Economic Comparison of Three Winter Wheat–Fallow Tillage Systems

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Economic Comparison of Three Winter Wheat-Fallow Tillage Systems

A.D. Halvorson, R.L. Anderson, N.E. Toman, and J.R. Welsh

Research Question
Economic information is needed to evaluate the sustainability of tillage systems used for winter wheat production in the Central Great Plains. This research evaluated the costs and returns from three winter wheat-fallow production tillage systems: conventional-till (CT), reduced-till (RT), and no-till (NT).

Literature Summary
Reduced-till and NT systems for winter wheat production using crop-fallow have improved precipitation storage efficiency. These tillage systems conserve more crop residue at the soil surface providing protection from wind and water erosion, which helps producers comply with the soil erosion requirements of the 1985 Food Security Act and 1990 Farm Bill. Little information is available from the Central Great Plains that compares the yield, costs, and returns from various wheat-fallow tillage systems.

Study Description
Yield and cultural data (1987–1992) from a long-term winter wheat-fallow tillage study conducted on a Weld silt loam soil were used in making the economic comparisons. Duplicate sets of plots were available to provide wheat yield data each year. Economic data were developed using 1991 estimated farm costs and Federal Farm Program requirements for a 1200 acre cultivated farm in eastern Colorado with a 706 acre wheat base and farmer owned equipment. Set-aside acres (15% acreage reduction) were not included in this economic analysis. Comparisons were also made using published custom rates.

Applied Questions
What effect does tillage system have on winter wheat yields?

Winter wheat yields were not significantly different among tillage systems during any of the individual crop years. Average 6-yr (1987–1992) grain yields were 40, 40, and 42 bu/acre for the CT, RT, and NT systems, respectively. An average yield of 40.4 bu/acre was used in this analysis for all tillage treatments, since tillage system did not significantly affect yields in this study.

Are reduced till and no-till wheat-fallow production systems as profitable as the traditional conventional till system?

When using farmer estimated costs of production, estimated net returns to land, labor, and capital were 107 and 96% of the CT system for the RT and NT systems, respectively. When labor costs are included, net returns to land, management, risk, and capital were 111 and 100% of CT for the RT and NT systems, respectively. When custom rates were used for the tillage practices, net returns to land, labor, and capital were 123 and 110% of CT for the RT and NT systems, respectively. A summary of costs and returns on a 1200 acre dryland winter wheat farm in eastern Colorado using average yields (1987–1992), farmer-operator costs, and 1991 production prices and government program payments are shown in Table 1.

Estimated tillage costs were $13/acre for CT compared with herbicide and tillage costs of $11/acre for RT and herbicide costs of $19/acre for NT to achieve weed control during fallow periods. One must realize that these costs

Full scientific article from which this summary was written begins on page 381 of this issue.
are estimates. Actual farmer costs will vary from farm to farm depending on age and size of machinery complement used. The results indicate that RT and NT systems are economically viable options for wheat-fallow farmers in the Central Great Plains. The benefits of RT and NT systems can be realized by farmers with the potential for economic gain.

Table 1. Summary of cost and returns on a 1200 acre dryland winter wheat farm in eastern Colorado using average yields (1987-1992), farmer-operator costs, and 1991 production prices and government program payments.

<table>
<thead>
<tr>
<th></th>
<th>CT</th>
<th>RT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total grain, bu (600 wheat acres)</td>
<td>24240</td>
<td>24240</td>
<td>24240</td>
</tr>
<tr>
<td>Gross returns, $</td>
<td>93684</td>
<td>93684</td>
<td>93684</td>
</tr>
<tr>
<td>Preharvest cost, $</td>
<td>24498</td>
<td>24276</td>
<td>29700</td>
</tr>
<tr>
<td>Harvest cost, $</td>
<td>12150</td>
<td>12150</td>
<td>12150</td>
</tr>
<tr>
<td>Total production cost, $</td>
<td>36648</td>
<td>36426</td>
<td>41850</td>
</tr>
<tr>
<td>Ownership cost, $</td>
<td>57036</td>
<td>57258</td>
<td>51834</td>
</tr>
<tr>
<td>Total of all costs, $</td>
<td>51138</td>
<td>48282</td>
<td>53154</td>
</tr>
<tr>
<td>Net return over production cost, $</td>
<td>42486</td>
<td>45342</td>
<td>40650</td>
</tr>
<tr>
<td>Return available for land, labor, capital, management, and risk, $</td>
<td>39246</td>
<td>43530</td>
<td>39396</td>
</tr>
</tbody>
</table>

Estimated preharvest labor hours: CT = 540 h; RT = 302 h; and NT = 209 h. 1200 acres.

