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Improving Soybean Performance in the Northern Great Plains through the use of Cover Crops

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INTRODUCTION

Maintaining plant growth with limited fallow periods in cropping systems is of great importance to prevent future soil degradation which can directly affect crop yield. Cover crops provide a green bridge from one cash grain crop to the next; offering "multiple services" including improved nutrient cycling and increasing following cash crop rooting depth. Cover crop use within the Northern Plains can be challenging due to limitations of favorable weather and lack of understanding of their functions since a majority of the previous research has been conducted in other regions of the country. With the anticipated production costs of soybeans and other grain crops on the upswing, farmers need additional solutions to maintain economical production while restoring soil health and associated ecological systems. Further adoption of cover crops will not occur unless research can provide a basis of their benefits or potential downfalls in regards to following cash crop seed yield within the Northern Plains region. The objectives of the research are to investigate the use of cover crops to improve soybean plant performance (growth, yield and quality) grown under conventional and no-tillage soil management practices.

METHODS

A two year oat hay-soybean rotation experiment was established in the spring of 2007, at the Eastern South Dakota Soil and Water Research Farm near Brookings, SD. Asgrow 2106RR soybeans were seeded in May of 2007 and 2008. The experimental design consisted of a split-plot design with four replications. Whole plots were tillage (no-tillage (NT) and conventional tillage (CT)) and the split plots were fertilizer (source x rate) treatments. Conventional tillage was performed with a chisel plow in the fall of each year and seedbed prepared in the spring using a field cultivator. The NT plots were established as NT in the spring of 2000. Cover crop and planting population were placed in a 2 x 4 factorial arrangement with two planting populations, either "Low" 120000 plants/ha or "Normal" 360000 plants/ha and four cover crop treatments. Cover crop treatments included no cover crop buckwheat+slender wheatgrass (BCK +SLWHT); radish+slender wheatgrass (RAD + SLWHT); and turnips+slender wheatgrass (TRN + SLWHT). Nitrogen (N), phosphorus (P) and potassium (K) were applied at 112 kg ha^{-1} of 14-36-13 (N-P_2O_5-K_2O) to all experimental units. Plots were 6 X 15 m. Phenology data according to Ritchie et al. (1996) were recorded weekly from the first of June until the end of August.

Aboveground soybean biomass sampling was performed at growth stage R1 by collecting 1 m of one row. Samples were dried for 120 h in a forced-air oven at 60°C, and then weighed to obtain dry matter production. Samples were ground with a Wiley Mill to pass a 0.079-inch sieve. Nitrogen concentration was determined on all

samples using dry combustion (Schepers et al., 1989) and ureide concentration as described by Young and Conway (1942). Grain yield was estimated by harvesting 50 ft of the two middle rows from each plot. Grain moisture and test weights were determined using a Dickey-John seed tester. Grain samples were oven dried at 60^0C, ground, and analyzed for N concentration as described above for biomass samples. Data analysis was performed using the GLM procedure in SAS (SAS, 1999).

RESULTS AND DISCUSSION

The cover crops did not produce a negative response towards quality in 2007 or 2008. (data not shown)

2007 was a very favorable year for soybean growth despite near zero precipitation in July. Seed yield differences were not detected among the cover crop treatments. (Figure 1)

2008 was stressful during soybean pod fill however the cover crops reflected a significant increase in soybean seed yield. (Figure 1)

2008 suggests cover crops are creating a favorable soil environment for soybean plant growth and seed yield.

Soil management and plant population had a strong influence on yield in 2007. (Figures 2 & 3)

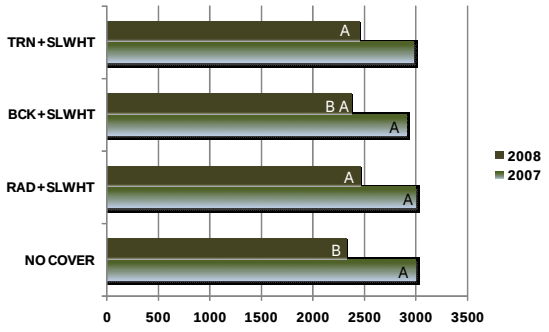

Figure 1. Grain yield (kg/ha) in response to cover crop type. Bars with the same letter not significantly different. Pr >F (.05)

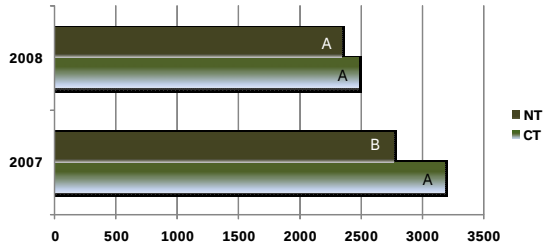

Figure 2. Effect of soil management on seed yield (kg/ha). Bars with the same letter are not significantly different. Pr > F (.05)

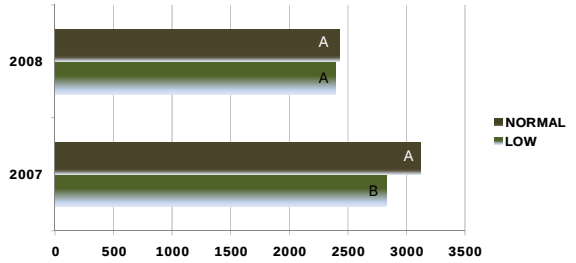

Figure 3. Seed yield (kg/ha) in response to planting population. Bars with the same letter are not significantly different. Pr > F (.05)

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