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# Economic Benefits of No-Till in a Rice-Soybean Rotation

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## Introduction

In 2007, most Arkansas rice was produced using conventional tillage (55%), while no-till accounted for only 9% (Wilson and Runsick, 2007). No-till soybean systems have been shown to have higher yields, lower production costs, higher profits and lower financial risk relative to conventional tillage systems (Klerk et al., 1998 and Ribera et al., 2004). No-till rice profitability is not as well documented, nor are the long-term economic implications of no-till management in a rice-soybean rotation. Since 2000, a long-term rotation study on tillage and fertility has been conducted on a rice-soybean rotation. This fact sheet documents the economics from the study and estimates when no-till becomes more profitable than conventional tillage.

The study was initiated in 2000 at the University of Arkansas Rice Research and Extension Center near Stuttgart, Arkansas, to compare conventional-tillage to no-tillage in a rice-soybean rotation at two fertility levels. Two rice and two soybean varieties were used each year in this study. When the study began, Wells and LaGrue rice varieties were used. Later in the study, LaGrue was replaced with Cybonnet and later with the RiceTec hybrid XL 723. Initially the soybean variety H4994RR and Pioneer 94M80 were used. Later H4994RR was replaced with AG4902 and more recently with AG4903. In all years, rice was planted using a 7.5-inch row spacing. A seeding rate of 90 lbs/acre was used for conventional rice varieties and 30 lbs/acre for hybrid rice varieties. All soybeans were planted into a 7.5-inch row spacing at a seeding rate of 60 lbs/acre. Grain yields have not differed between fertility treatments during the nine years of this study; therefore, the fertility treatments have been combined when reporting yield and economic differences by tillage.

Economic analysis for the study was based upon the 2000-2008 yield data from the long-term study. Five-year average input cost and price data for the period 2004-2008 were used in the economic analysis. The prices used for rice and soybeans were $5.97/bu and $8.71/bu, respectively. The price and input cost data came from the United States Department of Agriculture National Agricultural Statistical Service (NASS), Economic Research Service (ERS) and input costs data gathered by University of Arkansas Extension economists. All cost and price data were adjusted for inflation to 2008 dollars using the Producer Price Index. Input costs are matched with the quantities used for each crop. Machinery repair, maintenance and ownership costs are calculated with the use of the Mississippi State Budget Generator (Laughlin and Spurlock, 2006). Hauling cost was estimated at $0.22/bu for both rice and soybeans, while a drying charge of $0.35 was used for rice. Land cost for the analysis was calculated at 25% of production.

## Study Results

**Grain yield loss** is commonly cited as a reason for not adopting

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no-till. No-till had a lower mean numerical yield than conventional-till during the earlier years of the long-term study, although there was no statistically significant difference in the rice yields between the two tillage practices (Anders, 2006). Using the nine years of data, a linear (straight) line was fitted for the rice and soybean grain yield data to better understand long-term yield trends for the rice-soybean rotation under both tillage treatments (Figure 1). No-till yields were lower using the trend line for rice until 2005 and until 2004 for soybeans.

**Budgets** for the estimated production costs are presented in Table 1 by tillage and crop. No-till reduces the cost of labor, fuel, repair and maintenance per acre, but these cost savings are somewhat offset by the increase in herbicide and application cost. Excluding drying and hauling costs, no-till rice variable costs were estimated at roughly $459 per acre and $476 per acre for conventional-till. No-till soybeans averaged $223 per acre, while conventional-till soybeans averaged $230 per acre. Fixed costs are estimated to be less for no-till than conventional-till although all estimated fixed costs may not be entirely captured for no-till due to tillage equipment already owned after no-till adoption and the need for tillage equipment when fields are rutted.

