Comparing Tillage Systems (conventional, minimum, no-till) With Overhead Irrigation Using a 3-Year Crop Rotation of Corn, Soybean, and Barley (Nesson Valley 2014).

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Objectives

This project examines the interaction between tillage systems and soil quality and the interaction between crop production and tillage to better understand the benefits of overhead irrigation on production and tillage. Questions we hope to answer include: How is tillage going to affect the quality of our soil? Will soil quality affect crop production when irrigation is involved? What are the benefits of selecting the proper tillage to match the specific crop?

Methods

A three-year crop rotation of corn, soybean, and barley was initiated in the spring of 2008. The plots are setup in strips, 50 feet by 200 feet, and replicated four times in a split block design. Tillage of the conventional plots was initiated in the fall following harvest. In the spring, additional tillage was done to the conventional tillage plots. Conventional tillage (CT) consisted of multiple passes (6 total) with a disc, ripper, and mulcher resulting in <30 % residue left. Minimum tillage (MT) varied (≤ 2 passes) based on previous crop and was done in the spring prior to planting. Corn residue was aggressively disked (5mph) cutting at a depth of 4 inches while still maintaining >30% residue cover and mulched for firmer seed bed. Barley residue was also disked but ground speed and depth were reduced to maintain the > 30% residue cover and mulched to firm soil seedbed. A field cultivator was used to till the soil in soybean residue, leaving most of the residue on the soil surface. Only trash wipers (residue managers) were used in the No-till (NT) system to move residue from seed row. Crops were seeded with commercial field equipment and each crop was treated identically regardless of the tillage system during the growing season. Fertilizer was spring applied at recommended rates determined by soil testing. Weeds were managed with herbicides to minimize their impact on production. Percent residue cover, soil temperature in corn, and stand counts were measured after planting or crop emergence. Soil water content, shown in Figure 1, was measured weekly in all three crops and tillage systems to identify crop water needs. Representative areas within the plots were sampled with a plot combine for grain yield, protein, and test weight measurements. All crop and data analyses was done at the WREC.

No-till corn

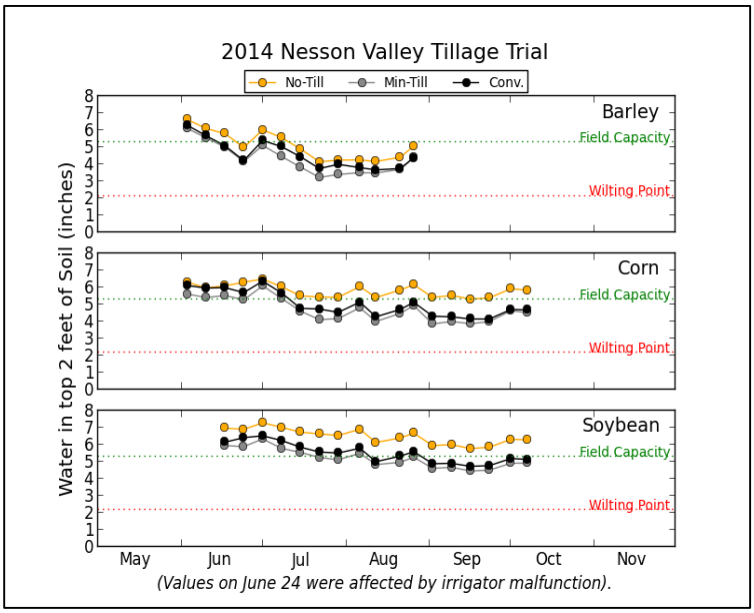


Figure 1

Results

Corn

The corn was planted May 22. The emergence date for the CT and MT was May 31 and NT was June 1. Measured stand counts were no different between treatments. Previous crop residue remaining on surface after planting was less than 10% on CT, 35% on MT and greater than 82% on NT. There were nine irrigations totaling 6.3 inches. The first irrigation was July 14 and the final irrigation was on August 15. At the start of the season, soil water (Figure 1) was similar among the treatments. As the summer progressed, soil moisture in the NT remained constant where as it decreased in CT and MT. Temperature sensors in the corn tillage plots showed soil temperature variability in tillage treatment, and in the accumulative soil growing degree days. Soil temperatures (Figure 2) were lower in NT than CT and MT during June. By the end of the growing season this resulted in the NT plots to having 162 degree day fewer heat units. A hailstorm stripped corn leaf matter causing premature plant death on September 3. At this time the crop was at full dent so harvest loses were to be expected. The first killing frost occurred September 11. This early plant death plus the delayed growth caused the NT plots to have considerably lower yield. Plots were harvested October 15 using a small plot combine and grain moistures had dried to 14 percent for all treatments. Yields (Table 1) were reduced compared to previous years. Test weights for CT, MT and NT were 53.6, 53.1, and 51.6 respectively.

