Economic Potential of Conservation Farming Annual Winter Forages for the Stocker Cattle Grazing Enterprise

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Abstract

The stocker cattle enterprise in the southern Plains regions of the United States is an important economic activity. Key to economic success in the business is the low-cost establishment and production of high quality winter forage. Intensive tillage and seedbed preparation and planting methods are typically used in the region; however, several factors have changed that may give the adoption of conservation-tillage and planting methods an economic advantage over the conventional establishment methods. The goal of this study was to determine the expected economic value associated with using a no-till conservation farming practice relative to the clean-till intensive system that is typically used to produce winter forage for stocker cattle grazing in the region. We show that the reduction in diesel fuel expenses and fixed machinery ownership costs more than out weight the expenses associated with application of the herbicide glyphosate. The expected net value of the no-till system relative to the conventional-till system was equal to $31 per acre; however, this value is quite sensitive to the relative difference in average cattle performance between the two systems.

Introduction

Stocker cattle grazing of annual winter forages such as wheat (*Triticum aestivum* L.) and rye (Secate cereal) is a vital economic activity in the southern Plains region of the US (Epplin et al. 2005; Peel; and Baggett, Ward, and Childs). A key ingredient for success in the stocker cattle business is an economically viable winter forage production system. Traditionally, producers in the region utilize intensive tillage and seed bed preparation methods for establishing winter forages. However, over the past three decades winter forage producers have been asking production scientists whether or not using conservation (including both no-till and reduced-till) farming practices would be more economical than conventional practices. Several studies have focused on determining the economic factors that drive the adoption of conservation farming practices (Epplin and Tice, Aw-Hassan and Stoecker, Napier et al., and Rahm and Huffman). These earlier studies reported that several factors, including farm size, insufficient stands due to ineffective no-till drills, expensive herbicide management practices, and substantially large investments necessary for conservation machinery and equipment, prohibitively reduced the likelihood of adoption of conservation methods.

In recent years, however, the factors affecting the adoption of conservation farming practices for producing winter forages have changed. For instance, Epplin et al. 2005 points out two primary factors that favor conservation practices for winter wheat: (1) the development of more effective no-till grain drills and air seeders, and (2) the expiration of the original patent for the herbicide glyphosate in 2000. In addition, we point out here that an additional factor is the price of diesel fuel, which has increased 120% since 2000 (USDA, NASS). Changes in these factors provide the impetus to reinvestigate the economics associated with using conservation farming practices in the southern Plains region of the United States to establish winter forages for the stocker cattle grazing enterprise. The goal of this research is to determine the expected economic value associated with using a no-till (NT) conservation farming practice relative to the clean-till (CT) intensive system that is typically used to produce winter forage for stocker cattle grazing in the region. Information provided by this study will be valuable to winter forage producers in helping them make decisions to whether or not they should adopt conservation farming practices, and will be beneficial to production scientists and forage and crop extension personnel located in the region.

Forage Establishment and Management

The demonstration project was conducted in south-central Oklahoma at the Noble Foundation's Pasture Demonstration Farm beginning the fall of 1996 and continued through the spring of 2003. Field operations for conventional clean-till and conservation no-till winter rye/ryegrass forage production systems are reported in Table 1. Fields in the study that were allocated to the conventional-till system were established each year of the study using tillage practices common for the region. Field operations for the conventional-till system began after the spring graze-out phase (stocker cattle removed and sold) in June with either a moldboard plow (20%) or chisel (80%). Later in August a disc operation was conducted followed by broadcasting Urea (46-0-0). A final disc activity was conducted just prior to planting winter forage seed in early September with a conventional drill. For the no-till system in the project, an initial application of glyphosate was applied followed by a partial application to only the places within each field that did not sufficiently respond to the first application. These herbicide treatments were conducted in August, prior to establishing winter forage using a no-till drill in early September. A second application of Urea (46-0-0) was applied to all fields in the demonstration in February. Table 2 provides a list of the operating input prices and application rates for both systems. Application of fertilizer and seed are assumed to be the same for each system.

Herd and Grazing Protocol

Each year of the project, a typical set of sale barn bull/steer calves are purchased in mid-September and shipped to a dry lot facility where they are preconditioned for 30 to 45 days. During this process, bull calves are castrated, calves bearing horns are dehorned, and all calves are vaccinated for both internal and external parasites. These activities better prepare calves to cope with the stresses associated with a stocker cattle production system (e.g., exposure to extreme weather and animal commingling), and typically renders higher rates of gain.