**Financial measurements** of no-till and conventional-till are presented in Table 2 as an average of the nine years based on 2004-2008 crop and input prices. Rice gross revenue for no-till averaged $983 per acre while conventional-till averaged $995 per acre. No-till rice variable costs averaged $18 per acre less than conventional-till ($546 per acre for no-till; $564 per acre for conventional-till). Returns above variable and land costs averaged $192 and $182 per acre for no-till and conventional-till rice, respectively. Including fixed costs estimates, no-till rice averaged a return above total costs of

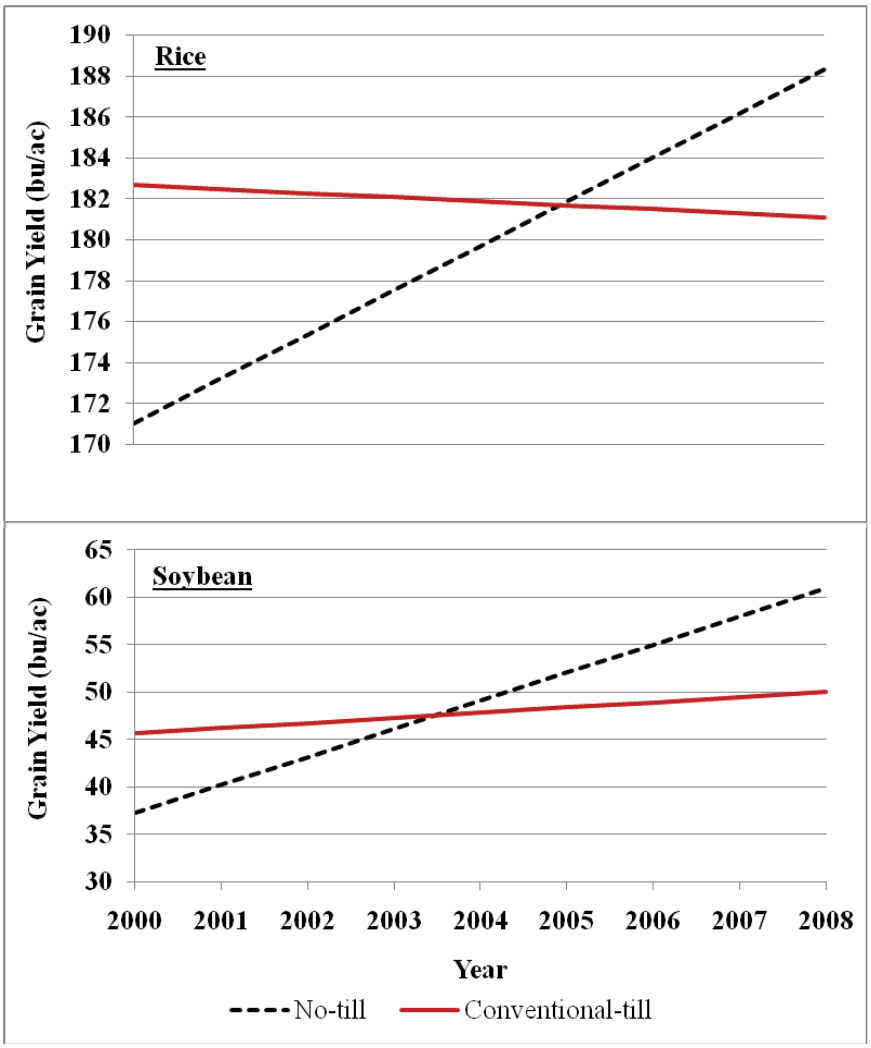


**Figure 1. Trend grain yields for the rice-soybean rotational study by tillage practice.**

**Table 1. Estimated costs for the rotational study.**

| Costs | No-till | | Conventional-till | |
|---|---|---|---|---|
| | Rice | Soybean | Rice | Soybean |
| | $/ac | | | |
| Fertilizer | 92.87 | 36.70 | 92.87 | 36.70 |
| Herbicides | 80.93 | 21.51 | 77.05 | 16.45 |
| Insecticides | 0.64 | 0.00 | 0.64 | 0.00 |
| Irrigation Supplies | 8.47 | 7.50 | 8.47 | 7.50 |
| Crop Seed | 68.29 | 58.80 | 68.29 | 58.80 |
| Adjuvants | 4.14 | 2.70 | 4.14 | 1.80 |
| Custom Work | 47.76 | 27.00 | 47.76 | 18.00 |
| Labor | 12.26 | 6.45 | 17.29 | 11.60 |
| Fuel | 106.56 | 42.50 | 118.68 | 54.94 |
| Repair & Maintenance | 17.14 | 10.43 | 20.74 | 14.08 |
| Interest | 19.76 | 9.61 | 20.52 | 9.89 |
| | | | | |
| Variable Costs | 458.82 | 223.20 | 476.45 | 229.76 |
| Fixed Costs | 74.25 | 52.15 | 92.30 | 70.55 |
| | | | | |
| Total Cost | 533.07 | 275.35 | 568.75 | 300.31 |

$133 per acre while conventional-till rice averaged $105 per acre. Soybean gross revenue for no-till averaged $409 per acre while conventional-till averaged $398 per acre. Variable costs were less for no-till soybeans than conventional-till by $6 per acre. Return above variable and land costs were $73 and $58 per acre for no-till and conventional-till soybeans. Including fixed expenses, no-till soybeans averaged $36 per acre and conventional-till averaged $3 per acre. Combining the two crops, assuming half the farm is rice and half is soybeans, gross revenue averaged $696 per acre for both no-till and conventional-till. Variable costs averaged $390 per acre and $402 per acre for no-till and conventional-till, respectively. Return above variable and land costs for no-till averaged $132 per acre while conventional-till averaged $120 per acre. Including fixed costs, no-till was even more profitable at $84 per acre compared to conventional-till at $54 per acre.