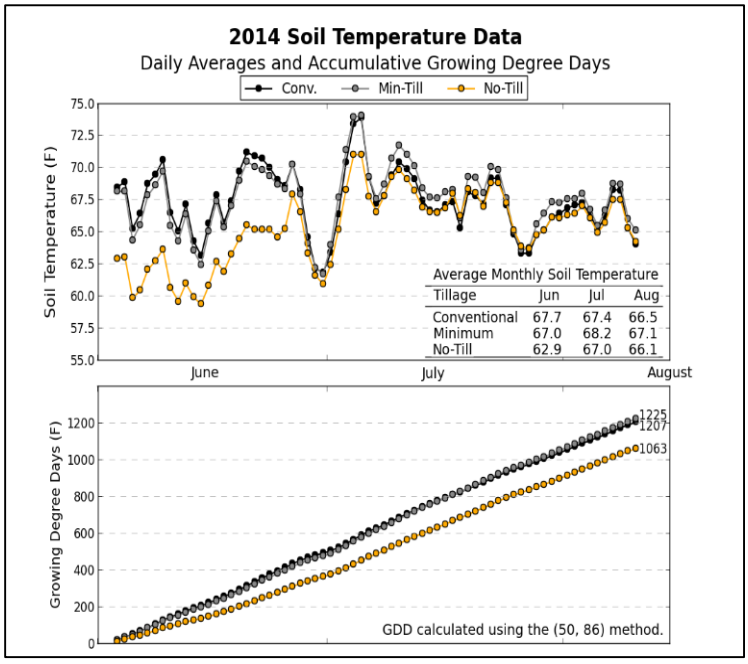
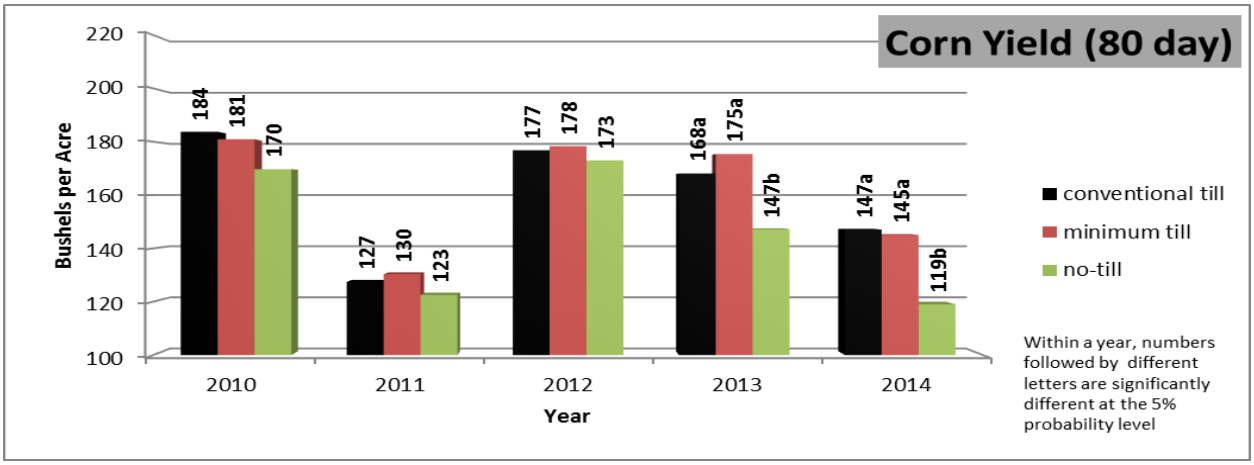


