

SOIL HEALTH BENEFIT FROM WINTER WHEAT IN THE ROTATION

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INTRODUCTION

This work is intended to answer the question: *Are there short term soil health benefits to having wheat in Kentucky farmers' crop rotation? Comparing wheat harvested for grain to wheat (or other small grain) as a cover crop, is it better for the soil to take wheat to grain harvest?* The soil health impacts of wheat insertion in a grain crop rotation are being evaluated in the context of a long-term rotation study. In that study, corn/wheat/double crop soybean, continuous corn, continuous soybean (full season), and corn/corn/soybean/soybean (full season) are grown such that all parts of each rotation are represented each year. Until last fall, no cover crops were used – wheat was grown for grain. The study was changed by inserting a wheat cover crop in one-half of each plot transitioning between the corn and soybean in the corn/corn/soybean/soybean rotation. To meet the experimental objectives, the main plot treatments are: 1) corn/wheat (grain)/double crop soybean; 2) corn/wheat cover crop/full season soybean; and 3) corn/no wheat cover crop/full season soybean. The sub-plot treatments are three rates of fertilizer N applied to the previous corn crop.

PROCEDURES

Soil health assessment will include both conventional soil chemical property testing (pH, organic matter, total N, plant available P, K, Ca, Mg, and Zn) and mineralizable/active C and N. Other tests would assess changes in soil physical (penetration resistance (PR), wet aggregate stability) and biological (soil respiration; microbial biomass, activity and diversity) properties. More than one soil sampling event was needed to determine whether or not a change in a soil property – soil health parameter due to wheat insertion has occurred. The first sampling was done at wheat green-up. Another set of soil samples was taken when the cover crop wheat was terminated for full season soybean establishment. Finally, a third set of soil samples was

taken just after soybean (both double crop and full season) harvest.

RESULTS

Soybean grain yield data for both years of the study are presented just below (Table 1). Soybean yield responded to crop rotation, with double crop soybean yielding least and full season soybean following corn yielding the most. Full season soybean following corn consistently yielded more when a wheat cover crop was planted after corn, but the yield benefit was small (average of +2.3 bu/A across the two years).

Table 1. Soybean Grain Yield Data for 2018 and 2019

Cropping System	Wheat Present?	2018 Soybean Yield (Bu/A)	2019 Soybean Yield (Bu/A)
Corn/wheat/dc soy	Yes	59.9 c*	29.6 c
Corn/fs soy	No	71.5 a [†]	39.6 a [†]
Corn/fs soy	Yes	73.6 a [†]	42.2 a [†]
Continuous fs soy	No	66.1 b	34.3 b

*Values within a column followed by the same lower case letter are not significantly different at the 90% level of confidence.
[†]Difference due to the presence of cover crop wheat, averaged across both years (+2.3 bu/A), was significantly different at the 75% level of confidence.

Following Table 1 is Table 2, which contains data from one of the soil health measurements, an assessment of soil urease activity under well controlled laboratory conditions. The measurement was done on surface (0 to 4-inch depth) soil samples taken in late May of 2019, after full-season soybean emergence. The cover crop wheat was chemically terminated. Wheat in the double crop system was fully headed and in early grainfill. The urease enzyme activity was highest in soil taken from the corn/full season soybean rotation, regardless of wheat cover crop absence/presence. Residues from the previous corn crop were sufficient to cause

greater urease activity, and the presence of the cover crop did little to further stimulate activity. However, in the corn/wheat/double crop soybean rotation, where urease activity was generally lower,

that urease activity was negatively related to the applied corn N rate. This may be due, in part, to the fact that the corn N source was Super U, which is urea co-primed with NBPT, a urease inhibitor.

Table 2. Effect of Rotation System, Wheat Presence and Fertilizer Nitrogen Rate on Soil Urease Activity – 23 May 2019.			
Crop Rotation System	Wheat Present	Fertilizer N Rate (lb N/A)	Soil Urease Activity (ug N/g soil/hr)
Corn-wheat (cover crop)-full season soybean	no		25.8 a*
Corn-wheat (cover crop)-full season soybean	yes		26.5 a
Corn-wheat (grain)-double crop soybean		0	23.7 b
Corn-wheat (grain)-double crop soybean		70	21.5 bc
Corn-wheat (grain)-double crop soybean		140	20.5 c
*Values followed by the same lower case letter are not significantly different at the 90% level of confidence.			

CONCLUSIONS

The soybean yield results are consistent – across both moist and dry seasons. The early soil health results have been mixed, and additional soil health measurements need to be completed to more fully evaluate the hypotheses.

ACKNOWLEDGEMENT

This research was funded by the Kentucky Small Grain Growers Association.