Mississippi Corn Promotion Board
2015 Progress Report

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

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Department: NMREC, PSS and DREC

Project Summary (Issue/Response)

Since soil quality changes occur at a slow rate, a seven year (2011-2017) 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 associated with 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 (old beds), bed-roller, disk (2x) + in-row subsoil-bed-roll (TerraTill®, a one-pass operation implement) and subsoil-bed-roll alone] are on the same site for the duration of the study. The year 2015 was the fourth year data was collected. The 2015 soil's buffer capacity, nutrient content, microbial biomass, respiration, water holding capacity and the crop residue/biomass fertilizer nutrient content analysis have not been completed for both locations.

Except for soil organic matter at Verona, crop residue management (burn and no-burn) at both locations had no significant impact on all the variables analyzed and did not interact with tillage systems. There was a crop residue management by tillage interaction for soil organic matter at Verona. In the no-burn corn residue, the disk (2x) + TerraTill, soil organic matter content was lower than TerraTill but not different from no-tillage and bed-roller. However, in the burn corn crop residue (2012 and 2014), TerraTill and disk (2x) + TerraTill were not different but lower than no-tillage and bed-roller. No-tillage March ground cover at both locations was higher than all other tillage treatments. TerraTill ground cover at both locations was higher than the disk (2x) + TerraTill. There were no population and plant spatial differences, and only minor corn crop residue yield and 100 seed weight differences at both locations. No-tillage early season corn growth, grain yield and net returns at both locations were lower than bed-roller, TerraTill and disk (2x) + TerraTill. At both locations, the bed-roller and disk (2x) + TerraTill net returns were not different. TerraTill returns were higher than the disk (2x) + TerraTill at Verona but not different at Stoneville (irrigated). Therefore, the disk operations at both locations did not increase yield or net returns. Bed integrity at both locations for no-tillage (old beds) system lasted two cropping seasons and had to be reshaped in the spring of 2014.

Project Results/Outcomes

Except for soil organic matter at Verona in 2015 (year 4 of data collection), both locations indicated crop residue management [burn stubble corn (only) and no burn] had no effect on corn population, early season growth, plant spatial differences, soil root resistance index (penetrometer), grain yield and net returns; and no interaction with tillage systems. At Verona, in the burned corn stubble, both bed-roller and no-tillage soil organic were not different but greater than the disk (2x) + TerraTill and TerraTill. In the no-burn, the disk (2x) + TerraTill soil organic matter content was lower than TerraTill, but not different from no-tillage and the bed-roller. March

Project Results

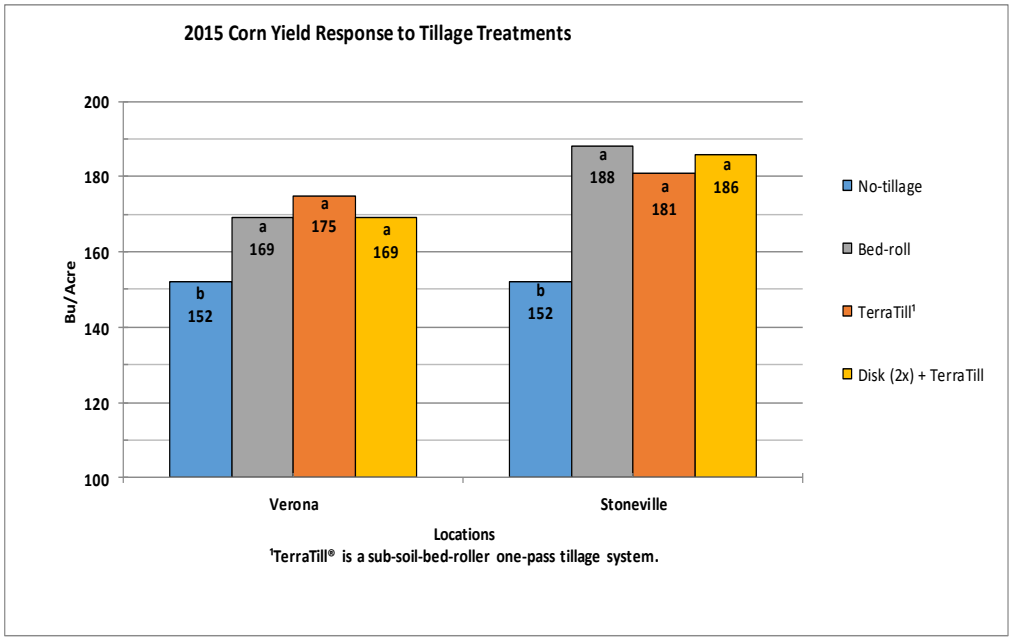
ground cover for no-tillage was 78 and 80% for Stoneville and Verona, respectively, which was greater than all other tillage treatments. The disk (2x) + TerraTill had the least ground cover at both locations. Ground cover plays an important role in dissipating the raindrop's energy on impact which results in less soil erosion. As the study progresses over time, we expect the fewer tillage trips and not burning the corn crop residue in the long term to have a positive impact on soil quality, yield and returns.

