorganic nitrogen fertilizer is applied at 60 lbs/A. No attempt is made to maintain winter cover.
2. Conventional tillage + 2 T/A poultry litter: Same tillage treatment as Treatment 1 with the addition of 2 Tons/A poultry litter.
3. Conservation tillage: Cotton stalks and other residue are allowed to remain on the soil surface until three weeks before planting. Efforts are made to maintain a minimum of 30% ground cover with residue. Inorganic nitrogen fertilizer is applied at 60 lbs/A.
4. Conservation tillage + 2 T/A poultry litter: Tillage and residue management similar to Treatment 3; however, poultry litter is applied at a rate of 2 Tons/A.
5. Conservation tillage + 4 T/A poultry litter; tillage and residue management are the same as Treatments 3 and 4. Poultry litter is applied at 4 Tons/A.

Plots of the five treatments approximately 0.25 acres in size are replicated four times in a randomized complete block design. Two plots of each treatment are fitted with acquisition systems designed to sample and quantify surface runoff and collect shallow ground water. The main components for surface runoff from each plot consist of appropriately sized collectors, approaches, and flumes equipped with data loggers, rainfall recorders, portable liquid-level recorders, and runoff samplers.

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Runoff during each rainfall event of one or more inches is collected for chemical analysis. The ground water acquisition system consists of a stainless steel lysimeter pan installed horizontally under undisturbed soil at approximately 45 inches below the surface. Leachate from the pan is siphoned under a vacuum from the collector for analysis. Surface runoff and leachate samples are analyzed by the LSU Department of Agricultural Chemistry Laboratory, Baton Rouge, LA.

Cotton data collected annually from each plot includes crop yield, plant height, incidences of disease, and fiber quality.

Results and Discussion

Utilization of poultry litter (PL) in a cotton production system accomplishes two goals. First, it provides a method for disposing of PL. Secondly, it provides valuable nutrients to the soil and may help replenish organic matter. The PL used in this study averaged 2.8% N which is about 56 pounds of N per ton of poultry litter (Table 1). Since roughly 60% of this N is available for crop uptake, this represents about 40 pounds of N per ton of PL[1]. Visual response of cotton to the N in PL was evident. In 1999, none of the treatments examined resulted in statistically significant differences in seed cotton or lint yield (Table 2). Results in 2000 were similar with the exception that the conservation tillage + 4 T/A PL yielded significantly more seed cotton than conventional tillage + 2 T/A PL.

Conservation tillage appears to be important in avoiding loss of nutrients from poultry litter by surface water runoff. This is supported by the fact that levels of total nitrogen, nitrates, total phosphorous, and phosphates in surface runoff water from the conventional tillage + 2 T/A PL plots were greater than any of the other treatments including conventional tillage + 60 lbs N/A (Table 3).

Results from this study appear to indicate that poultry litter can be used as a source of nutrients for cotton production without adversely affecting water quality, but conservation tillage practices may be needed as part of an overall best management practice. Utilizing poultry litter may also help maintain organic matter, although evidence of this would require long-term studies.

References

[1]Poultry Litter. The University of Georgia College of Agricultural & Environmental Sciences Cooperative Extension Service Web Site, Available: http://www.griffin.peachnet.edu/caes/cotton/99/99poult.html [date accessed 12/5/2000].

Table 1. Analysis of poultry litter used in this study.

	N	P	K	S	Mg	Ca
Source			%			
Dry Basis	3.20	1.50	2.51	0.60	2.50	2.50
As Received	2.80	1.25	2.25	0.49	0.50	2.20

Table 2. The effects of the different poultry litter treatments on seed and lint cotton yields in 1999 and 2000.[1]

Treatment	Seed Cotton Yield (lbs/A)		Lint Yield (lbs/A)	
	1999	2000	1999	2000
Conventional Tillage + 60 lbs N/A	2090 a	1356 a	845 ab	510 a
Conventional Tillage + 2 Tons Poultry Litter/A	2065 a	1251 a	837 b	476 a
Conservation Tillage + 60 lbs N/A	2035 a	1500 a	824 ab	578 a
Conservation Tillage + 2 Tons Poultry Litter/A	2208 a	1463 a	911 ab	558 a
Conservation Tillage + 4 Tons Poultry Litter/A	2018 a	1620 a	818 a	609 a

[1]Means within a column followed by the same letter are not significantly different (DMRT, P≤ 0.05).

Table 3. Analysis of water collected from runoff and lysimeters.[1]

Treatment	*Runoff* Nitrogen	Nitrate	Phosphorous[2]	Phosphate[3]
	PPM			
Conventional Tillage + 60 lbs N/A	0.31 b	0.54 a	0.79 d	1.90 c
Conventional Tillage + 2 T/A Poultry Litter	1.03 a	0.84 a	1.37 a	3.81 a
Conservation Tillage + 60 lbs N/A	0.56 b	0.82 a	0.86 cd	2.68 bc
Conservation Tillage + 2 T/A Poultry Litter	0.42 b	0.63 a	1.17 ab	3.60 ab
Conservation Tillage + 4 T/A Poultry Litter	0.65 b	0.77 a	1.07 bc	2.75 bc

Treatment	*Lysimeter* Nitrogen	Nitrate	Phosphorous[2]	Phosphate[3]
	PPM			
Conventional Tillage + 60 lbs N/A	5.97 a	3.51 a	0.00 b	0.00 a
Conventional Tillage + 2 T/A Poultry Litter	8.17 a	5.79 a	0.22 ab	0.00 a
Conservation Tillage + 60 lbs N/A	7.62 a	3.48 a	0.45 a	0.00 a
Conservation Tillage + 2 T/A Poultry Litter	9.72 a	3.88 a	0.07 b	0.00 a
Conservation Tillage + 4 T/A Poultry Litter	7.59 a	6.00 a	0.00 b	0.00 a

[1]Means within a column and sample source group are not significantly different (DMRT, P# 0.05).
[2]The lowest detection limit for phosphate was 2 ppm, so values below that limit were entered as 0 for statistical analysis.
[3]The lowest detection limit for phosphorous was 0.25 ppm, so values below that limit were entered as 0 for statistical analysis.