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**Economic Analysis of Corn and Soybean Crop Residue Management and Tillage Strategies
in Mississippi**

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Economic Analysis of Corn and Soybean Crop Residue Management Strategies in Mississippi

Objective

The objective of this paper is to evaluate the economic returns and risk associated with alternative crop residue management and tillage strategies in two different locations in Mississippi over the 2012 to 2014 crop years.

Background

Soil management and cropping systems are two of the most important factors influencing soil structure (soil aggregate stability). The use of tillage in crop production decreases the soil aggregate stability and the decomposition of different crop residue has also been shown to degrade soil structure. Under identical management and soil situations, soybean resulted in greater erosion than continuous corn or soybean following corn (Lafren and Moldenhauer, 1979). McCracken (1984) found that equal amounts of soybean and corn residue, allowed to decompose in soil for 4 months, did not produce the same level of stable soil aggregates, suggesting that the amount of decomposing soybean residue may be a major factor reducing the soil structure in soil following soybean growth. Martens (2000) suggested the decrease in soil stability after soybean growth was due to a decrease in the content of soil humic substances caused by substantially lower phenolic acid content (humic acid precursors) in the soybean residue.

Information is unavailable in Mississippi regarding cropping systems and tillage effects on soil quality, ground residue cover, yield and net returns. Since soil quality changes occur at a slow rate, a long-term study is being conducted to learn how to manage soil through cropping systems to improve soil function. The study is being conducted to determine how corn and soybean crop residue management [(burn corn crop residue (only) vs no-burn)] and tillage in irrigated and non-irrigated environments affect 1) soil quality, crop growth, and yield; 2) crop residue yield and nutrient content in a corn-soybean rotation; and 3) the returns above total specified expenses for each tillage system and location. It was expected that fewer tillage operations and not burning crop residue would have a greater positive impact on soil quality, yield and returns. Using current and/or projected production costs and grain pricing, the economic analysis will allow us to measure the direct benefit to growers in the near-and long term.

Data and Methods

The study was conducted at Verona (NMREC, non-irrigated) and Stoneville (DREC, irrigated) to evaluate the effects of corn and soybean residue management systems, in a corn-soybean rotation, on soil quality, grain yield, and the risk associated with the economic returns for these systems. The study sites were maintained on silt loam or sandy loam soils suited to corn and soybean production. The experimental design is a split-split plot with 4 replications (Verona) or 6 replications (DREC). Corn and soybean in rotation is the main plot treatment; residue burn (corn only) and no-burn are the sub-plot treatments; and fall tillage treatments [no-tillage, bed-roll, disk + subsoil-bed-roll (one-pass operation), and subsoil-bed-roll] are the sub-sub plots. Due to low residue amount produced by soybean, the soybean plots were not burned. Since both corn and soybean have different irrigation schedules, corn and soybean plots were adjacent to each other.

Crop residue management (burn and no-burn) and tillage treatments were on the same site for the duration of the study. Data collected at each location included: operations performed, grain yield, soil quality factors, crop emergence, stand uniformity/spatial variability, crop residue yield and nutrient analysis. The net returns above total specified costs were determined for each treatment and location.

The economic analysis included in this study was based on enterprise budgeting of net returns above total specified expenses. Returns above total specified expenses are used as a proxy for the economic concept of net returns above variable plus fixed costs. The net returns per acre are based on the average reported price for soybeans and corn at Greenwood, MS for the week including the harvest date (USDA-AMS). Costs were calculated for each treatment within each year, as well as for the 3-yr average. For irrigated treatments fixed costs associated with wells and deep tillage are included, as well as direct costs associated with pumping water and trips across the field. Direct and fixed expenses associated with each operation are taken from Mississippi State University Budgets (MSU) for each year.

Some items are intentionally left out of these cost calculations, i.e., costs for land or land rent, taxes, insurance premiums, general farm overhead, and expected incomes from government payments or insurance payments as they vary widely between operations. Standard deviations are reported for the cost per acre for each treatment and for the net returns per acre for each treatment. The standard deviation allows for comparison of the risk associated with costs and returns over the 3-yr period and may provide a method of separating treatments with similar costs and returns (Pringle and Martin).