As discussed earlier, lower yields could reduce profitability in the first few years in no-till as compared to the later years. Table 3 breaks down the rotation's return above variable costs and the rotation's return above total cost into two time periods. The first time period is from 2000-2004 and the second time period is from 2005-2008. Return above variable costs for no-till in the first time period averaged $98 per acre while conventional-till averaged $124 per acre. Standard deviation is a measure of variability and can be used to determine which tillage system had more variability during each time period. As the standard deviation increases, risk or variability in return increases. In the first time period, no-till has a lower average return above variable costs, but its standard deviation is $30 per acre compared with $60 per acre for conventional-till. This implies no-till had less variability than conventional-till in the first time period. The second time period is quite different than the first. No-till is much more profitable with a return above variable costs at $175 per acre compared to $115 per acre for conventional-till. The standard deviation for no-till slightly increased and conventional-till stayed the same. Another important component is the maximum and minimum returns during the time periods. No-till had the highest minimum return in both time periods, implying no-till performs better than conventional-till in "poor" crop years. The maximum return was highest for conventional-till in the first time period ($199 per acre) but was highest for no-till in the second time period ($215 per acre).

When fixed costs are included, the return above total costs for the two tillage treatments averaged almost the same in the first time period. No-till averaged $50 per acre while conventional-till averaged $58 per acre. Although the average returns were almost identical, the standard deviation for no-till was $30 per acre and $60 per acre for conventional-till. The second time period had more dramatic profitability results for no-till. No-till averaged $127 per acre while conventional-till averaged $49 per acre. An interesting highlight in Table 3 is the maximum return achieved for conventional-till in