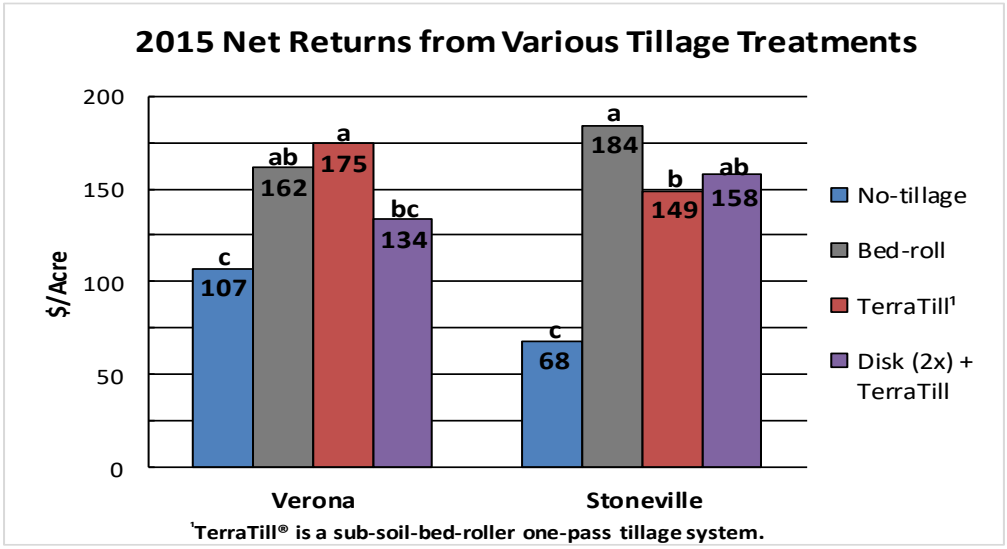
Early [7 days after planting (DAP)] corn seedling populations for no-tillage were lower at Stoneville with no differences at Verona. However, 14 DAP, there were not tillage systems population differences. Early season number of leaves per plant and plant spatial differences indicated no differences between tillage systems at both locations. However, no-tillage had less early season growth and the yields of 152 bu/acre at both locations were lower than the other tillage systems. Bed-roller, TerraTill and disk (2x) + TerraTill grain yields at Verona (non-irrigated) of 169 to 175 bu/acre and 181 to 188 bu/acre at Stoneville (irrigated) were not different. Irrigation at Stoneville was applied 7/16/15 and 8/07/15. The disk (2x) operations at both locations did not increase yield and had lower soil organic matter than the other tillage systems. Kernel weight and crop residue yields for all tillage treatments at both locations only showed minor tillage differences. No-tillage had higher root resistance indices (penetrometer) than bed-roller, TerraTill and disk (2x) + TerraTill at the 3- and 6-inch depths at Verona, but only at the 3-inch depth at Stoneville. Bed integrity at both locations for the no-tillage (on old beds) system lasted two crop production seasons, and then had to be re-bedded in 2014.