Results and Discussion

The 2012 net returns per acre at Verona are based on a soybean price of \$16.43 per bushel and \$7.12 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110). Direct and fixed expenses are taken from Mississippi State University Budgets (MSU Department of Agricultural Economics Budget Report 2012-07 Estimated total specified corn production expenses per acre for each treatment are shown below in Table 1.

Table 1. Total Corn Specified Expenses per Acre by Treatment for 2012 at Verona.

Treatment Name	Total Specified Costs per Acre
Burn: no tillage	\$476.07
Burn: bed-roller	\$483.79
Burn: disk (2x) + TerraTill - bed-roller	\$513.60
Burn: TerraTill - bed-roller	\$494.46
No burn: disk(2x) + TerraTill - bed-roller	\$513.60
No burn: no tillage	\$476.07
No burn: bed-roller	\$483.79
No burn: TerraTill - bed-roller	\$494.46

The *No burn Disk (2x)– no tillage* treatment produced the highest mean net return above total specified costs for corn production in 2012. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 2.

Table 2. 2012 Verona Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$7.12 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: disk(2x) + TerraTill - bed-roller	\$ 1,181.50	\$ 74.57
No burn: TerraTill - bed-roller	\$ 1,153.29	\$ 44.51
Burn: TerraTill - bed-roller	\$ 1,136.91	\$ 41.64
Burn: disk (2x) + TerraTill - bed-roller	\$ 1,087.69	\$ 73.10
No burn: bed-roller	\$ 1,070.69	\$ 32.50
No burn: no tillage	\$ 954.88	\$ 70.01
Burn: bed-roller	\$ 878.27	\$ 81.33
Burn: no tillage	\$ 873.88	\$ 50.13

Analysis indicated that there was a statistically significant difference between the Burn and No-burn main treatments, a significant difference in tillage treatments and a significant interaction between the residue management and tillage treatments at the 0.05 level (Table 3).

Table 3. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Verona for Corn Production

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	6	9.92	0.0198
tillage	3	18	43.09	<.0001
burn*tillage	3	18	4.27	0.0192

It was found that the No burn residue management treatment had a statistically different (higher) return than the Burn residue management treatment. (Table 4).

Table 4. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Residue Management System for 2012 at Verona for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Residue Management Treatment	LS Mean	
No burn	\$ 1,090.08	A
Burn	\$ 994.19	B

It was found that the Terratill – bed roller and the Disk (2x) + TerraTill – bed roller treatments had statistically different (higher) returns than the Bed-roller and No Tillage treatments. Also, the Bed-roller treatment had a statistically different (higher) return than the No Tillage treatment (Table 5).

Table 5. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Verona for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
TerraTill - bed roller	\$ 1,145.10	A
Disk (2x) + TerraTill - Bed-roller	\$ 1,134.59	A
Bed-roller	\$ 974.48	B
No Tillage	\$ 914.38	C

Table 6. Total Soybean Specified Expenses per Acre by Treatment for 2012 at Verona.

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 433.49
Burn: bed-roller	\$ 441.21
Burn: disk (2x) + TerraTill - bed-roller	\$ 471.02
Burn: TerraTill - bed-roller	\$ 451.88
No burn: disk(2x) + TerraTill - bed-roller	\$ 471.02
No burn: no tillage	\$ 433.49
No burn: bed-roller	\$ 441.21
No burn: TerraTill - bed-roller	\$ 451.88

The ***Burn: disk (2x) + TerraTill – bed roller*** treatment produced the highest mean net return above total specified costs for soybean production in 2012. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 7.

Table 7. 2012 Verona Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$16.43 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
Burn: disk (2x) + TerraTill - bed-roller	\$ 811.75	\$ 85.30
Burn: TerraTill - bed-roller	\$ 796.39	\$ 58.39
No burn: disk(2x) + TerraTill - bed-roller	\$ 794.50	\$ 33.79
No burn: TerraTill - bed-roller	\$ 776.67	\$ 37.88
Burn: no tillage	\$ 753.17	\$ 70.61
Burn: bed-roller	\$ 745.04	\$ 62.07
No burn: bed-roller	\$ 721.63	\$ 68.07
No burn: no tillage	\$ 701.00	\$ 39.99

Analysis indicated that there was no statistically significant difference between the residue management treatments and no interaction between the residue management and tillage treatments at the 0.05 level. However, there was a significant difference found between tillage treatments (Table 8).