Economic Comparison of Three Winter Wheat-Fallow Tillage Systems


WILL TILLAGE SYSTEMS INCREASE WATER STORAGE?

The Water Storage benefits of RT and NT systems for winter wheat production systems using estimated production costs or application rates of herbicides could be reduced, the added benefits of erosion potential with RT and NT help producers comply with the soil erosion requirements of the 1985 Food Security Act and the crop residue on the soil surface, thus providing increased precipitation storage efficiency and decreased soil erosion potential and improved surface residue levels. The objective of this paper is to evaluate the costs and returns from three winter wheat-fallow production systems, the latter of which is on-going at the Central Great Plains Station on a Paleustoll. Tillage systems include: CT, where tillage is performed with a Haybuster' model 3200 undercutter and rodweeder until winter wheat planting in September; and NT, where a mix of contact and residual herbicides are applied shortly after winter wheat harvest and then tillage is used respectively. When custom rates were used for the tillage systems, net returns to land, labor, and capital were virtually the same when using farmer based costs. Using farmer estimated costs of production, costs or application rates of herbicides could be reduced, the custom rates, preharvest costs were in the order 110% when using farmer based costs and an average of 107% with 6-yr average grain yields of 40.4, 40, 40, and 95% for the RT, CT, and NT systems, respectively. When custom rates were used for the tillage systems, the costs variations were significantly different between tillage systems from ARS and CSU. Received Aug. 1993. *Corresponding author.

MATERIALS AND METHODS

Field Data. The yield and cultural data (1987-1992) were obtained from a long-term tillage experiment were used in making the economic comparisons in this evaluation. This experiment is on-going at the Central Great Plains Station on a Paleustoll. Tillage systems include: CT, where tillage is performed with a Haybuster' model 3200 undercutter and rodweeder until winter wheat planting in September; and NT, where a mix of contact and residual herbicides are applied shortly after winter wheat harvest and then tillage is used respectively. When custom rates were used for the tillage systems, the costs variations were significantly different between tillage systems from ARS and CSU. Received Aug. 1993. *Corresponding author.

were then developed for a 1200 acre farm with a 706 acre tillage production systems, costs per acre for each system were developed from the cultural practices used. Budgets received during phases of the cropping period is reported.

To estimate the costs and returns from the three systems evaluated in this study.

Table 1. Typical herbicide and tillage operations used in the tillage systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Herbicide 1</th>
<th>Herbicide 2</th>
<th>Herbicide 3</th>
<th>Tillage 1</th>
<th>Tillage 2</th>
<th>Tillage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Tillage Treatment</td>
<td>Atrazine</td>
<td>Paraquat</td>
<td>2,4-D</td>
<td>Sweep</td>
<td>Sweep</td>
<td>Rodweed</td>
</tr>
<tr>
<td>Reduced Tillage Treatment</td>
<td>Atrazine</td>
<td>Paraquat</td>
<td>2,4-D</td>
<td>Sweep</td>
<td></td>
<td>Rodweed</td>
</tr>
<tr>
<td>No Tillage Treatment</td>
<td>Atrazine</td>
<td>Paraquat</td>
<td>2,4-D</td>
<td></td>
<td></td>
<td>Rodweed</td>
</tr>
</tbody>
</table>

Table 2. Estimated herbicide prices used in this economic analysis for 1991.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Price</th>
<th>Application Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraquat</td>
<td>$5.50/lb ai</td>
<td>0.375 lb a.i./acre</td>
</tr>
<tr>
<td>Surfactant</td>
<td>$17/gal</td>
<td>0.125% v/v applied at 20 gal/acre in Sept.</td>
</tr>
</tbody>
</table>

Precipitation received during the fallow period, wheat plantings, and harvests are shown in Table 3. The average acre per farm of wheat harvested was 600 acres under a wheat-fallow system.

Table 3. Precipitation received during the fallow period, wheat plantings, and harvests.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting</td>
<td>22.9</td>
<td>23.0</td>
<td>22.5</td>
<td>24.4</td>
<td>25.4</td>
</tr>
<tr>
<td>Harvest</td>
<td>10.5</td>
<td>10.4</td>
<td>10.5</td>
<td>11.8</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Table 4. Ownership costs of machinery complement used in budgets.

<table>
<thead>
<tr>
<th>Machinery</th>
<th>Tractor</th>
<th>Grain Drill</th>
<th>Pick-Up</th>
<th>Seeding</th>
<th>Fertilizer N</th>
<th>Weed Spray, Spring</th>
<th>Weed Spray, Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$30,000</td>
<td>$20,000</td>
<td>$15,000</td>
<td>$500</td>
<td>$10,000</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
</tbody>
</table>
Wheat yield based on the medium-sized winter wheat-fallow dryland farms in eastern Colorado was used to develop operational and ownership costs for the three different tillage systems. Operational costs include fuel, lubrication, and repair for each implement. Ownership costs include depreciation, interest on investment, insurance, and taxes based on the machinery complement used in the farming operation. Table 4.