Because this project was designed as an on-farm demonstration, the paddocks used for each system were grazed by a single herd rather than individual groups of steers of similar size and genetics that were randomly assignment to one of the two forage treatments. As a result, animal response data for each system (e.g., average daily gains) were not collected. In addition, establishment methods for each of the two systems were not randomized or replicated over space, and hence statistical inference of the data is limited. However, the size of the grazing paddock used in the demonstration (41 acres for the conventional-till system and 23 acres for the no-till system) does provide very good insight into how these two systems compare under an actual large-scale production scenario, and grazing of each system was conducted over an eight year period, which allowed us the opportunity to ferret out some of the variation in forage yields- and steer grazing days due to differences in weather and soil mineralization from year to year.

In each year the group of stockers was placed on the pasture with the highest amount of grazeable forage as determined by forage height measurement (normally about November 1) and would continue to be rotated to the pasture with the next highest amount of grazeable forage, typically grazing a paddock 3-5 days in the fall phase and 2-3 days in the spring phase before rotated to the next best pasture. Cattle were moved from a paddock at the time that approximately 50% of the initially measured forage was removed. Therefore the number of days on a specific pasture depended upon initial forage height measurement and stocking rate.

Stocking rates ranged between 400 and 600 pounds of beef per acre during the fall phase of growth (i.e., November 1 – March 1) and between 800 and 1200 pounds of beef per acre during the spring phase of grown (i.e., March 1 – June 1). Forage production was measured prior to the first phase of grazing in November by taking height measurement and forage clippings from each pasture for each system. Grazing days were collected for each treatment throughout the grazing period and divided into fall and spring production.

Partial Budgeting

The relative expected value between the two establishment systems is defined as the expected net return of the conventional clean-till system minus the expected net return of the conservation no-till system. Because the winter forage was managed the same for each year and system we only consider the costs that are expected to differ between the two systems in our analysis; that is, the costs associated with field preparation and planting activities.

Several assumptions were assumed in our calculations. First, since cattle performance data were not obtained from the demonstration, we made the assumption that cattle realized an average daily gain of two-pounds per head per day for both systems. We support this assumption with the findings reported by Anders et al. who report a four-year average daily gain for the no-till forage system of 2.1 and 2.3 for the fall and spring grazing phases, respectively. For the conventional-till forage system in their study, they report four-year average daily gains of 1.8 and 2.3 for the fall and spring grazing phases, respectively. Second, fixed ownership costs for tillage and planting machinery (i.e., tractors, tillage and seedbed preparation equipment, conventional drill, and a no-till drill) for each system determined by Epplin et al. 2005 for a representative 640-acre farm were utilized in the study.[1] Third, the 2007 local retail price of $1.75 per pint of the herbicide glyphosate, and a custom application rate of $4.00 per acre (Kletke and Doye) was used for the no-till system. Fourth, the estimated diesel fuel expense reported in Epplin et al. 2005 was re-calculated using $2.75 per gallon for both systems, instead of the $2.25 they used. We also assumed that all fertilizer application was applied using custom application services. Lastly, a value of gain of $0.55 per pound was assumed for each system and year of the study.

Results

Forage production and steer grazing days for the conventional till and no-till forage systems for each year are reported in Table 3. Average forage production for the conventional-till system was substantially higher than average forage production measured for the no-till system. This difference was statistically significant at a 95 percent level of confidence. In contrast, steer grazing days for each system were different between grazing phases (fall and spring) and between systems (conventional-till and no-till). However, total steer grazing days between systems were not statistically different at the 0.05 level. Notice that even though the clean-till system realized a substantially higher average level of forage production (416 lbs) over the eight-year study, the average number of steer grazing days favored the no-till system. This discrepancy between forage production and grazing days favoring the no-till system is likely

[1] Epplin et al. 2005 used a farm machinery selection template (MACHSEL) to obtain estimates of machinery fixed costs for the conventional till and no till tillage and planting equipment for producing winter wheat in Oklahoma. Conventional-till and no-till establishment methods for annual winter forages for stocker grazing are essentially the same as establishment methods used for winter wheat. MACHSEL also provides the estimated costs of diesel fuel, lube, and repairs necessary for operating the equipment with its calculations for fixed machinery ownership costs. MACHSEL was developed by Kletke and Sestak.

attributed to the ability to graze the no-till pasture in wetter soil conditions than the conventional tilled pastures. No-tilled pastures do not get as "boggy" as conventional tilled pastures allowing for more days for cattle to access the forage over a typical grazing cycle. Anders et al. also reported a higher average number of steer grazing days for the no-till grazing system relative to the conventional grazing system; however, they did not report forage production data.

