Kansas Agricultural Experiment Station Research Reports

Volume 3
Issue 2 *Southeast Agricultural Research Center Reports*

Article 12

January 2017

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

D. W. Sweeney
Kansas State University, dsweeney@ksu.edu

Philip Barnes
Kansas State University, lbarnes@ksu.edu

Gary Pierzynski
Kansas State University, gmp@ksu.edu

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

Abstract

Soybean yields measured from 2014 through 2016 were more than 50% greater from the residual from N-based turkey litter applications during 2011 through 2013 than in the control where no nitrogen (N) or phosphorus (P) was applied. However, residual from P-based turkey litter applications or fertilizer-only did not result in soybean yield different from the no N-P control. This residual effect on yield was largely due to increased pods per plant.

Keywords

soybean, turkey litter, fertilizer, residual, tillage

Cover Page Footnote

Partially funded by U.S. Department of Agriculture Natural Resource Conservation Service Conservation Innovation Grant.

K-STATE Research and Extension

2017 SEARC Agricultural Research

Response of Soybean Grown on a Claypan Soil in Southeastern Kansas to the Residual of Different Plant Nutrient Sources and Tillage[1]

D.W. Sweeney, P. Barnes[2], and G. Pierzynski[3]

Summary

Soybean yields measured from 2014 through 2016 were more than 50% greater from the residual from N-based turkey litter applications during 2011 through 2013 than in the control where no nitrogen (N) or phosphorus (P) was applied. However, residual from P-based turkey litter applications or fertilizer-only did not result in soybean yield different from the no N-P control. This residual effect on yield was largely due to increased pods per plant.

Introduction

Increased fertilizer prices in recent years, especially noticeable when the cost of phosphorus spiked in 2008, have led US 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

[1] Partially funded by U.S. Department of Agriculture Natural Resource Conservation Service Conservation Innovation Grant.

[2] Kansas State University Department of Biological and Agricultural Engineering.

[3] Kansas State University Department of Agronomy.

litter were applied prior to planting grain sorghum each spring. Individual plot size was 1 acre. The five treatments, replicated twice, were:

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

Starting in 2014 after the previously-mentioned 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

During 2014-2016, the residual effects of turkey litter and fertilizer amendments affected soybean yield 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. Even though the average number of pods/plant was greatest where N-based turkey litter had been applied with no-till, the stand tended to be lower than where the N-based turkey litter was incorporated with tillage, but was only significant in 2015 (year interaction data not shown). Dry matter production was greatest early (V3) and late (R6) in the season where N-based turkey litter had been applied and incorporated with tillage than in the other residual treatments (Table 1).

Table 1. Residual effect of turkey litter and fertilizer amendments on following soybean yield, yield components, and dry matter production averaged across years (2014-2016)

						Dry matter			
Residual amendment[†]	Yield	Stand (× 1000)	Seed weight	Pods /plant	Seeds /pod	V4	R2	R4	R6
	bu/a	plants/a	mg			---------- lb/a ----------			
Control	32.3	112	125	28	2.3	340	1070	2700	3540
Fert-C	37.3	112	135	34	2.1	440	1720	3580	5250
TL-N	49.4	107	126	50	2.3	400	1820	4200	5980
TL-N-C	52.7	112	127	43	2.3	610	2210	4650	7310
TL-P-C	34.3	106	133	33	2.3	360	1600	3280	4710
LSD (0.05)	7.9	NS	NS	5	NS	90	480	560	1360

[†] Control, no turkey litter or nitrogen (N) or phosphorus (P) fertilizer with no-till; Fert-C, commercial fertilizer incorporated with conventional tillage; TL-N, N-based turkey litter application with no-till; TL-N-C, N-based turkey litter application incorporated with conventional tillage; and TL-P-C, P-based turkey litter application and supplemental N application incorporated with conventional tillage.