Mississippi Corn Promotion Board
2013 Progress Report

Project Title: Corn and Soybean Crop Residue Impact on Soil Quality, Yield and Returns

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Project Summary (Issue/Response)

Since soil quality changes occur at a slow rate, a five year (2011-2015) study is being conducted to evaluate the effects of corn and soybean crop residue management and tillage systems (in a corn-soybean rotation) on soil quality (soil physical, chemical and biological properties), grain yield, crop residue yield and nutrient content, and the economic returns with associated risks for these crop production systems in irrigated (Stoneville) and non-irrigated (Verona) environments.

Crop residue management [burn (corn only) and no-burn] and tillage treatments [no-tillage, bed-roller, disk (2x) + in-row subsoil-bed-roll (TerraTill®, a one-pass operation implement provided by Bigham Brothers, Lubbock, TX) and subsoil-bed-roll alone] are on the same site for the duration of the study. Since the crop rotation (corn and soybean) plot establishment in 2011, 2013 was the second year of data collection [(bed height, ground cover (vegetation/old crop residue), seedling emergence, early season seedling growth, grain and crop biomass yield and soil sampling]. The 2013 soil and crop residue/biomass analysis has not been completed.

No-tillage ground cover (old crop residue and winter vegetation) in March at both locations was higher than all other tillage treatments. Only at Stoneville, root growth resistance index (penetrometer readings) at 3- inch depth, and soil bulk density analysis indicated differences in tillage systems. Observations at both locations indicated corn seedling emergence for no-tillage was slightly slower, but 1 to 2 weeks after planting there were no population differences with only minor plant spatial variability and early season growth differences. At Stoneville, (irrigated) the bed-roller treatment yield was lower than no-tillage, disk (2x) + TerraTill and TerraTill which were not different. Yield for no-tillage and bed-roller at Verona (non-irrigated) was not different but both were lower than TerraTill and disk (2x) + TerraTill. The disk (2X) operations at both locations did not increase yield. Corn crop residue yield and 100 seed weights for tillage systems at both locations only showed minor differences. Preliminary 2012 (Verona) economic analysis in a risk/reward framework indicated the net return per acre for the no-burn disk (2x) + TerraTill treatment was the highest. But the risks associated with its net returns were higher than the no-burn TerraTill treatment which had similar net returns.

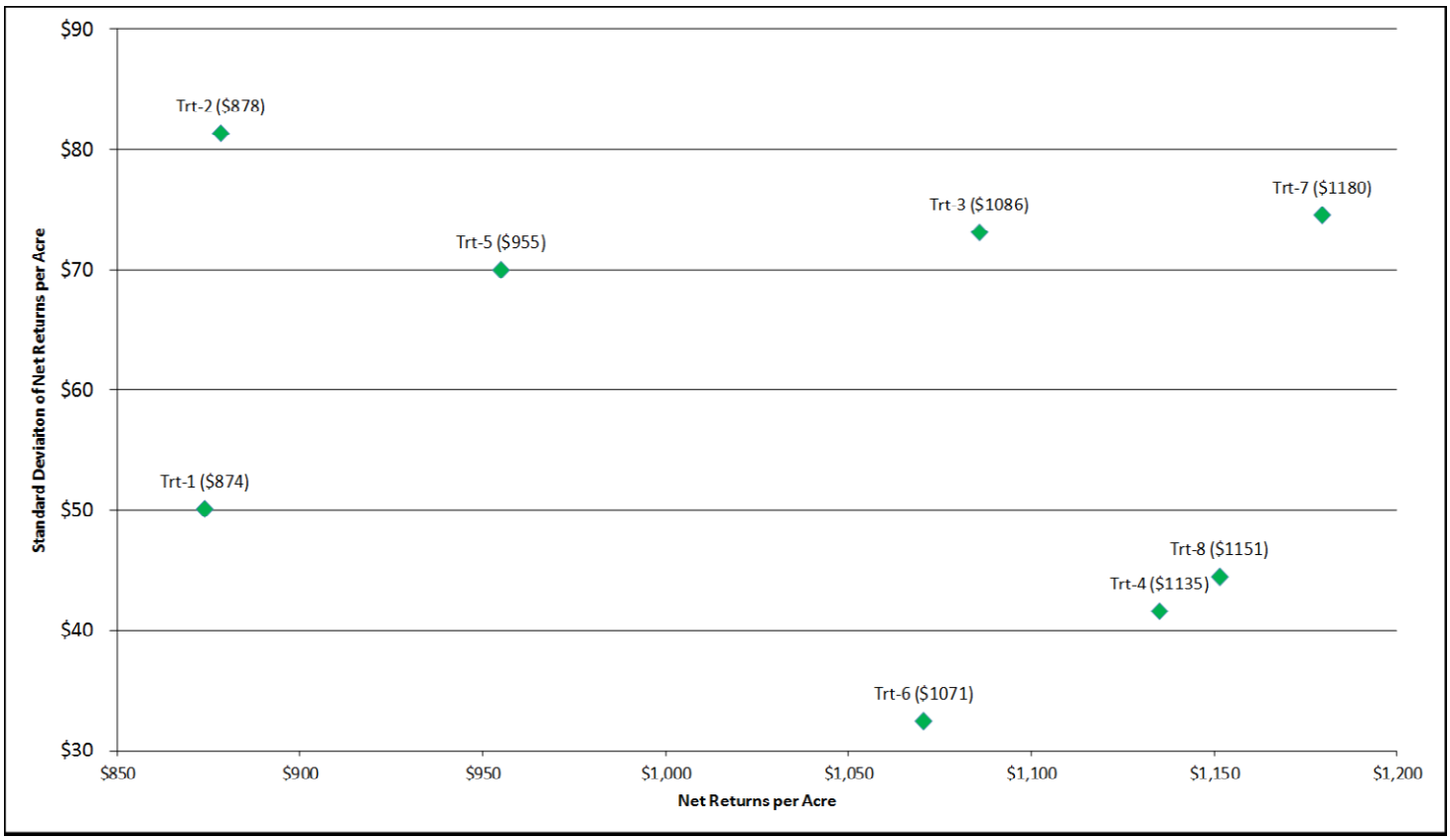
This is a multi-funded project with Mississippi Soybean Promotion Board (50%) and Mississippi Corn Promotion Board (50%). Bigham Brothers, Lubbock, Texas supports this project with two (one for each location) TerraTill® [in-row subsoil-bed-roll (one pass operation)] implements; and a United Soybean Board grant (10/1/13) will support additional soil quality research on this project.