Figure 2

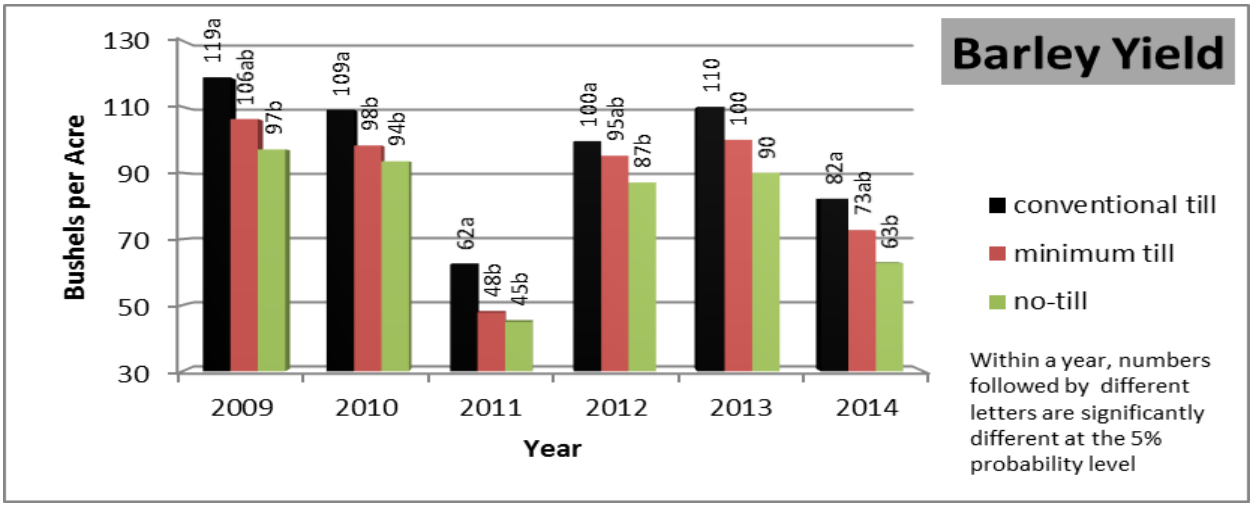
Table 1



Barley

The barley was planted May 12. The emergence was similar for the three treatments but stand counts were lower in the NT plots. This has been a consistent trend over the course of this study as it has been a challenge getting good seed to soil contact with the residue. Previous crop residue remaining on surface after planting was less than 8% on CT, 30% on MT and greater than 89% on NT. The residue in NT is greater because less corn residue broke down from the previous year. There were no differences in soil water content (Figure 1) throughout the summer for the three tillages. There were nine irrigations totaling 5.8 inches. The first irrigation was on June 9 and the final irrigation was on July 24. Rainfall amounts from May 1 to September 1 was below normal (7.5 inch). The cooler growing season temperatures had a greater impact on NT plots compared to CT and MT. Plots were harvested September 3. Yields trends were similar to the previous five years. CT (Table 2) have yielded the best followed by MT and then NT which has consistently been the lowest yielding. Test weights for CT, MT and NT were 50.2, 50.5, and 48.4 respectively.

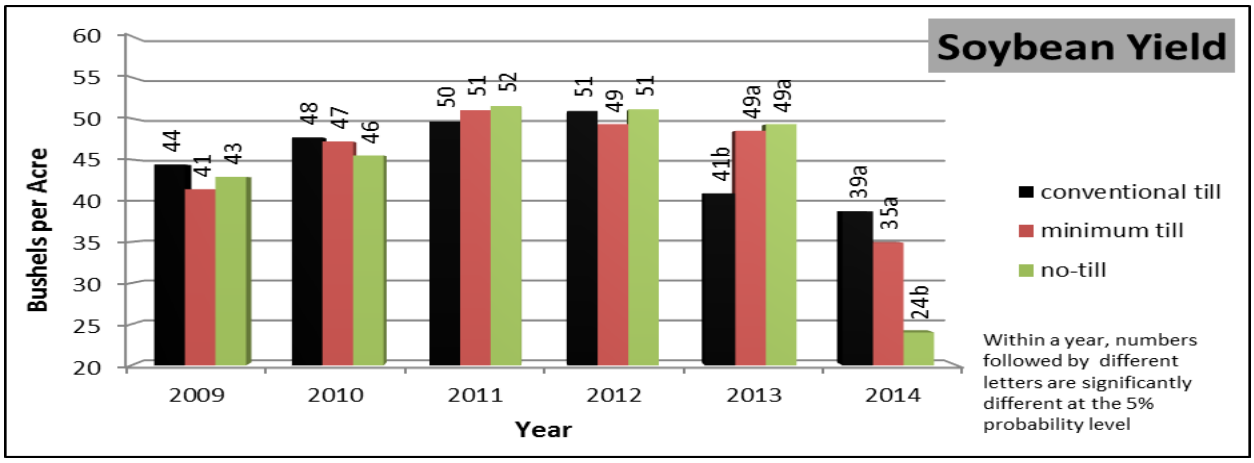
Table 2



Soybean

The soybeans were planted May 28. Emergence and stand counts were similar among the three treatments. Previous crop residue remaining on surface after planting was less than 20% on CT, 44% on MT and greater than 90% on NT. After emergence plant growth was slower in NT compared to CT and MT. A hail storm caused significant plant damage on September 3 that slowed reproductive development. This delayed plant growth impacted plant maturity and was detected at the first killing frost on September 11. All three tillage treatments were impacted by the hailstorm and early frost: CT and MT had reached late R5 early R6, and NT was at the early R5 reproductive stages. There were nine irrigations totaling 4.5 inches. The first irrigation was on July 17 and the final irrigation was on August 15. Soil water content (Figure 1) was similar to the previous years with the NT starting out wetter and maintaining this higher level throughout the growing season. Plots were harvested October 10. Soybean yields have been consistent prior to the past two years (Table 3), as Sclerotinia (white mold) disease impacted the yields of treatments in 2013 and hail damage and an early frost impacted yield this season. Test weights for CT, MT and NT were 56.3, 56.3, and 55.8 respectively.

Table 3



Conclusions

Comparing tillages systems with a three year rotation of corn, soybean and barley has reached its half-way point (6 of the 12 years) and MT is proving to be as effective as CT in a three year rotation under irrigation. Other observations made are the soybean NT system following corn is doing as well as the CT and MT systems. The results have demonstrated reduced tillage can be as productive in an irrigated environment as a CT system.