Variable yield patterns such as average grain yield received during fallow and crop growing periods. Above average precipitation during a 2-yr fallow-crop period may or may not result in a higher-than-average yield. For example, compare the years 1987 through 1992.

RESULTS AND DISCUSSION

While yields from the three tillage systems were not significantly different, there were differences in cost and returns from a projected budget analysis. Grain yields varied from year to year due to variation in total precipitation. Precipitation during the 6 yr included crop years of above average, below normal (Table 3).

The major differences in cost are the herbicides in the NT system vs. the tillage costs in the CT system. The CT system had a higher ownership cost in our analysis because of greater machinery use and inventory than RT and NT. Ownership costs for the various systems on a per-acre basis are split between operating costs and ownership costs. Operational costs for tillage, spraying, fertilizer, seeding, and pickup truck are summarized in Table 5.

Machine replacement, cropped acres $36,648, $36,426, $36,248.

Machine taxes/insurance, cropped acres $36,848, $36,626, $36,448.

Real estate taxes, $2/acre, cropped acres $14,550, $11,916, $11,184.

Weed spray, summer acres $156,140, $156,140, $156,140.


Interest (on op. capital, 10% for 8 mo) $20.80, $20.80, $20.80.

Preharvest costs $61.08, $60.71, $69.75.

Fertilizer N acres $40.83, $40.46, $49.50.

Fertilizer P, acres $15.00, $15.00, $15.00.

Fertilizer K, acres $2.72, $1.36, $2.85.

Herbicides, acres $9.05, $3.62, $--.

Harvest costs acres $20.25, $20.25, $20.25.

Harvest labor, acres $8.75, $8.75, $8.75.

Preharvest labor, acres $15.00, $15.00, $15.00.

Seed, acres $2.46, $2.46, $2.46.

Seed rate, acres $2.04, $1.58, $1.33.

Disking, acres $12.78, $12.78, $--.

Planting, acres $18.64, $18.64, $18.64.

Combines, acres $16.21, $12.28, $11.31.

Combine harvest, acres $15.00, $15.00, $15.00.

Shell damage, acres $2.00, $2.00, $2.00.

Baler, acres $5.25, $5.25, $5.25.

Baling labor, acres $2.04, $1.58, $1.33.

Harvest labor, acres $12.78, $12.78, $--.

Preharvest labor, acres $15.00, $15.00, $15.00.

Machine costs per acre $156,140, $156,140, $156,140.

Net return over production cost $2.04, $1.58, $1.33.

Table 6. Budget analysis data for three dryland winter wheat-fallow production systems (conventional-till [CT], reduced-till [RT], and no-till [NT]).

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<thead>
<tr>
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<tr>
<td>CT</td>
<td>38 35 37</td>
<td>1.10</td>
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</tr>
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</tr>
</tbody>
</table>
NT systems are decreased if one considers the labor had the lowest profitability because the tillage costs were assessed at a higher rate than farmer-owned operations. This is due to the increased purchases of herbicides used in place of tillage operations that are used spraying operations rather than farmer owned machinery, Schaubert and Sharp, 1992) are used for tillage and management. Returns above production costs for the CT, RT and NT systems were $95.06, $95.43, and $86.39/acre, respectively (Table 6). The estimated return of $93,684 for CT, RT, and NT on a whole-farm basis. Gross yields, gross returns, preharvest, harvest, and government program payments.

Returns per farm compared with CT and NT when using No-till does afford the added benefit of leaving about a $13/acre and $7/acre advantage over CT and NT, respectively (Table 7). Fo r example, return to land, management, and risk when using custom rates. The CT trips at a faster speed over the fields, which reduces labor more efficiently and reducing soil erosion potential can be be adopted by farmers without economic loss. The benefits of NT and RT systems for storing precipitation for CT and compliance with NT, the per-acre return to capital, management, and risk was 111% of CT for the RT system and about the same as CT for the NT system. Thus, risk management must be considered when results of this study suggest that RT and NT systems can be adopted by farmers without economic loss. The benefits of increased crop residue on the soil surface with making decisions on which tillage system to use. The added benefits of NT and RT systems for storing precipitation and no-till (NT) using custom rates for eastern Colorado. Return available for land, labor, capital, management, and risk was 111% of CT for the RT systems and about the same as CT for the NT systems. The differences between CT and RT system remained the most profitable with NT availability to pay for land, labor, capital, risk, and requirements (Table 7).