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

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Abstract
Tillage system and crop rotation have significant long-term effects 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 effects 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 climate conditions in Iowa. The objective of this study is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

Keywords
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Disciplines
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Effects of Long-term Tillage and Crop Rotation on Yield and Soil Carbon

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Introduction

Tillage system and crop rotation have significant long-term effects 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 effects 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 climate conditions in Iowa. 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 conducted on eight Iowa State University Research and Demonstration Farms in 2002. Treatments included five tillage systems (no-tillage, strip-tillage, chisel plow, deep ripper, and moldboard plow) across two crop rotations (corn-corn-soybean and corn-soybean) and several soil associations. The experimental design was a completely randomized block design with four replications. Initial soil samples were collected in 2002 prior to implementing the tillage treatments. The soil samples were collected from all sites for depths of 0–6, 6–12, 12–18, and 18–24 in. and will be analyzed for total carbon and total nitrogen concentration. Subsequent soil samples were again collected in 2004 from all sites for depths of 0–6, 6–12, 12–18, and 18–24 in. and will be analyzed for total carbon and total nitrogen concentration.

The plot size is 8 rows × 80 ft. Yield was determined from the center three rows of each corn plot and five rows of each soybean plot. The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen will be monitored on a biannual basis, or more often. Seasonal measurements such as nitrogen use efficiency, soil bulk density, and infiltration rate will be taken on selected sites depending on availability of funding.

Results and Discussion

In 2003, the five tillage systems under corn-soybean rotation did not show a significant difference in corn yield, averaging 209 bushels/acre (Figure 1). However, for second-year corn of the corn-corn-soybean rotation, the no-tillage yield was significantly lower than the other four tillage systems' yields by 16–28 bushels/acre (Figure 2). No-tillage soybean yields for 2003 were significantly different from deep rip, 38.7 and 42.2 bushels/acre, respectively (Figure 3).

Corn yields of the corn-soybean rotation for the 2004 growing season averaged 199 bushels/acre (Figure 4). No-tillage and strip-tillage corn had a significantly lower yield than moldboard plow tillage. Soybean yields in 2004 were not significantly different for either the corn-corn-soybean or the corn-soybean rotations and averaged 56 and 59 bushels/acre, respectively (Figures 5 and 6). However, it is too early to speculate about the tillage or the crop rotation effects on yield because these systems have only been in place two years.

Acknowledgments

We would like to thank Kevin Van Dee and Jared Anderson for their time and labor for plot setup, planting, and harvesting.

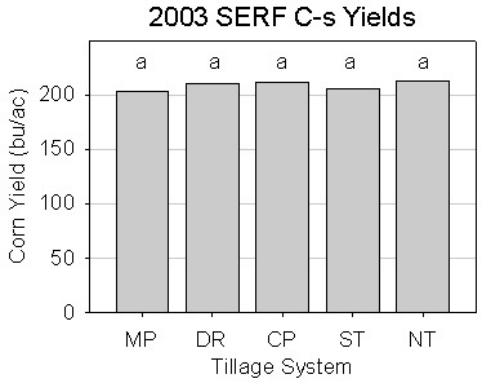

Figure 1. Effect of tillage system on corn yield in a corn-soybean rotation for 2003 at Crawfordsville, Iowa.

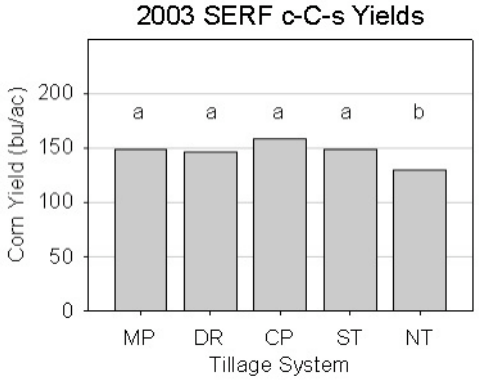

Figure 2. Effect of tillage system on second-year corn yield in a corn-corn-soybean rotation for 2003 at Crawfordsville, Iowa.

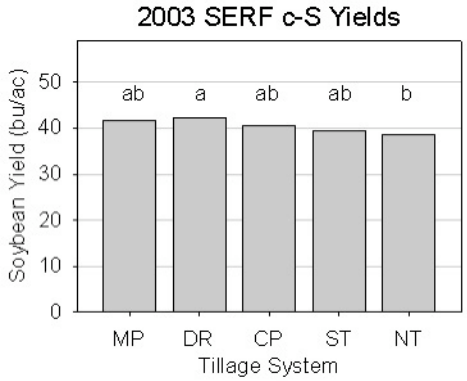

Figure 3. Effect of tillage system on soybean yield in a corn-soybean rotation for 2003 at Crawfordsville, Iowa.

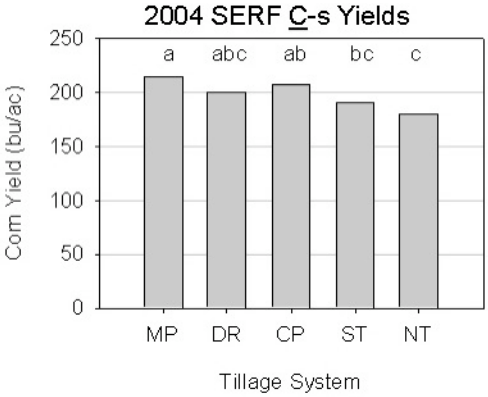

Figure 4. Effect of tillage system on corn yield in a corn-soybean rotation for 2004 at Crawfordsville, Iowa.

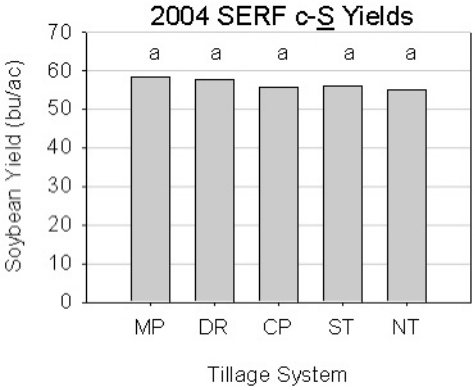

Figure 5. Effect of tillage system on soybean yield in a corn-soybean rotation for 2004 at Crawfordsville, Iowa.

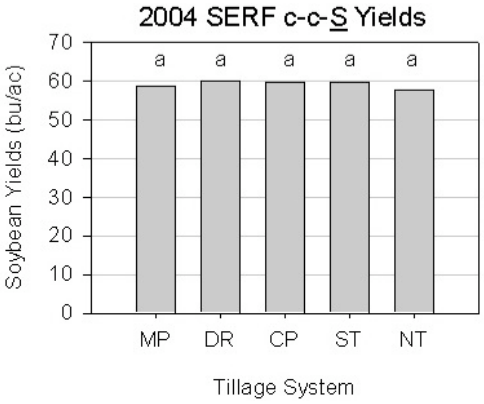

Figure 6. Effect of tillage system on soybean yield in a corn-corn-soybean rotation for 2004 at Crawfordsville, Iowa.