Table 8. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Verona for Soybean Production.

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	6	0.61	0.4654
tillage	3	18	9.27	0.0006
burn*tillage	3	18	0.42	0.7394

It was found that the *Terratill – bed roller* and the *Disk (2x) + TerraTill – bed roller* tillage treatments had statistically different (higher) returns than **the *Bed-roller* and *No Tillage*** treatments. (Table 9).

Table 9. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Verona for Soybean Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
Disk (2x) + TerraTill - Bed-roller	\$ 803.12	A
TerraTill - bed roller	\$ 786.53	A
Bed-roller	\$ 733.33	B
No Tillage	\$ 727.08	B

The net returns per acre for Stoneville and 2012 are based on a soybean price of \$16.43 per bushel and \$7.12 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110. Estimated total specified corn production expenses per acre for each treatment are shown below in Table 10.

Table 10. Total Corn Specified Expenses per Acre by Treatment for 2012 at Stoneville.

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 559.73
Burn: bed-roller	\$ 567.45
Burn: disk (2x) + TerraTill - bed-roller	\$ 597.26
Burn: TerraTill - bed-roller	\$ 578.12
No burn: disk (2x) + TerraTill - bed-roller	\$ 597.26
No burn: no tillage	\$ 559.73
No burn: bed-roller	\$ 567.45
No burn: TerraTill - bed-roller	\$ 578.12

The ***No burn– no tillage*** treatment produced the highest mean net return above total specified costs for corn production in 2012. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 11.

Table 11. 2012 Stoneville Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$7.12 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: no tillage	\$ 649.86	\$ 149.58
Burn: no tillage	\$ 579.02	\$ 97.70
No burn: TerraTill - bed-roller	\$ 561.60	\$ 114.87
Burn: TerraTill - bed-roller	\$ 547.87	\$ 169.74
Burn: disk (2x) + TerraTill - bed-roller	\$ 531.05	\$ 171.10
No burn: bed-roller	\$ 497.25	\$ 145.95
No burn: disk (2x) + TerraTill - bed-roller	\$ 469.25	\$ 101.92
Burn: bed-roller	\$ 462.85	\$ 137.21

Analysis indicated that there was no statistically significant difference between the Burn and No-burn main treatments and no significant interaction between the residue management and tillage treatments. Also, it was found that there was no statistically significant difference in the mean net returns for the tillage treatments (Table 12).

Table 12. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Stoneville for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
No Tillage	\$ 614.43	A
TerraTill - bed roller	\$ 554.74	A
Disk (2x) + Terratill - Bed-roller	\$ 500.15	A
Bed-roller	\$ 480.05	A

Table 13. Total Soybean Specified Expenses per Acre by Treatment for 2012 at Stoneville.

Treatment Name	Total Specified Costs per Acre
Burn: no tillage	\$326.66
Burn: bed-roller	\$334.38
Burn: disk (2x) + TerraTill - bed-roller	\$364.19
Burn: TerraTill - bed-roller	\$345.05
No burn: disk (2x) + TerraTill - bed-roller	\$364.19
No burn: no tillage	\$326.66
No burn: bed-roller	\$334.38
No burn: TerraTill - bed-roller	\$345.05

The **No burn: disk (2x) + TerraTill – bed roller** treatment produced the highest mean net return above total specified costs for soybean production in 2012. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 14.

