SOIL HEALTH BENEFIT FROM WINTER WHEAT IN THE ROTATION

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INTRODUCTION

This work is intended to answer the question: ***Are there long term soil health benefits to having wheat in Kentucky farmers' crop rotation? Comparing wheat harvested for yield 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 greenup. 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 will be taken just after soybean (both double crop and full season) harvest.

RESULTS

At the writing of this report, full-season soybean harvest had just been done, but grain drying was not complete, so grain yield cannot yet be determined. Double-crop soybean are not yet ready to harvest.

In the figure on the next page are some of our soil penetration resistance data. These resistance data were taken near wheat green-up. The data are shown as means plus or minus one standard deviation. Five observations were taken per plot, with four replicate plots per treatment. The penetrometer records resistance/pressure (1 Mpascal = 145 lb/in^2) at 1 cm depth intervals (10 cm = 4 inches), and data were taken to a depth of 60 cm (24 inches). The data exhibit large standard deviations, which is typical. There is little influence of the cover crop below 8 inches (20 cm), and resistance values are generally higher under the wheat cover crop in the 0 to 8 inch (0 to 20 cm) depth increment. This is likely due to one, two, or some of all of three different reasons. The first is that though we were careful

to make these measurements when the profile was moist, the growing wheat is using soil moisture and making the soil somewhat drier – and drier soil exhibits greater resistance. Second, the no-till drill used to plant the wheat could have caused some compaction in the upper root zone. Third, the wheat root system and associated mycorrhizal fungi act to bind soil particles into aggregates – and these bound aggregates also create greater resistance. We will know more about the latter mechanism when we complete the aggregate stability analyses.

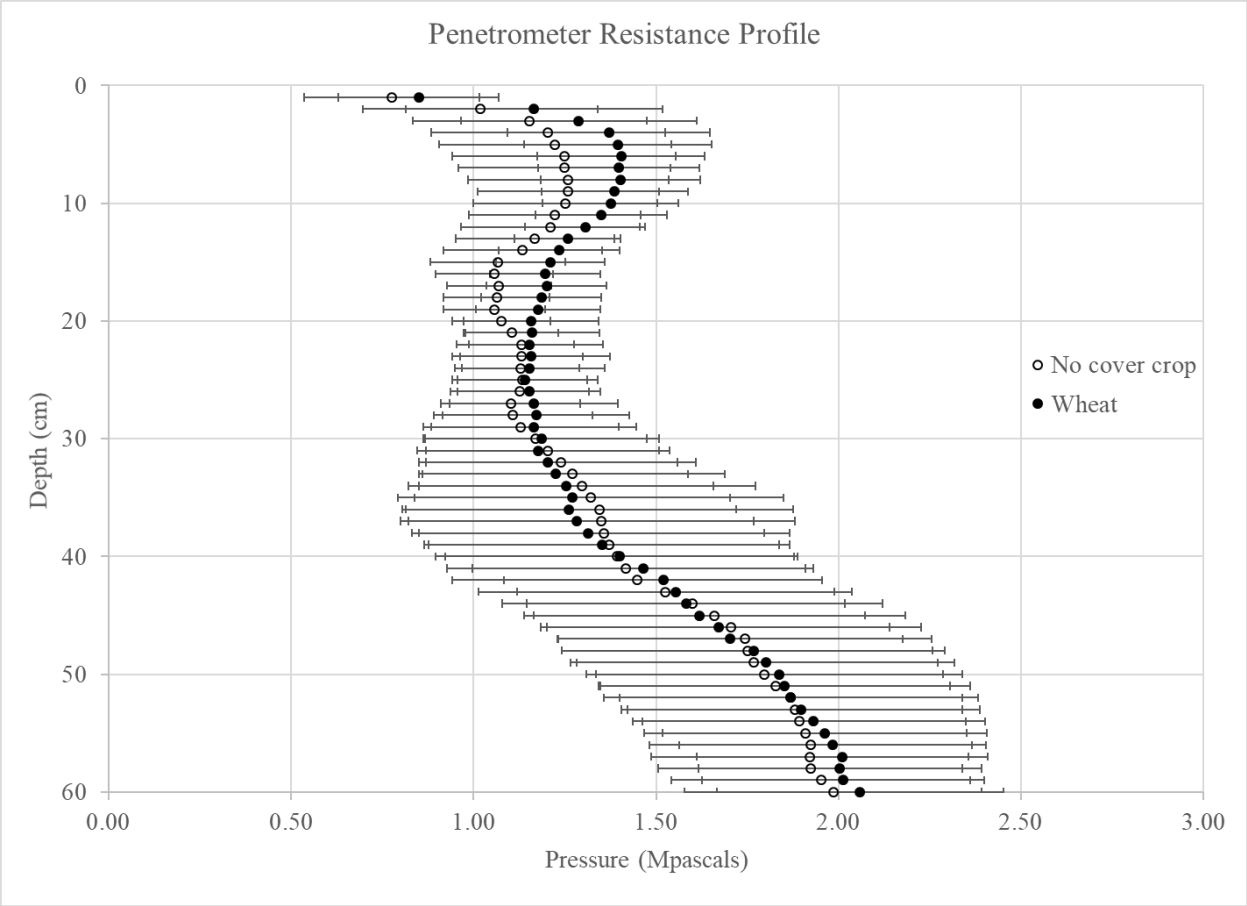

Table 1, on next page, contains data from one of the soil health measurements, an assessment of N mineralization of soil organic N under anaerobic laboratory conditions. The measurement was done on surface (0 to 4 inch depth) soil samples taken in April 2018, at wheat green up.

Though there was a trend for greater organic N mineralization in the system where wheat was being grown through grain harvest, the difference was not statistically significant. No difference due to the absence or presence of a wheat cover crop preceding full-season soybean was found in these data. The greater difference was found to be due to the historical fertilizer N rate. There was no statistically significant difference in organic N mineralization between the lowest two fertilizer N rates, but there was a statistically significant increase in N release at the highest fertilizer N rate.

TABLE 1. EFFECT OF ROTATION SYSTEM, WHEAT PRESENCE AND FERTILIZER NITROGEN RATE ON MINERALIZATION OF SOIL ORGANIC NITROGEN IN			
Crop Rotation System	**Wheat Present**	**Fertilizer N Rate (lb N/A)**	**Organic N Released (ppm N)**
corn-wheat (grain)-double crop soybean	yes		60.3a*
corn-wheat (cover crop)-full season soybean	no		51.3a
corn-wheat (cover crop)-full season soybean	yes		52.4a
		0	49.7B**
		70	49.9B
		140	64.4A

*Values followed by the same lower case letter are not significantly different at the 90% level of confidence.

** Values followed by the same upper case letter are not significantly different at the 90% level of confidence.

CONCLUSIONS

These early results are quite mixed, and both yield and additional soil measurements are needed to more fully evaluate the hypotheses. We do have differences in these early data, and those differences can be explained. We make additional reports as the rest of the data come in.

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