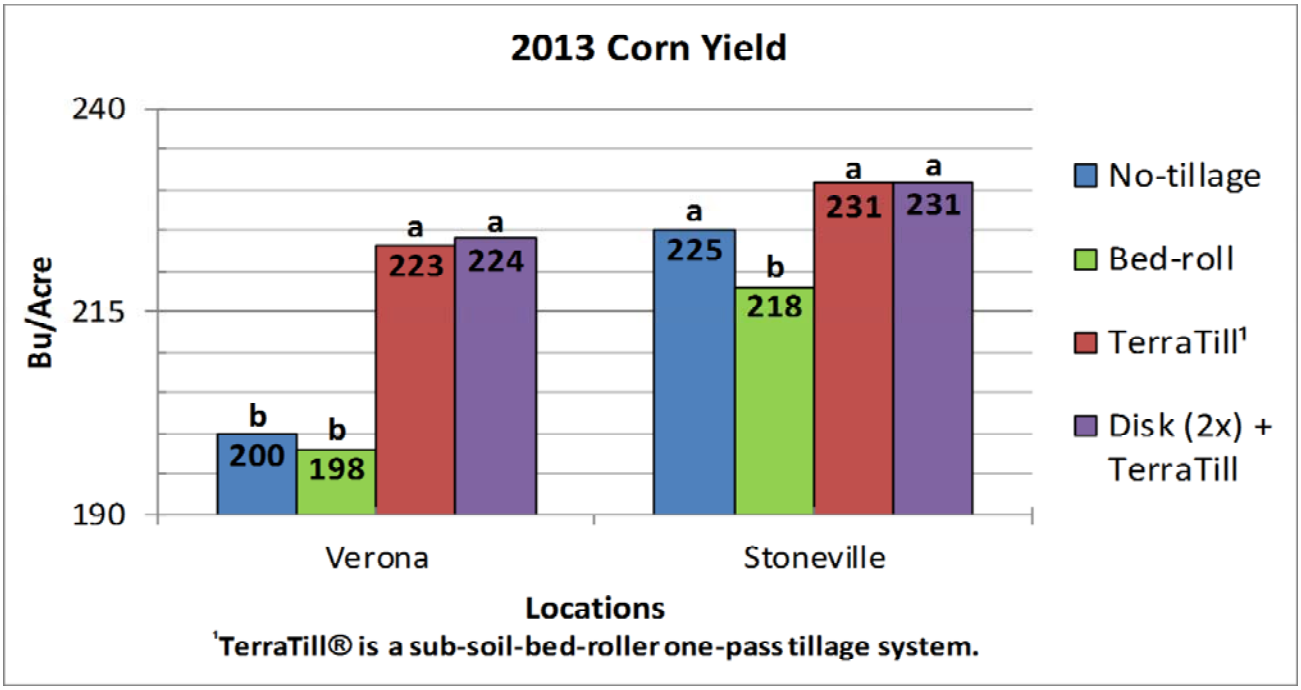
Project Results

In year 2 of a 5-year study, burning crop residue has not had a negative impact on yield and ground cover. However, this year at Stoneville, the no-burn crop residue had slightly higher ground cover than the burn crop residue treatment. Ground cover in March at both locations for no-tillage was 61 and 89% for Stoneville and Verona, respectively, which was higher than all other tillage treatments. Ground cover plays an important role in dissipating the raindrop's energy on impact which results in less soil erosion. As the study progresses over time, we expect the fewer tillage trips and not burning crop residue in the long term to have a positive impact on soil quality, yield and returns.

Observations at both locations indicated corn seedling emergence with no-tillage was slightly slower than the other tillage treatments, but 1 to 2 weeks after planting, populations were 27,000 to 28,000 at Verona and 33,000 to 34,000 plants/acre with no tillage treatment differences. Plant spatial variability at Verona showed no differences with minor differences at Stoneville. Both locations showed only minor early season growth differences among tillage treatments. However, there were tillage treatment grain yield differences at Stoneville and Verona. The (irrigated) bed-roller treatment yield of 218 bu/acre at Stoneville was lower than no-tillage, disk (2x) + TerraTill and TerraTill which had yields of 225, 231 and 231 bu/acre, respectively, which were not different in yield. Kernel weight at Stoneville indicated no differences among treatments. No-tillage and bed-roller yields of 198 and 200 bu/ac at Verona (non-irrigated) were not different but both were lower than both TerraTill and disk (2x) + TerraTill yields of 223 bu/acre. Kernel weight and rows of grain/ear for both TerraTill and the disk (2x) + TerraTill treatments were higher than the no-tillage and bed-roller treatments. The disk (2x) operations did not increase yield at both locations. Corn crop residue yields for all tillage treatments at both locations were not different and ranged from 3.4 to 4.0 tons/acre at Verona, and 4.1 to 4.7 tons/acre at Stoneville. Root growth resistance index (penetrometer) measurements at Verona indicated no differences at both the 3- and 6-inch depths. Stoneville results indicated no differences due to tillage at the 6-inch depth. But the 3-inch depth indicated TerraTill had the highest index and was higher than the disk (2x) + TerraTill but not different from no-tillage or bed-roller. TerraTill also had the highest soil bulk density which was higher than all other tillage systems.