Table 14. 2012 Stoneville Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$16.43 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: disk (2x) + TerraTill - bed-roller	\$ 761.96	\$ 42.71
No burn: no tillage	\$ 737.60	\$ 24.12
No burn: bed-roller	\$ 700.22	\$ 87.28
Burn: no tillage	\$ 665.94	\$ 91.51
No burn: TerraTill - bed-roller	\$ 659.60	\$ 80.52
Burn: bed-roller	\$ 626.91	\$ 136.13
Burn: TerraTill - bed-roller	\$ 581.28	\$ 77.09
Burn: disk (2x) + TerraTill - bed-roller	\$ 567.23	\$ 68.95

No statistically significant difference was found between the Burn and No-burn main treatments at the Alpha=0.05 level. However, it was found that the mean net return per acre for the *No Tillage* treatment was significantly different (higher) than the mean net return per acre for the *TerraTill - bed roller* treatment (Table 15).

Table 15. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2012 at Stoneville for Soybean Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean		
No Tillage	\$ 701.77	A	
Disk (2x) + Terratill - Bed-roller	\$ 664.60	A	B
Bed-roller	\$ 663.56	A	B
TerraTill - bed roller	\$ 620.44		B

The net returns per acre for 2013 at Verona are based on a soybean price of \$12.73 per bushel and \$4.27 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110). Direct and fixed expenses priced are taken from Mississippi State University Budgets (MSU Department of Agricultural Economics Budget Report 20123-05). Estimated total specified corn production expenses per acre for each treatment are shown below in Table 16.

Table 16. Total Corn Specified Expenses per Acre by Treatment for 2013 at Verona.

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 532.20
Burn: bed-roller	\$ 539.86
Burn: disk (2x) + TerraTill - bed-roller	\$ 569.20
Burn: TerraTill - bed-roller	\$ 550.32
No burn: disk(2x) + TerraTill - bed-roller	\$ 569.20
No burn: no tillage	\$ 532.20
No burn: bed-roller	\$ 539.86
No burn: TerraTill - bed-roller	\$ 550.32

The **Burn: Terratill – bed-roller** treatment produced the highest mean net return above total specified costs for corn production in 2013 with the **No burn: bed-roller** treatment generating the smallest mean net return per acre. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 17.

Table 17. 2013 Verona Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$4.27 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
Burn: TerraTill - bed-roller	\$ 410.13	\$ 17.45
No burn: disk(2x) + TerraTill - bed-roller	\$ 403.27	\$ 39.83
No burn: TerraTill - bed-roller	\$ 391.05	\$ 48.08
Burn: disk (2x) + TerraTill - bed-roller	\$ 366.65	\$ 33.09
Burn: no tillage	\$ 351.07	\$ 58.09
Burn: bed-roller	\$ 330.76	\$ 36.14
No burn: no tillage	\$ 294.94	\$ 23.34
No burn: bed-roller	\$ 283.33	\$ 35.50

Analysis indicated that there was no statistically significant difference between the **Burn** and **No-burn** main treatments, a significant difference in tillage treatments and a significant interaction between the residue management and tillage treatments at the 0.05 level (Table 18).

Table 18. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Verona for Corn Production.

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	6	1.18	0.3196
tillage	3	18	15.25	<.0001
burn*tillage	3	18	6.88	0.0028

It was found that the **No burn** residue management treatment return was not statistically different than the **Burn** residue management treatment. (Table 19).

Table 19. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Residue Management System for 2013 at Verona for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Residue Management Treatment	LS Mean	
Burn	\$ 364.65	A
No burn	\$ 343.15	A

It was found that the **Terratill – bed roller** and the **No Tillage** treatments had statistically different (higher) returns than the **Disk (2x) + TerraTill – bed roller** and the **Bed-roller** treatments (Table 20).

Table 20. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Verona for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
TerraTill - bed-roller	\$ 400.59	A
No Tillage	\$ 377.17	A
Disk (2x) + TerraTill - bed-roller	\$ 324.99	B
Bed-roller	\$ 312.85	B

Table 21. Total Soybean Specified Expenses per Acre by Treatment for 2013 at Verona.

Treatment Name	Total Specified Cost Acre
Burn: no tillage	\$ 247.17
Burn: bed-roller	\$ 254.83
Burn: disk (2x) + TerraTill - bed-roller	\$ 284.17
Burn: TerraTill - bed-roller	\$ 265.29
No burn: disk(2x) + TerraTill - bed-roller	\$ 284.17
No burn: no tillage	\$ 247.17
No burn: bed-roller	\$ 254.83
No burn: TerraTill - bed-roller	\$ 265.29

The **No burn: bed-roller** treatment produced the highest mean net return above total specified costs for soybean production in 2013 with the **Burn: no-tillage** treatment generating the smallest mean net return per acre. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 22.