Estimates for gross receipts, operating expenses, fixed machinery ownership costs, and net return to land, labor, and management by system are reported in table 4. Gross receipts (calculated as steer days times assumed average daily gain times value of gain) for the no-till system was about five percent greater (or $12.10 per acre) relative to the conventional-till system. Again, we note here that this estimate is based on the assumption that cattle performance in terms of average daily gains was the same for both systems; however, this assumption is in line with actual measured gains reported in the literature.

Net differences in operating plus machinery expenses provides for an addition $20 per acre benefit to the no-till system relative to the conventional-till system. The no-till system did require approximately eight dollars worth of herbicide (glyphosate) and herbicide application expenses, but the reduction in the quantity and hence cost of diesel fuel ($23) and cost associated with owning the tillage and planting equipment ($6) for the no-till system more than compensated for the additional herbicide application expenses. In fact, there was an 84 percent reduction in the diesel fuel expenses associated with using no-till in place of the conventional-till systems. Further increases in diesel fuel prices and further improvements on no-till drills for annual forage and cereal grains will improve the relative cost advantage of no-till conservation farming in the region. Sharp increases in herbicides and custom application rates would reduce the value of no-till; however, since the patent expiration of glyphosate, there has been a steady downward trend in its price.

The 8-year average net value of the no-till system relative to the conventional-till system was approximately $32 per acre. Understanding that the central weakness of the demonstration was the lack of measured stocker cattle response data, it seem reasonable to assume that the additional value due to the animal response associated with the annual forage system would likely be sensitive to the relative difference in average daily gain between the two systems. In response to this we calculated the average daily gain that would have to exist for the gross revenue of the no-till system to be equal to the gross revenue of the conventional-till system. It turns out, as expected, that the difference in gross revenue between the two systems is very sensitive to the relative difference of the average daily gain of two pounds per head per day assumption we made earlier in the paper. We found that if the average daily gain of the no-till system is approximately five percent lower (1.9 versus 2.0 lbs per head per day) than that of the conventional-till system, then the two systems would be indifferent on the revenue side of the net return equation. Looking at the problem from the conventional-till side, we found that an average daily gain of 2.27 (13.5 percent) would be required by the conventional-till system to reduce the $31 advantage of the no-till system to zero, and hence give the advantage back to the conventional-till system.

Summary

The purpose of this paper was to determine if the relative economics associated with no-till conservation establishment of annual winter forage systems for stocker grazing have changed relative to the conventional-tillage establishment methods currently used in the southern Plains regions of the US. First, we found that a primary factor that improves the value of no-till relative to conventional-till is the substantial reduction in diesel fuel expenditure. A second factor that influences the relative profitability of no-till is the reduction in fixed ownership costs associated with machinery and equipment necessary for no-till farming. These two factors more than compensate for the costs associated with applying the herbicide Glyphosate when establishing pastures using the no-till system. In all the relative reduction in cost for the no-till system relative to the conventional-till system was approximately $20 per acre. The estimates for gross revenue for the two systems were computed using measured steer grazing days and the assumptions that steers gained an average of two-pounds per day and receive a value of gain of $0.55. The relative expected value of the no-till system based on eight years of data was determined to be $31 per acre. However, it was shown that if steers grazing the conventional-till system realized an average daily gain that was 13.5 percent greater than gains realized in the no-till system, then producers would likely not adopt no-till practices.

The primary limitation of this study is the lack of measured cattle response data to winter forage pasture for each system. This limitation warrants additional research that focuses on measuring cattle performance on winter annual pastures established using conservation-farming practices.

References

Anders, M., P. Beck, S. Gadberry, and B. Watkins. "Impact of Conservation Tillage Practices on Winter Wheat Production for Grazing Stocker Cattle." University of Arkansas Cooperative Extension Service, Fact Sheet FSA3116, 2007.

Aw-Hassan, A., and A. Stoecker. "Analysis of Wheat Tillage Systems for Long Term Profitability and Conservation Compliance in Grant County." *Current Farm Economics* 65(1992):13-29.

Baggett, H.B., C.E. Ward, and M.D. Childs. "The Effects of Feeder Cattle Grades on Performance and Net Return." *Journal of the American Society of Farm Managers and Rural Appraisers* (2004):1-6.

Epplin, F.M., C.J. Stock, D.D. Kletke, and T.F. Peeper. "Cost of Conventional Tillage and No-till Continuous Wheat Production for Four Farm Sizes." *Journal of the American Society of Farm Managers and Rural Appraisers* (2005):69-76.

Epplin, F.M., and T.F. Tice. "Influence of crop and Farm Size on Adoption of Conservation Tillage." *Journal of Soil and Water Conservation* 41(1986):424-427.