The economic analysis for Verona and Stoneville indicated crop residue management had no effect on net returns above total specified costs, and there was no interaction with tillage treatments. Both bed-roller ($162/acre) and TerraTill ($175/acre) net returns at Verona were not different but TerraTill had higher net returns than no-tillage ($107/acre) and the disk (2x) + TerraTill ($134/acre). At Stoneville, the bed-roller had the highest net returns ($184/acre), but was not different from the disk (2x) + TerraTill net returns ($158/acre). Both had higher returns than no-tillage ($68/acre). But the net returns for the disk (2x) + TerraTill ($158/acre) was not different from TerraTill ($149/acre). Both locations indicated the disk operations did not increase yield or net returns. Net returns were based on the corn price for the week of corn harvest date ($3.69/bu for Verona and $3.49/bu for Stoneville) for each location, with the direct and fixed expense priced on values from 2015 Mississippi State University "Corn Production" Budgets. Some items were intentionally left out of these cost calculations e.g., 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 7-year (2011-2017) research study when completed will provide producers the necessary information to make an informed decision regarding the economic returns associated with these crop residue management-tillage 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 crop residue management-tillage 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 analysis using current and/or projected production costs and grain pricing also will allow us to measure the net return above total specified costs for these crop residue management tillage systems in the near- and long term.


2015 Corn Yield Response to Tillage Treatments
200
180
160
140
120
100
Bu/Acre
b 152
a 169
a 175
a 169
b 152
a 188
a 181
a 186
Verona
Stoneville
Locations
No-tillage
Bed-roll
TerraTill¹
Disk (2x) + TerraTill
¹TerraTill® is a sub-soil-bed-roller one-pass tillage system.


2015 Net Returns from Various Tillage Treatments
200
150
100
50
0
$/Acre
c 107
ab 162
a 175
bc 134
c 68
a 184
b 149
ab 158
Verona
Stoneville
No-tillage
Bed-roll
TerraTill¹
Disk (2x) + TerraTill
¹TerraTill® is a sub-soil-bed-roller one-pass tillage system.

Project Deliverables

Poster Presentation:

Professional Meetings:

Taylor, A.R., N.W. Buehring, M.P. Harrison, L.L. Falconer, W.L. Ebelhar, W.L. Kingery and S.G. Shanmugam. 2015. Crop residue management and tillage system effect on bed height, ground cover, corn grain yield and net returns in a soybean/corn rotation. American Society of Agronomy Meeting. Minneapolis, MN. Nov. 15-18, 2015.

Shanmugam, S.G., N.W. Buehring, M.W. Ebelhar, M.S. Cox, J.L. Oldham and W.L. Kingery. 2015. Impact of tillage and residue management on soil microbial biodiversity under soybean-corn rotation, 2015. American Society of Agronomy Meeting, Minneapolis, MS. Nov. 15-18, 2015.

Harrison, M.P., N.W. Buehring, A.R. Taylor, M.W. Ebelhar, L.L. Falconer, W.L. Kingery and S.G. Shanmugam. 2015. Soybean yield and net returns response to corn crop residue management and tillage systems in a corn-soybean rotation. American Society of Agronomy Meeting, Minneapolis, MN. Nov. 15-18, 2015.

Grower Meetings:

Harrison, M., N. Buehring, A. Taylor, W. Ebelhar, L. Falconer, W. Kingery and S.G. Shanmugam. Soybean yield and net returns response to corn crop residue management and tillage systems. Presented at North Mississippi Research and Extension Center Producer Advisory Council Meeting. Feb. 19, 2015, Verona. MS.

Taylor, A., M. Harrison, N. Buehring, W. Ebelhar, L. Falconer, W. Kingery, and S.G. Shanmugam. Tillage system effect on corn grain, crop residue nutrient yield and net returns. Presented at North Mississippi Research and Extension Center Producer Advisory Council Meeting. Feb. 19, 2015, Verona, MS.

PowerPoint presentations:

Ebelhar, M. Wayne, Normie W. Buehring and William Kingery. 2015. Crop Residue Management and Tillage Interactions for Soybean/Corn Rotations. American Society of Agronomy, Southern Branch Meeting, February 1-4, 2015, Atlanta, GA.

MAFES Bulletins:

(Expected)

Buehring/MCPB/2016/ MCPB 2016 Brief-Buehring 1-25-2016