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Response of Soybean Grown on a Claypan Soil in Southeastern Kansas to the Residual of Different Plant Nutrient Sources and Tillage

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Cover Page Footnote

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Summary

The residual effects of turkey litter and fertilizer amendments applied in previous years had little effect on the yield, yield components, and dry matter production of the following soybean crop grown in 2014.

Introduction

Increased fertilizer prices in recent years, especially noticeable when the cost of phosphorus spiked in 2008, have led U.S. producers to consider other alternatives, including manure sources. The use of poultry litter as an alternative to fertilizer is of particular interest in southeastern Kansas because large amounts of poultry litter are imported from nearby confined animal feeding operations in Arkansas, Oklahoma, and Missouri. Annual application of turkey litter can affect the current crop, but information is lacking concerning any residual effects from several continuous years of poultry litter applications on a following crop. This is especially true for tilled soil compared with no-till, because production of most annual cereal crops on the claypan soils of the region is often negatively affected by no-tillage planting. The objective of this study was to determine if the residual from fertilizer and poultry litter applications under tilled or no-till systems affects soybean yield and growth.

Experimental Procedures

A water quality experiment was conducted near Girard, KS, on the Greenbush Educational facility's grounds from spring 2011 through spring 2014. Fertilizer and turkey litter were applied prior to planting grain sorghum each spring. Individual plot size was 1 acre. A total of 10 plots with five treatments were replicated twice. The five treatments were:

- Control – no N or P fertilizer or turkey litter – no tillage
- Fertilizer only – commercial N and P fertilizer – chisel-disk tillage
- Turkey litter, N-based – no extra N or P fertilizer – no tillage
- Turkey litter, N-based – no extra N or P fertilizer – chisel-disk tillage
- Turkey litter, P-based – supplemented with fertilizer N – chisel-disk tillage

Starting in 2015 after the above study, soybean was planted in the plots with no further application of turkey litter or fertilizer. Prior to planting soybean, tillage operations were done in appropriate plots as in previous years. A subarea of 20 ft × 20 ft near the center of each 1-acre plot was designated for crop yield and growth measurements. Samples were taken for dry matter production at V3 (approximately 3 weeks after planting), R2, R4, and R6 growth stages. Yield was determined from the center 4 rows (10 × 20 ft) of the subarea designated for plant measurements in each plot.

Results and Discussion

The residual effects of turkey litter and fertilizer amendments had little effect on following soybean yield, yield components, and dry matter production (Table 1). The number of pods per plant where turkey litter had been previously applied based on N needs of the former grain sorghum crop was greater than in the no-amendment control. Also, the early growth of the soybean plants at V3 appeared to respond to the residual of the high litter rate with tillage (TL-N-C) compared with either the control or the TL-N no-till residual. However, in the reproductive stages of growth (R2, R4, and R6), the residual treatments seemed to have no effect on dry matter production.

Table 1. Residual effect of turkey litter and fertilizer amendments on following soybean yield, yield components, and dry matter production in 2014

Residual amendment ¹	Yield bu/a	Stand (×1000) plants/a	Seed weight mg	Pods/ plant	Seeds/ pod	Dry matter			
						V3	R2	R4	R6
Control	31.2	118	156	24.5	2.3	60	680	2,020	2,650
TL-N	37.0	121	149	39.5	2.4	60	1,100	3,200	4,970
TL-N-C	38.8	121	157	37.5	2.4	280	1,570	3,680	6,160
TL-P-C	26.7	118	160	29.5	2.4	120	1,050	3,140	4,750
Fert-C	32.1	117	159	31.0	2.3	130	1,060	2,460	4,760
LSD (0.10)	NS	NS	NS	8.7	NS	170	NS	NS	NS

¹ Control, no turkey litter or N and P fertilizer with no tillage; TL-N, N-based turkey litter application with no tillage; TL-N-C, N-based turkey litter application incorporated with conventional tillage; TL-P-C, P-based turkey litter application and supplemental N application incorporated with conventional tillage; Fert-C, commercial fertilizer only incorporated with conventional tillage.