

EFFECT OF ROTATION AND TILLAGE ON SOYBEAN YIELD

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Multi-year project

Justification:

Because of a variety of conditions, including weather and soil properties, many of Missouri's soils are highly erosive. Until recently, Missouri ranked second among all states for average soil loss. Soil conservation is essential to continued productivity of Missouri cropland. No-tillage is an excellent method for soil conservation. Plant residues left on the surface of the soil intercept falling rain drops, dissipating their energy, and reducing their ability to dislodge soil particles.

The portion of Missouri soybean acreage planted after soybean is about 30%, and this number is larger than all other Midwestern states. Soybean following soybean usually yields less than soybean following another crop such as corn. However, data collected in Missouri were not available until this experiment was established.

This experiment is part of a long-term study conducted on plots that were first established in 1991. Tillage and rotation treatments have been applied to the same plots in each year for 15 years. The objectives of this experiment is to determine if soybean grain yield is affected by the use of no-tillage practices, if continuous soybean yields less than soybean rotated with corn, and if there is an interaction between rotation choice and tillage choice.

Method:

The experimental design was a split plot with whole plots arranged as a randomized complete block with four replications. Whole plots were two rotation systems, continuous soybean and soybean rotated with corn. The split plots were two tillage systems (Figure 1.). Tilled plots were chisel plowed on February 28 followed by a field cultivator operation. No-tillage plots were planted without tillage. Asgrow brand AG3905 was planted in plots of both tilled and no-tillage treatments on May 24 at a seeding rate of 169,000 seeds/acre. Plots were 100 feet long and eight 30-inch rows wide.



Figure 1. An example of a tilled plot on the left and an example of a no-tillage plot is on the right. Both plots are from the continuous soybean treatment.

The pre-emergence herbicide was Dual II Magnum. WeatherMax was used as a burndown and for post emergence weed control. Stand counts were made at about the 2-leaf stage in four 10-foot lengths of row in each plot. Before harvest rows 2, 3, 6, and 7 were end-trimmed to 90 feet. These four rows were harvested with a plot combine and yield was corrected to 13% moisture.

Results:

Tillage choice did not affect stand density for the rotation cropping system (Figure 2). However, in the continuous soybean system, no-tillage resulted in a greater stand density than the tilled treatment. The presence of corn residue, whether tilled or not tilled, reduced soybean stand density. It is not clear why this effect occurred. However, the effect was small and probably did not affect yield.

The greatest yield was with the use of no-tillage in the rotation cropping system (Figure 3). The lowest yield was for the combination of the tilled treatment with the continuous soybean cropping system. Continuous soybean yielded less than soybean rotated with corn regardless of tillage choice (Figure 3). Disease incidence information was not collected, but other research across the Midwest has shown that continuous soybean yields less than soybean rotated with some other crop even without expression of diseases. We used a soybean variety with resistance to soybean cyst nematode. However, after repeated use of varieties with the same resistance gene, a race shift could have occurred. We will collect SCN data during the 2007 experiment.

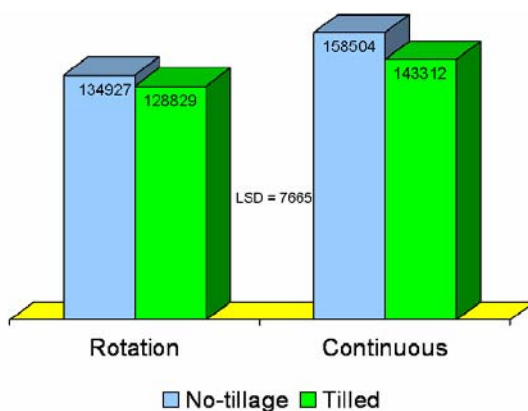


Figure 2. Effect of tillage choice and rotation on soybean stand density. The unit for the values is number of plants/acre. The LSD can be used to compare any two values.

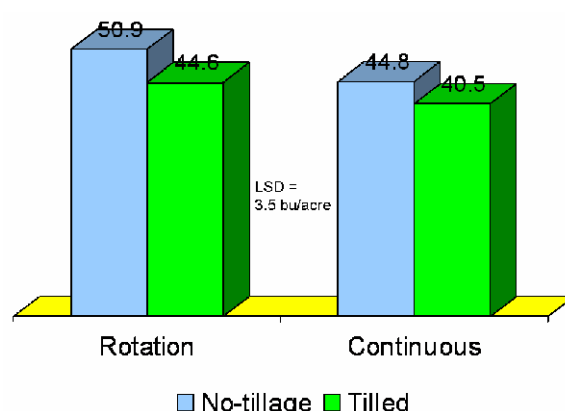


Figure 3. Effect of tillage choice and rotation on soybean yield. The unit for the values is bushels/acre. The LSD can be used to compare any two values.

Figure 4 presents yield data from this field site since 1992 for the tillage treatments. Averaged over all years for which data are available the no-tillage plots yielded 6.7% more than the tilled plots. The soil type for this site is a Mexico silt loam with a shallow claypan. This soil is considered poorly drained so these data are encouraging for the yield potential of soybean grown without tillage. For 2005 and 2006, the yield advantages for no-tillage were 19 and 14%. Weather conditions during flowering and early seed fill in 2005 and 2006 were drier than normal, and this might partially explain the advantage of no-tillage.