Table 22. 2013 Verona Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$12.73 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: bed-roller	\$ 725.06	\$ 25.81
Burn: TerraTill - bed-roller	\$ 716.92	\$ 68.01
No burn: TerraTill - bed-roller	\$ 714.98	\$ 59.25
No burn: disk(2x) + TerraTill - bed-roller	\$ 707.97	\$ 42.68
No burn: no tillage	\$ 647.84	\$ 104.12
Burn: disk (2x) + TerraTill - bed-roller	\$ 629.59	\$ 80.27
Burn: bed-roller	\$ 606.96	\$ 50.77
Burn: no tillage	\$ 531.87	\$ 69.96

Analysis indicated that there was a statistically significant difference between the residue management treatments and no interaction between the residue management and tillage treatments at the 0.05 level. There was a significant difference found between tillage treatments (Table 23).

Table 23. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Verona for Soybean Production.

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	6	7.27	0.0358
tillage	3	18	5.91	0.0055
burn*tillage	3	18	1.71	0.2013

It was found that the *No burn* residue management treatment return was statistically different (higher) than the *Burn* residue management treatment. (Table 24).

Table 24. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Residue Management System for 2013 at Verona for Soybean Production. (Means with same letter are not significantly different at Alpha=0.05).

Residue Management Treatment	LS Mean	
No burn	\$ 698.97	A
Burn	\$ 621.34	B

It was found that the *TerraTill – bed roller*, the *Disk (2x) + TerraTill – bed roller*, and the *Bed-roller* tillage treatments had statistically different (higher) returns than the *No Tillage* treatments. (Table 25).

Table 25. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Verona for Soybean Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
TerraTill - bed-roller	\$ 715.95	A
Disk (2x) + TerraTill - bed-roller	\$ 668.78	A
Bed-roller	\$ 666.01	A
No Tillage	\$ 589.86	B

The net returns per acre at Stoneville are based on a soybean price of \$12.73 per bushel and \$4.27 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110). Direct and fixed expenses priced are taken from Mississippi State University Budgets (MSU Department of Agricultural Economics Budget Report 20123-05).

Table 26. Total Corn Specified Expenses per Acre by Treatment for 2013 at Stoneville.

Treatment Name	Total Specified per Acre
Burn: no tillage	\$ 544.10
Burn: bed-roller	\$ 551.76
Burn: disk (2x) + TerraTill - bed-roller	\$ 581.10
Burn: TerraTill - bed-roller	\$ 562.22
No burn: disk (2x) + TerraTill - bed-roller	\$ 581.10
No burn: no tillage	\$ 544.10
No burn: bed-roller	\$ 551.76
No burn: TerraTill - bed-roller	\$ 562.22

The **No Burn: Terratill – bed-roller** treatment produced the highest mean net return above total specified costs for corn production in 2013 with the **Burn: bed-roller** treatment generating the smallest mean net return per acre. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 27.

Table 27. 2013 Stoneville Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$4.27 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: TerraTill - bed-roller	\$ 427.21	\$ 52.46
Burn: TerraTill - bed-roller	\$ 420.00	\$ 46.85
No burn: no tillage	\$ 419.66	\$ 73.41
Burn: no tillage	\$ 416.98	\$ 108.56
No burn: disk (2x) + TerraTill - bed-roller	\$ 415.06	\$ 43.66
Burn: disk (2x) + TerraTill - bed-roller	\$ 391.83	\$ 95.11
No burn: bed-roller	\$ 383.89	\$ 95.06
Burn: bed-roller	\$ 376.02	\$ 92.56

Analysis indicated that there was no statistically significant difference in corn net returns per acre between the **Burn** and **No-burn** main treatments, no significant difference in tillage treatments and no significant interaction between the residue management and tillage treatments at the 0.05 level (Table 28).

Table 28. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Stoneville for Corn Production.

