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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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Abstract

The residual from previous high rate turkey litter applications, which were based on N requirements of the previous grain sorghum crop, increased soybean yield above that obtained from the residual of P-based turkey litter applications (low rate), commercial fertilizer, or the control. Even though early soybean growth was not significantly affected by residual treatments, the greatest dry matter production at the R6 growth stage was where the N-based litter had been applied and incorporated.

Keywords

soybean

Cover Page Footnote

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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[1]

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Summary

The residual from previous high rate turkey litter applications, which were based on N requirements of the previous grain sorghum crop, increased soybean yield above that obtained from the residual of P-based turkey litter applications (low rate), commercial fertilizer, or the control. Even though early soybean growth was not significantly affected by residual treatments, the greatest dry matter production at the R6 growth stage was where the N-based litter had been applied and incorporated.

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-till 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:

[1] Partially funded by USDA NRCS Conservation Innovation Grant.

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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 × 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-V4 (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

In 2015, the residual effects of turkey litter and fertilizer amendments affected soybean yield, stand, and pods/plant (Table 1). The two treatments which had previously received a high application rate of turkey litter based on N requirements, regardless of tillage system, resulted in greater yields than from plots that had received low rates of turkey litter (P-based), commercial fertilizer, or no fertilizer N or P. Stand count was lower and the number of pods/plant was greater where N-based turkey litter had been applied than in the other residual treatments. Dry matter production was unaffected by residual treatment until pod formation and fill at the R4 and R6 growth stages. At R6, dry matter production was greatest where turkey litter had previously been applied on an N-basis (high rate) and incorporated.

Table 1. Residual effect of turkey litter and fertilizer amendments on following soybean yield, yield components, and dry matter production in 2015

Residual amendment[†]	Yield	Stand (×1000)	Seed weight	Pods/ plant	Seeds/ pod	Dry matter			
						V4	R2	R4	R6
	bu/a	plants/a	mg			lb/a			
Control	39.1	110	103	37	2.1	370	1790	3790	4970
Fert-C	46.0	117	126	40	2.1	530	2760	4450	6490
TL-N	58.5	91	109	66	2.3	430	2630	4920	7720
TL-N-C	65.3	117	121	49	2.4	750	3060	5770	10040
TL-P-C	43.8	112	124	33	2.3	420	2440	3760	5220
LSD (0.10)	11.6	8	NS	13	NS	NS	NS	880	1350

[†] 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.