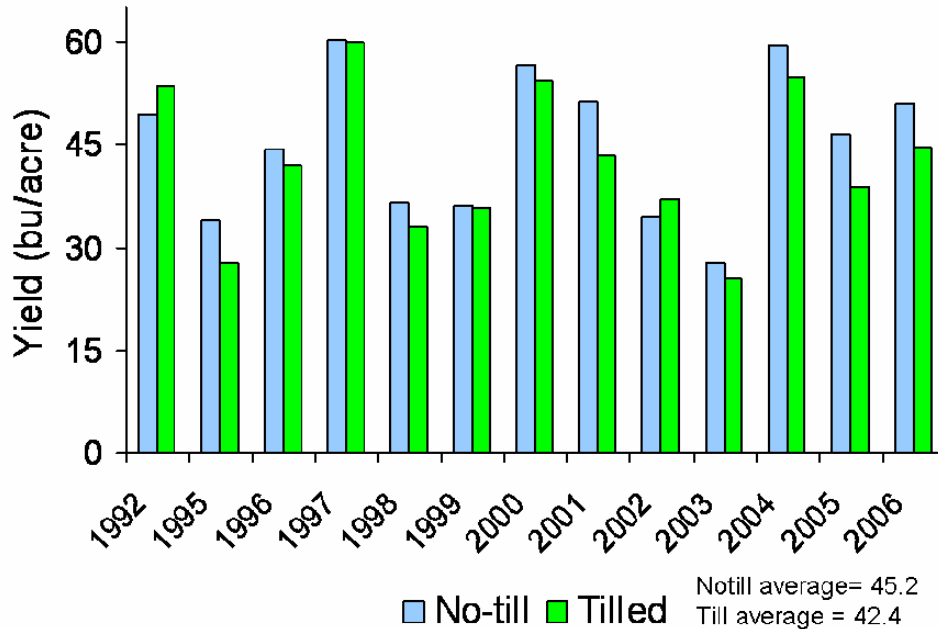
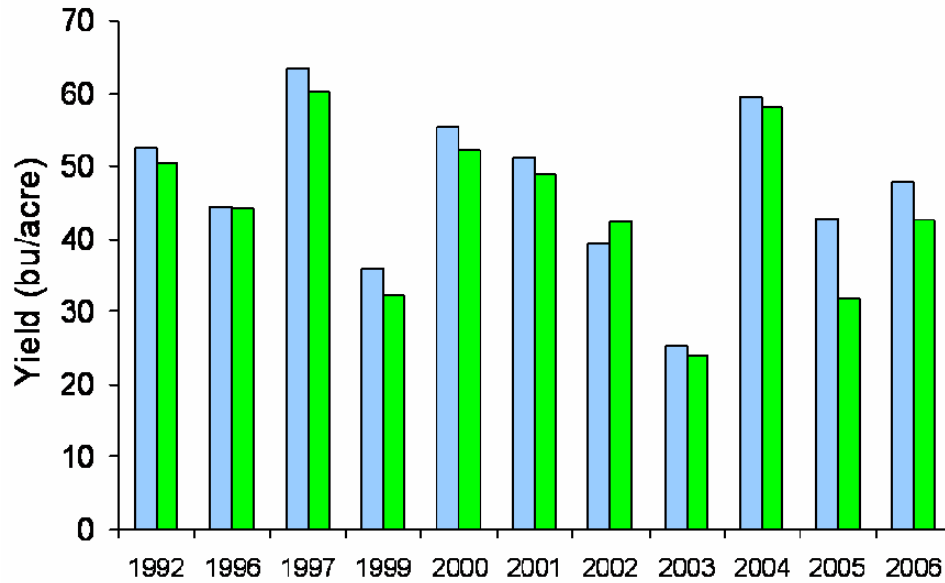


Figure 4. Effect of tillage choice on soybean grain yield since 1992. Plots have been maintained with specific tillage treatment since 1992. Values are for the rotation cropping system only. Long term average yields are in bushels/acre.

Figure 5 presents yield data from this field site since 1992 for the cropping systems treatments. Averaged over all years for which data are available soybean rotated with corn yielded 6.3% more than continuous soybean. For 2005 and 2006, the yield advantages of soybean rotated with corn were 34 and 12%. These numbers are larger than the long term average in this field partly because the long term average includes one year (2002) with a negative effect from rotation. However, except for 1999, the yield advantages were between 1 and 6%, so the last two years have exhibited a considerably larger than average response. As stated earlier, we have used SCN resistant varieties with the same resistance gene. Some of the negative effect from continuous soybean might be due to an SCN race shift. We will collect SCN information in the 2007 experiment.



Rotation average = 47.1
 Continuous average = 44.3

■ Rotation ■ Continuous

Figure 5. Effect of rotation system (rotation treatment is soybean rotated with corn in alternant years) grain yield since 1992. Plots have been maintained with specific tillage treatment since 1992. Values are averaged over the two tillage treatments. Long term average yields are in bushels/acre.

Conclusions:

1. Averaged over all years the no-tillage treatment yielded 6.7% more than the tilled treatment. In 2006, the yield advantage for no-tillage was 14%
2. Averaged over all years for which data are available soybean rotated with corn yielded 6.3% more than continuous soybean. In 2006, the yield advantage for rotation was 12%
3. There was no interaction between cropping systems and tillage treatments.