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	10	0.07	0.7971
tillage	3	30	1.9	0.1517
burn*tillage	3	30	0.1	0.9596

Table 29. Total Soybean Specified Expenses per Acre by Treatment for 2013 at Stoneville.

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 326.62
Burn: bed-roller	\$ 334.28
Burn: disk (2x) + TerraTill - bed-roller	\$ 357.73
Burn: TerraTill - bed-roller	\$ 344.74
No burn: disk (2x) + TerraTill - bed-roller	\$ 369.96
No burn: no tillage	\$ 326.62
No burn: bed-roller	\$ 334.28
No burn: TerraTill - bed-roller	\$ 344.74

The **Burn: disk (2x) + TerraTill - bed-roller** treatment produced the highest mean net return above total specified costs for soybean production in 2013 with the **No Burn: bed-roller** treatment generating the smallest mean net return per acre.

Table 30. 2013 Stoneville Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$12.73 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
Burn: disk (2x) + TerraTill - bed-roller	\$ 383.13	\$ 34.29
No burn: TerraTill - bed-roller	\$ 372.21	\$ 143.23
Burn: no tillage	\$ 352.73	\$ 106.87
No burn: no tillage	\$ 347.52	\$ 147.42
No burn: disk (2x) + TerraTill - bed-roller	\$ 347.32	\$ 76.09
Burn: TerraTill - bed-roller	\$ 346.24	\$ 29.06
Burn: bed-roller	\$ 293.54	\$ 70.40
No burn: bed-roller	\$ 275.81	\$ 84.82

Analysis indicated that there was no statistically significant difference in soybean net returns per acre between the **Burn** and **No-burn** main treatments, no significant difference in tillage treatments and no significant interaction between the residue management and tillage treatments at the 0.05 level (Table 31).

Table 31. Type III Tests for Fixed Effects for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2013 at Stoneville for Soybean Production.

Effect	Num DF	Den DF	F Value	Pr > F
burn	1	10	0.06	0.8094
tillage	3	30	2.11	0.1195
burn*tillage	3	30	0.26	0.8556

The 2014 net returns per acre at Verona are based on a soybean price of \$9.16 per bushel and \$3.70 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110). Direct and fixed expenses priced are taken from Mississippi State University Budgets (MSU Department of Agricultural Economics Budget

Report 2014-05). Estimated total specified corn production expenses per acre for each treatment are shown below in Table 32.

Table 32. Total Corn Specified Expenses per Acre by Treatment for 2014 at Verona.

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 496.52
Burn: bed-roller	\$ 496.89
Burn: disk (2x) + TerraTill - bed-roller	\$ 527.02
Burn: TerraTill - bed-roller	\$ 507.90
No burn: disk(2x) + TerraTill - bed-roll	\$ 527.02
No burn: no tillage	\$ 496.52
No burn: bed-roller	\$ 496.89
No burn: TerraTill - bed-roller	\$ 507.90

The ***Burn: TerraTill – bed-roller*** treatment produced the highest mean net return above total specified costs for corn production in 2014. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 33.

Table 33. 2014 Verona Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$3.70 per Bushel.

Treatment Name	Mean Net Return (\$/acre)	Standard Deviation
Burn: TerraTill - bed-roller	\$ 524.77	\$ 29.55
No burn: TerraTill - bed-roller	\$ 511.73	\$ 13.18
No burn: disk(2x) + TerraTill - bed-roller	\$ 498.81	\$ 9.19
No burn: bed-roller	\$ 496.56	\$ 29.63
Burn: bed-roller	\$ 472.23	\$ 39.05
No burn: no tillage	\$ 447.54	\$ 62.69
Burn: no tillage	\$ 439.40	\$ 63.04
Burn: disk (2x) + TerraTill - bed-roller	\$ 430.45	\$ 42.95

Analysis indicated that there was no statistically significant difference between the Burn and No-burn main treatments. However, it was found that the ***Terratill – bed-roller*** treatment was significantly different than all other tillage treatments (Table 34).

Table 34. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2014 at Verona for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
TerraTill - bed-roller	\$ 518.25	A
No Tillage	\$ 469.10	B
Disk (2x) + TerraTill - bed-roller	\$ 463.50	B
Bed-roller	\$ 459.88	B

Table 35. Total Soybean Specified Expenses per Acre by Treatment for 2014 at Verona.