**Table 2. Average financial measurements in a rice and soybean rotation, 2000-2008[1].**

| Financial Measurements | Rice | | Soybeans | | Rotation[2] | |
|---|---|---|---|---|---|---|
| | NT[3] | CT | NT | CT | NT | CT |
| | $/acre | | | | | |
| Gross Revenue | $983 | $995 | $409 | $398 | $696 | $696 |
| Land Cost[4] | $246 | $249 | $102 | $99 | $174 | $174 |
| Variable Costs | $546 | $564 | $234 | $240 | $390 | $402 |
| RAVC[5] | $192 | $182 | $73 | $58 | $132 | $120 |
| Fixed Costs | $59 | $77 | $37 | $55 | $48 | $66 |
| RATC[6] | $133 | $105 | $36 | $3 | $84 | $54 |

1 Based upon 2004-2008 crop and input prices

2 Rotation is one half acre rice and one half acre soybeans

3 NT = No-till and CT = Conventional-till

4 Land cost is assumed to be 25% of gross revenue

5 RAVC = Return above variable costs

6 RATC = Return above total costs

**Table 3. Summary statistics of the long-term study.**

| Summary Statistics | Return Above Variable Costs | | | | Return Above Total Costs | | | |
|---|---|---|---|---|---|---|---|---|
| | Time Period 1 2000-2004 | | Time Period 2 2005-2008 | | Time Period 1 2000-2004 | | Time Period 2 2005-2008 | |
| | NT[1] | CT | NT | CT | NT | CT | NT | CT` |
| | $/acre | | | | | | | |
| Mean | $98 | $124 | $175 | $115 | $50 | $58 | $127 | $49 |
| Standard Deviation | $30 | $60 | $36 | $60 | $30 | $60 | $36 | $60 |
| Minimum | $67 | $48 | $129 | $25 | $19 | -$18 | $82 | -$41 |
| Maximum | $136 | $199 | $215 | $152 | $88 | $133 | $167 | $86 |

1 NT = No-till and CT = Conventional-till

the second period ($86 per acre) was roughly the same as the minimum return achieved for no-till during the same period ($82 per acre).

Another way to look at the economic implications is to determine which year no-till becomes more profitable. Using the trend line yields and estimated cost, Figure 2 presents the return above variable cost for each year and Figure 3 presents the cumulative Net Present Value (NPV) of no-till and conventional-till. NPV can be defined as the value of future cash inflows for a specific period of time in today's dollar value. A discount rate is used in the NPV calculation and is used to weight the value put on a dollar earned in the future compared to a dollar earned today. The higher the discount rate, the more a dollar is valued today compared to future income.

Based upon trend yield, no-till return above variable costs would surpass conventional-till during year four (2003). As presented earlier, rice trend grain yields in no-till became greater than conventional-till in 2005, and no-till soybean trend yields passed conventional in 2004. Using a discount rate of 6% on the return above variable cost, cumulative NPV for no-till would be greater than conventional-till in year eight (2007). Although income for no-till became larger than conventional-till in 2003, it would take another four years to capture the value of forgone income in the early years under no-till with no changes in fixed costs. Many factors will influence the payoff for no-till and impact profitability. The greater costs savings realized will decrease the time no-till is less profitable than conventional-till. Grain yields will also impact the payoff time. The value of no-till relative to conventional-till will increase the less grain yields are reduced.

