Long-term Cropping Systems

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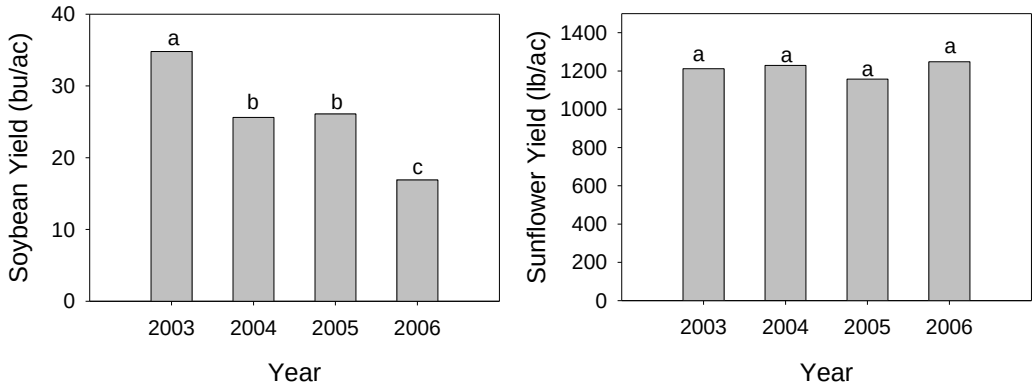
Production agriculture in North Dakota has a strong characteristic of diversified crops. Diversified cropping systems could minimize farming risk, provide sustainable production, and increase environmental conservation. To examine the benefits of cropping systems, the North Dakota State University Carrington Research Extension Center initiated a long-term cropping system in 1987. The goal of this study is to determine the effects of tillage system, N fertility level, and crop rotation on crop yield and quality, biomass production, and changes in soil quality. Hard red spring wheat, soybean, sunflower, barley, field pea, canola, and corn were planted in three different four-year crop rotations in conventional-, minimum-, and no-tillage systems. This report is an overview for the fifth cycle of the study which occurred from 2003 through 2006.

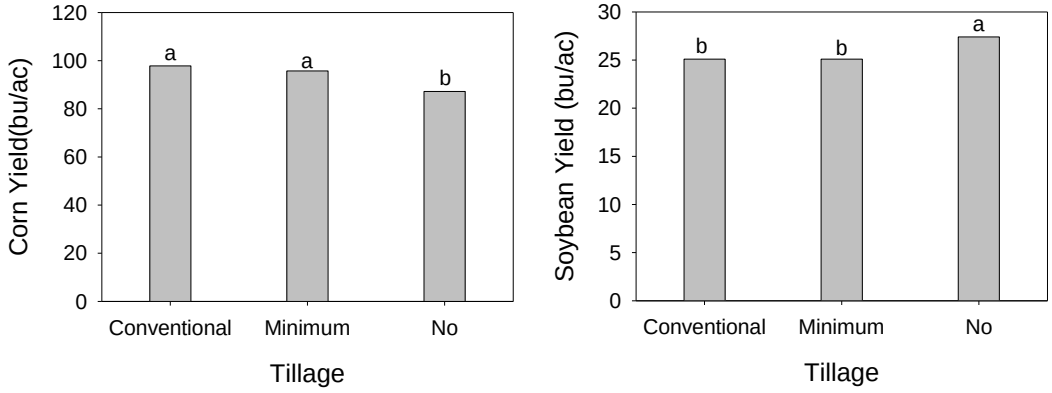
Grain production of all crops was greatly influenced by year, which provided significantly different environments including precipitation, temperature, and diseases pressure, except sunflower and field pea, which had relatively consistent yields through out the study period. Figure 1 shows the dynamic difference year can have on differing crops. Oil content in grain tended to be affected by year more than grain protein content. The year effect had a similar pattern on all crops biomass production as well.

Fig. 1. Year effects on soybean and sunflower grain yield in long-term cropping system.



Tillage system had a significant impact on grain yield, but not grain quality. In general, grain yields of all crops were significantly lower in the no-till system than the conventional- and minimum-tillage systems. The exception was soybean which had a significantly higher yield in the no-till system than the conventional- and minimum-tillage systems (Fig. 2). Biomass production had a similar pattern to grain yield and grain quality was not affected by tillage system.

Fig. 2. Tillage effects on corn and soybean grain yield in long-term cropping system.



Grain and biomass yields of non-legume crops responded to increased N fertilization up to 80 lbs./ac except hard red spring wheat, which had the highest yield at 40 lbs. N/ac rate and manure application had similar effects as chemical nitrogen fertilizer application on grain and biomass yield.

Soil quality parameters were significantly changed by tillage systems and fertilization. This study shows that crop rotations with three or more different crop types did not have negative impact on soil quality. Soil organic matter and soil phosphorus at the 0 to 6 inch depth was highest in the no-till system and soil nitrogen at the 0-6 inch depth was not different among tillage systems (Fig.3). However, soil nitrogen at the 12 to 24 and 24- to 48-inch depths were significantly lower in the no-till system. Higher soil nitrogen in the subsurface soil was associated with increased nitrogen fertilization. These results show the potential for nitrogen leaching with increased fertilization and tillage. Manure application based on N rate increased both soil organic matter and phosphorus in the surface soil.

Fig. 3. Tillage effects on changes in soil organic matter and phosphorus in long-term cropping system.