Treatment Name	Total Specified Cost Acre
Burn: no tillage	\$ 296.85
Burn: bed-roller	\$ 297.22
Burn: disk (2x) + TerraTill - bed-roller	\$ 327.35
Burn: TerraTill - bed-roller	\$ 308.23
No burn: disk (2x) + TerraTill - bed-roller	\$ 327.35
No burn: no tillage	\$ 296.85
No burn: bed-roller	\$ 297.22
No burn: TerraTill - bed-roller	\$ 308.23

The ***Burn: TerraTill – bed-roller*** treatment produced the highest mean net return above total specified costs for soybean production in 2014. No statistically significant difference was found between the Burn and No-burn main treatments or the tillage treatments at the Alpha=0.05 level. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 36.

Table 36. 2014 Verona Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$9.16 per Bushel.

Treatment Name	Mean Net Return (\$/acre)	Standard Deviation
Burn: TerraTill - bed-roller	\$ 455.94	\$ 101.51
Burn: bed-roller	\$ 439.01	\$ 71.65
No burn: TerraTill - bed-roller	\$ 416.79	\$ 40.37
Burn: no tillage	\$ 414.88	\$ 65.45
No burn: no tillage	\$ 411.90	\$ 19.39
No burn: disk (2x) + TerraTill - bed-roller	\$ 407.74	\$ 42.44
No burn: bed-roller	\$ 404.21	\$ 17.45
Burn: disk (2x) + TerraTill - bed-roller	\$ 403.16	\$ 88.81

The 2014 net returns per acre at Stoneville are based on a soybean price of \$9.16 per bushel and \$3.46 per bushel for corn, which was the average reported price for the week including the harvest date (USDA Market News- JK_GR110). Direct and fixed expenses are taken from Mississippi State University Budgets (MSU Department of Agricultural Economics Budget Report 2014-05). Estimated total specified corn production expenses per acre for each treatment are shown below in Table 37.

Table 37. Total Corn Specified Expenses per Acre by Treatment for 2014 at Stoneville (Note: Because all beds were re-hipped, there is no difference in cost of no-tillage and bed-roller treatments for 2014).

Treatment Name	Total Specified per Acre
Burn: no tillage	\$ 497.98
Burn: bed-roller	\$ 497.98
Burn: disk (2x) + TerraTill - bed-roller	\$ 535.87
Burn: TerraTill - bed-roller	\$ 516.75
No burn: disk (2x) + TerraTill - bed-roller	\$ 535.87
No burn: no tillage	\$ 497.98
No burn: bed-roller	\$ 497.98
No burn: TerraTill - bed-roller	\$ 516.75

The No burn– bed-roller treatment produced the highest mean net return above total specified costs for corn production in 2014. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 38.

Table 38. 2014 Stoneville Corn Residue Management Study Returns above Total Specified Expenses per Acre with Corn Price of \$3.46 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: bed-roller	\$ 305.47	\$ 47.97
No burn: no tillage	\$ 275.26	\$ 48.51
Burn: bed-roller	\$ 271.38	\$ 40.16
Burn: TerraTill - bed-roller	\$ 266.50	\$ 45.00
No burn: TerraTill - bed-roller	\$ 255.41	\$ 49.72
Burn: disk (2x) + TerraTill - bed-roller	\$ 255.31	\$ 9.13
Burn: no tillage	\$ 228.84	\$ 55.21
No burn: disk (2x) + TerraTill - bed-roller	\$ 228.47	\$ 28.16

Analysis indicated that there was no statistically significant difference between the Burn and No-burn main treatments. However, it was found that the mean net return per acre Bed-roller treatment was significantly different (higher) than the No Tillage and Disk (2x) + TerraTill – bed roller treatments (Table 39).

