Effects of Long-term Tillage and Crop Rotation on Soil Carbon and Soil Productivity

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Introduction

Tillage system and crop rotation have a significant long-term effect on soil productivity and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. In addition, both tillage and crop rotation have affects on weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soils and climatic conditions in the state. The objective of this study is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

Materials and Methods

This study was originated on eight Iowa State University Research and Demonstration Farms in 2002 and continued in 2003. At the McNay research farm, five tillage systems (no-till, strip-tillage, chisel plow, deep ripper, and moldboard plow) and two crop rotations (corn-corn-soybean and corn-soybean) were established in the fall of 2002 over corn residue. The two crop rotations were used in three blocks—two blocks with corn-corn-soybean and one with corn-soybean. The two corn-corn-soybean blocks were started in different years in the rotation to have the same crop in all growing seasons for each rotation. Initial soil samples were collected in the fall of 2002 prior to implementing the tillage treatments. The soil samples were collected from all sites for depths 0–6, 6–12, 12–18, and 18–24 inches and will be analyzed for total carbon and total nitrogen. The experimental design was a randomized complete block design with four replications.

The plot size is 12 rows × 114 ft. Corn yield is determined from the center eight rows of each corn plot. The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen are monitored bi-yearly, or more basis. Seasonal measurements such as nitrogen use efficiency, soil bulk density, infiltration rate, etc., were conducted on selected sites depending on availability of funding.

Results and Discussion

In 2003, the five tillage systems under the corn-corn-soybean rotation did not show a significant difference in corn yields, averaging 168 and 159 bushels/acre from both blocks (Figures 1 and 2). It is not possible to determine if there is a true yield drag between the first year and second year corn due to corn as the previous crop for both blocks. The corn-soybean rotation did not show significant yield differences due to tillage systems, averaging 164 bushels/acre (Figure 3). The corn-soybean rotation obtained similar yields to the corn-corn-soybean rotation.

It is too early to speculate about the tillage or the crop-rotation effects on yield because these systems have only been in place for one growing season. The 2002 growing season should be viewed as a setup season to establish the crop rotation sequence and tillage treatments.

Acknowledgments

We would like to thank Jim Secor and the McNay Research Farm staff for their time and labor for plot setup, planting, and harvesting.

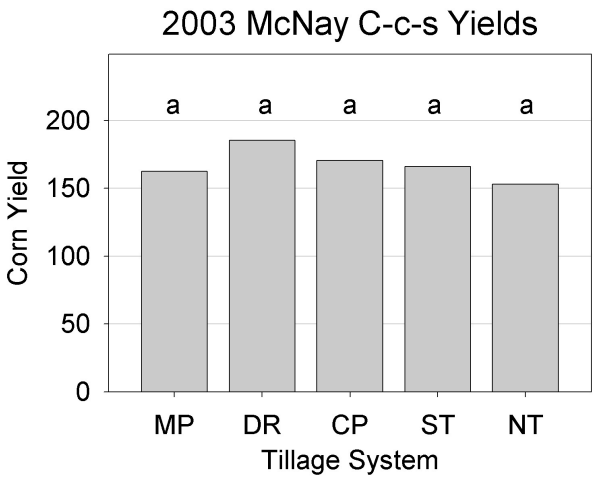

Figure 1. Effect of tillage system on corn yield in a corn-corn-soybean rotation for 2003 near Chariton, IA.

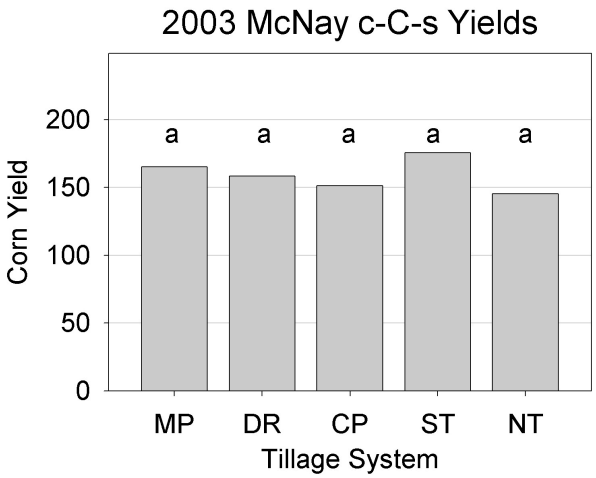

Figure 2. Effect of tillage system on second year corn yield in a corn-corn-soybean rotation for 2003 near Chariton, IA.

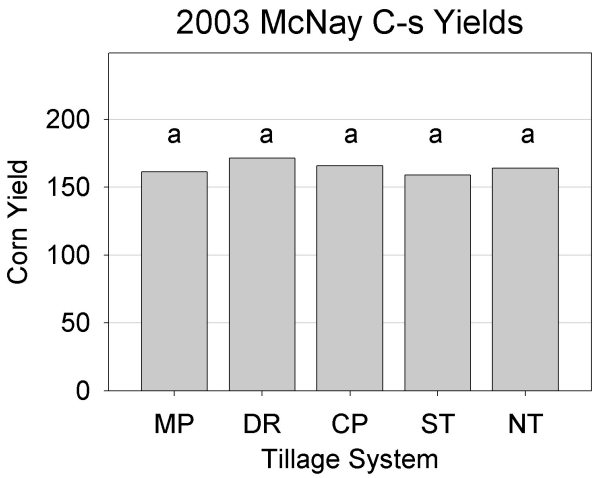

Figure 3. Effect of tillage system on corn yield in a corn-soybean rotation for 2003 near Chariton, IA.