Doye, D., R. Sahs, and D. Kletke. "Oklahoma Farm and Ranch Custom Rates, 2003-2004." Oklahoma Cooperative Extension, Current Report CR-205-0404, 2004.

Napier T.L., C.S. Thraen, A. Gore, and W.R. Goe. "Factors Affecting Adoption of Conventional and Conservation Tillage Practices in Ohio." *Journal of Soil and Water Conservation.* 39(1984): 205-209.

Peel, D.S. "Stocker Cattle: Shock Absorber for the Beef Industry." *Visions* 73(2000):1-6.

Rahm, M.R., and W.E. Huffman. "The Adoption of Reduced Tillage: The Role of Human Capital and other Variables." *American Journal of Agricultural Economics* 66(1984):405-413.

US Department of Agriculture. "Agricultural Prices: 2006 Summary." National Agricultural Statistics Service. Pr 1-3 (07a). Internet site: http://usda.mannlib.cornell.edu/usda/current/AgriPricSu/AgriPricSu-07-20-2007_revision.pdf [Accessed November 1st, 2007].

Table 1. Field Operations and Stocker Activity for Conventional Clean-Till and Conservation No-Till Rye/Ryegrass Forage Production Systems

Field Operation	Month	Conventional-till	No-till
Moldboard Plow (used on 20% of Acres)	June	*	
Chisel (used on 80% of acres)	June	*	
Apply Herbicide (Glyphosate)	August		*
Disk	August	*	
Broadcast (46-0-0)	August	*	*
Disk	September	*	
Band Fertilizer (18-46-0)	September	*	*
Plant Rye/Ryegrass (Conventional-Till Drill)	September	*	
Plant Rye/Ryegrass (No-Till Drill)	September		*
Place Stocker Cattle on Forage	November		
Broadcast (46-0-0)	February	*	*
Remove Stocker Cattle	June	*	*

Table 2. Operation Inputs for Conventional-Till and No-Till Rye/Ryegrass Forage Production System

Operating Inputs	Date	Unit	Price ($)	Conventional	No-till
Glyphosate	August	Pt.	1.75		1.25
Custom Application		Acre	4.00		1.5
Urea (46-0-0)	August	Lbs.	0.50	100	100
Custom Application		Acre	3.00	1	1
Rye Seed	September	Lbs.	0.12	100	100
Ryegrass Seed	September	Lbs.	0.80	15	15
Urea (46-0-0)	February	Lbs.	0.50	100	100
Custom Application		Acre	3.00	1	1

Table 1. Forage Production and Steer Grazing Days for Conventional Till and No-Till Winter Forage Systems by Year (1996-2003)

	Year								
Establishment Method/Variable	1996	1997	1998	1999	2000	2001	2002	2003	Average†
Conventional-Till Establishment									
Forage production (lbs/acre)	1525	1778	995	1560	730	2387	1297	2390	1583[a]
Steer days per acre in the fall	82	95	79	72	0	91	75	50	68[c]
Steer days per acre in the spring	165	145	160	125	136	188	87	154	145[e]
Steer days per acre in total	247	240	239	197	136	279	162	204	213[f]
No-Till Establishment									
Forage production (lbs/acre)	1350	981	610	1245	340	1650	1755	1408	1167[b]
Steer days per acre in the fall	124	97	78	71	0	77	108	94	81[d]
Steer days per acre in the spring	127	142	112	133	171	192	91	178	143[e]
Steer days per acre in total	251	239	190	204	171	269	199	272	224[f]

† results with letters that differ are significantly different at the 0.05 level.

Table 4. Estimates of Gross Revenue, Variable and Fixed Production Costs, and Net Return by System ($/acre)

Reciept/Expense	NT[a] ($/ac)	CT ($/ac)	DF ($/ac)
Average Gross Receipts (steer days x ADG x VOG)	246.4	234.3	12.10
Production Costs that Vary by System			
Herbicide Expenses	3.28	0.00	3.28
Custom Herbicide Application Expenses	6.00	0.00	6.00
Diesel Fuel, Lube and Repairs for Tillage and Planting Activities	4.21	27.03	-22.82
Portion of Annual Operating Capital that Differs Between Systems	0.63	1.26	-0.63
Fixed Machinery Expenses for Tillage and Planting	22.49	28.09	-5.60
Total Operating Plus Machinery Cost	36.61	56.38	-19.77
Net Return to Field Preparation and Planting ($/acre)	210	178	31.87

[a] NT = No-Till, CT = Conventional Till, DF = Difference between NT and CT.