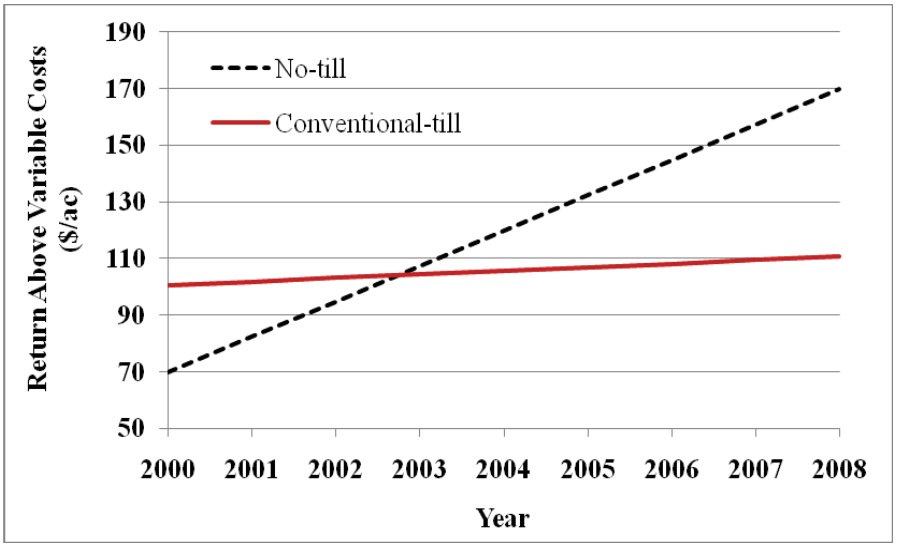


**Figure 2. Return above variable costs for a rice-soybean rotation by tillage practice.**

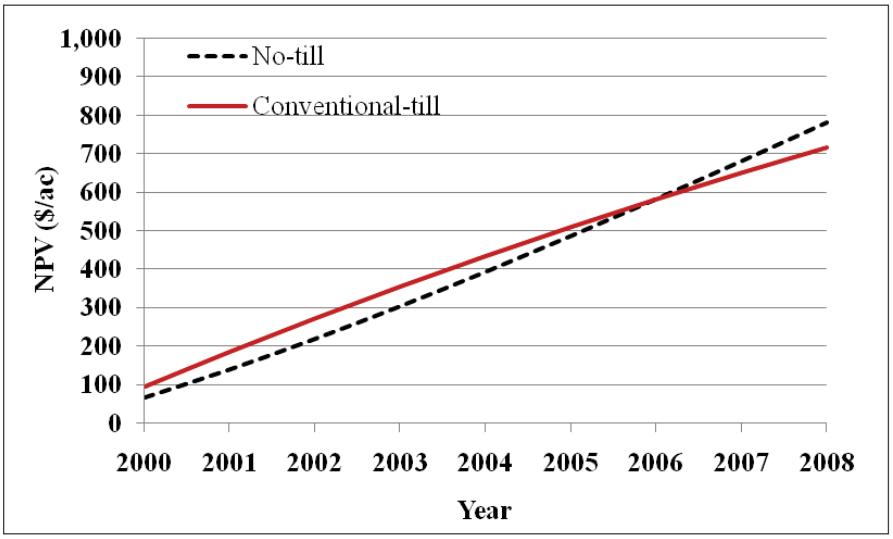


**Figure 3. Cumulative net present value (NPV) of a rice-soybean rotation by tillage practice.**

## Conclusion

Nine years of no-till research has been conducted to date with a rice-soybean rotation. The data indicates grain yields on average were lower in no-till compared to conventional-till in the early years but, statistically speaking, there was no difference in yields. Yield will depend on management, variety selection and soil characteristics. Costs savings in fuel, labor, repair, maintenance and machinery can be realized under no-till as compared to conventional-till, while herbicide costs may increase. The study indicates that no-till can be more profitable than conventional-till but will greatly depend on yield and cost savings. Using the trend yield from the study, no-till became more profitable than conventional-till in the fourth year (2003). Using a discount rate of 6%, the cumulative net present value of no-till return above variable costs became greater than conventional-till in the eighth year (2007).

It is hard to quantify how much management, variety and soil characteristics each impacted yield and thus profitability in the

early years of no-till. There is typically a learning curve with trying something new. It is recommended that anyone interested in trying no-till first and foremost talk with a producer who is currently practicing no-till. Someone practicing no-till can give guidance and insight into making no-till successful on your farm. It is also recommended that you talk with an agronomist or extension specialist with no-till experience. Another recommendation would be to start small. Starting on a small field will allow for mishaps while learning the no-till system without bankrupting the farm operation. As no-till becomes more familiar, you will be able to successfully increase no-till acreage and your bottom line!

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