The Verona year 2012 preliminary economic analysis in a risk/reward framework (standard deviation) which indicates the consistency for the tillage treatment net returns has been completed. While the no-burn disk (2x) + TerraTill had the highest net return (above specified costs) of $1,180/acre, the risk associated with its net returns (standard deviation of $75/acre) was higher than the no-burn TerraTill with a standard deviation of $45/acre and a net return of $1,151/acre. The net returns were based on a corn price of $7.12/bu with direct and fixed expense priced on values from Mississippi State University Budgets. Some items were intentionally left out of these cost calculations i.e., costs for land or land rent, taxes, insurance, general farm overhead, and expected income from government payments or insurance payments, as they vary widely between operations.





Project Impacts/Benefits

Since soil quality improvement processes occur at a slow pace, this 5-year (2011-2013) research study when completed will provide producers the necessary information to make an informed decision regarding the economic returns and the risk/ rewards associated with these tillage-crop residue management systems in irrigated and non-irrigated environments. It will provide information regarding their positive or negative impact on yield, soil quality and fertilizer nutrient use efficiency. Results from these studies will also provide needed information on the level of soil quality enhancement or degradation (soil organic matter, soil aggregate stability, bulk density, soil microbial biomass, soil respiration, etc.) from these tillage-crop residue management practices on both alluvial delta and prairie coastal plain soils in Mississippi. The outcome of this research will provide Mississippi growers the information that will enable them to understand how they can develop "Soil Quality Enhancement Activities" meeting the requirements for NRCS's Conservation Stewardship Program. The economic risk/reward analysis using current and/or projected production costs and grain pricing also will allow us to measure the net return above specified costs and the associated risk for these tillage-crop residue management systems in the near- and long term.

Project Deliverables

1) **Field Presentations.**

NMREC, August 9, 2013, Mississippi Soybean Promotion Board site visit.

NMREC, August 23, 2013, Mississippi Corn Promotion Board invited site visit.

DREC, July 18, 2013

2) **Poster Presentation**: North Mississippi Producer Advisory Council Meeting, February 21, 2013, Verona, MS.

3) **PowerPoint presentations** at regional and state professional meetings (expected)

North Mississippi Producer Advisory Council Meeting, February 21, 2013.

4) **MAFES Bulletins** (expected)

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