Table 39. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2014 at Stoneville for Corn Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean		
Bed-roller	\$ 288.42	A	
TerraTill - bed roller	\$ 260.95	A	B
No Tillage	\$ 252.05		B
Disk (2x) + Terratill - Bed-roller	\$ 241.89		B

Table 40. Total Soybean Specified Expenses per Acre by Treatment for 2014 at Stoneville (Note: Because all beds were re-hipped, there is no difference in cost of no-tillage and bed-roller treatments for 2014).

Treatment Name	Total Specified Expenses per Acre
Burn: no tillage	\$ 318.08
Burn: bed-roller	\$ 318.08
Burn: disk (2x) + TerraTill - bed-roller	\$ 355.97
Burn: TerraTill - bed-roller	\$ 336.85
No burn: disk (2x) + TerraTill - bed-roller	\$ 355.97
No burn: no tillage	\$ 318.08
No burn: bed-roller	\$ 318.08
No burn: TerraTill - bed-roller	\$ 336.85

The No burn: bed-roller treatment produced the highest mean net return above total specified costs for soybean production in 2014. The mean and standard deviation of expected net returns above total specified costs for each treatment are shown below in Table 41.

Table 41. 2014 Stoneville Soybean Residue Management Study Returns above Total Specified Expenses per Acre with Soybean Price of \$9.16 per Bushel.

Treatment Name	Mean Net Return	Standard Deviation
No burn: bed-roller	\$ 273.04	\$ 25.68
Burn: bed-roller	\$ 269.77	\$ 37.49
No burn: no tillage	\$ 267.57	\$ 41.83
Burn: no tillage	\$ 257.21	\$ 46.89
Burn: TerraTill - bed-roller	\$ 237.69	\$ 34.95
Burn: disk (2x) + TerraTill - bed-roller	\$ 226.44	\$ 32.60
No burn: TerraTill - bed-roller	\$ 219.89	\$ 36.50
No burn: disk (2x) + TerraTill - bed-roller	\$ 216.22	\$ 21.25

No statistically significant difference was found between the Burn and No-burn main treatments at the Alpha=0.05 level. However, it was found that the mean net return per acre for the Bed-roller and No Tillage treatments were significantly different (higher) than the mean net returns per acre for the TerraTill – bed roller and the Disk (2x) + Terratill – Bed-roller treatments (Table 42).

Table 42. Least Square Means for Net Returns Above Total Specified Expenses per Acre by Tillage System for 2014 at Stoneville for Soybean Production. (Means with same letter are not significantly different at Alpha=0.05).

Tillage Treatment	LS Mean	
Bed-roller	\$ 271.40	A
No Tillage	\$ 262.39	A
TerraTill - bed roller	\$ 228.79	B
Disk (2x) + Terratill - Bed-roller	\$ 221.33	B

The only statistical difference for the burn versus no-burn treatment was for soybeans at the Verona site for 2012 and 2013. There was no statistically significant difference found for the burn versus no-burn treatment for corn production at Verona or Stoneville in any year.

Statistically significant differences were found in tillage treatments for corn production at Verona in 2012, 2013 and 2014. In 2012, the TerraTill-bed roller and the Disk (2X) + TerraTill-bed roller treatments were statistically significantly higher. In 2013, the TerraTill-bed roller treatment and No-till treatments were statistically significantly higher. In 2014, the TerraTill-bed roller treatment was statistically significantly higher than other tillage treatments.

Statistically significant differences were found for tillage treatments and soybean production at Verona in 2013 only. The TerraTill-bed roller and No-till systems were found to have significantly higher returns.

For corn production at Stoneville, no significant difference was found between tillage treatments in 2012 and 2013. In 2014, the Bed-roller treatment was found to be statistically significantly higher.

For soybean production at Stoneville, in 2012 the no-Till system was found to be statistically significantly higher. In 2014, the mid-roller and no-Till systems were found to be statistically significantly higher.

In conclusion, it was found that in the irrigated production systems employed at Stoneville, there was no difference in the burn versus no-burn treatments. At the dryland production site in Verona, the TerraTill-bedroll system appears to be a consistently high performer for corn production. For Verona, no consistent results seem to appear for soybean production between the alternate tillage systems. At the irrigated site in Stoneville, no tillage system for either corn or soybean production seems to be consistently superior in generating net returns above tillage systems and residue management system.

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