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ECONOMICS AND MARKETING

Economic Analysis of Cotton Conservation Tillage Practices in the Mississippi Delta

James Hanks and Steven W. Martin*

ABSTRACT

Producers and conservationists are concerned about soil erosion and soil loss. Producers are also concerned about profits. Many studies have examined tillage methods as a means of conserving soil. Other studies have evaluated cover crops as a means to conserve soils. This paper evaluates a combination of these two methods of soil conservation based on the economic returns associated with each of the defined systems. Field studies were conducted at Stoneville, MS, from 2000 through 2004. Treatments consisted of conventional till, no-till, low-till sub-soiling, no-till with a winter wheat cover crop, and low-till sub-soiling with a winter wheat cover crop. Partial budgets were developed for each treatment over the 5 yr of the study. Within the partial budgets, both direct and total specified expenses for the specified tillage and cover crop practices were calculated. Results indicated that the highest returns and the lowest relative risk were obtained from a traditional no-till system compared with the other systems in this study. Yield increases did not offset the added expense from planting cover crops. Sub-soiling also did not increase returns enough to offset the added expense and may have even reduced yields. The conventional tillage system had relatively high returns but was among the riskiest (highest variance) of the treatments analyzed. Producers requiring a cover crop system might choose the no-till cover crop system, since it had the highest mean net returns of the two cover crop systems.

Producers and conservationists are concerned about soil erosion and soil loss. Producers are also concerned about profits. Many studies have examined tillage methods as a means of conserving soil (Culpepper et al., 2005; Harrison et al., 2004; Waitrak et al., 2005). Other studies have evaluated cover crops as a means to conserve soils (Cummings et al., 2003, McGregor et al., 1996). While these studies are useful, none has focused on a combination of the two methods (cover crops and tillage) from an economics perspective. This study seeks to evaluate and report on the combination of these two methods of soil conservation based on the economic returns associated with each of the defined systems.

Cotton production in some areas has switched to no-till and/or conservation tillage because of mandates associated with highly erodible soils. Other cotton growing areas are using less tillage as a means to cut production costs. Conventional farming methods (sub-soiling, disking, cultivating, etc.) often require 7 to 10 trips across the field for field preparation and weed control (Anonymous, 2005). As production costs have risen (diesel fuel in 1999 was $0.17 per liter versus $0.59 in 2006) (Anonymous, 1998; 2005), producers have sought alternative methods to produce cotton. Most in the cotton industry assume herbicide-tolerant cotton cultivars have facilitated the reduction in tillage trips (Roberts et al., 2006).

Some of the “conservation” tillage systems include fall seedbed preparation. The implementation of fall seedbed preparation and a spring “burn down” herbicide has led to these fields being left bare throughout much of the year, possibly increasing soil loss. Bare soils during the winter and spring, which is historically the rainy season in the Mid-south and Southeast, may lead to soil losses that are not much different from the traditional/conventional farming system. Cover crops may be an alternative to reduce soil losses in these types of systems, as well as no-till systems (Martin and Locke, 2006).

As production costs have risen over the last few years, cotton lint prices have remained relatively stable (USDA, 2006), so producers are reluctant to adopt new production systems and practices without information on how these systems and practices will affect farm returns. This study evaluates a cover crop versus no cover crop practice across three tillage systems. Tillage systems evaluated included a “com-

J. Hanks, USDA-ARS, Jamie Whitten Agricultural Research Center, Stoneville, MS 38776; Steven W. Martin, Delta Research and Extension Center, P. O. Box 69, Stoneville, MS 38776
*Corresponding author: smartin@ext.msstate.edu

mon practices" conventional tillage system (i.e. fall sub-soiling plus fall and spring seedbed preparation), no-till, and no-till with fall sub-soiling.

MATERIALS AND METHODS

Field studies were conducted at Stoneville, MS, from 2000 through 2004. Land area was approximately 3.04 h with cotton grown on 96.52-cm row spacings. Plots were eight rows wide and 237.74 m in length. The soil was a Dundee very fine sandy loam but changed to a Dundee silty clay loam down the row. Treatments were conventional till (CT), no-till (NT), low-till sub-soiling (LTSS), no-till with a winter wheat (a common Mid-south and southeastern cover crop) cover crop (NTCC), and low-till sub-soiling with a winter wheat cover crop (LTSSCC).

The CT treatment consisted of shredding stalks, sub-soiling down the row in the fall, followed by a fall seedbed preparation with a 4-row crop cultivator (model 886; Deere and Co.; Moline, IL). Seedbeds were re-established in the spring using the 4-row cultivator and knocked down with a do-all prior to planting. The CT treatment might be considered traditional or usual practice for many producers in the Mid-south. The NT treatment had no soil disturbed other than planting. Nitrogen fertilizer was applied to the NT treatment with an 8-row coulter-type applicator (model 3pt-88JB-HF; Bell, Inc.; Inverness, MS), which was consistent with the nitrogen application on all plots. The LTSS treatment consisted of a low-till sub-soiling down the row in the fall with a 4-shank low-till sub-soiler (Short Line Mfg.; Shaw, MS). The LTSS treatment would be considered by many as a reduced tillage system.

Tillage treatments for the two cover crop treatments, NTCC and LTSSCC, were the same as those described for NT and LTSS. The cover crop consisted of planting 27.22 kg of pasture wheat in the fall with a (Tye 104-4527 Model #1 4-row drill; Agco Corp.; Duluth, GA) grain drill. The wheat was killed in the spring with herbicides consistent with the herbicide applications made to the other treatments.

Furrow irrigation was used to supply supplemental water to the entire test each year as needed. Irrigation was accomplished by applying water through 30.48-cm diameter polypipe with outlets at every other furrow. The polypipe was located at the east (right) side of the field, and water flowed from east to west.

Yield data were collected with a yield monitor (model PF3000 Pro; AgLeader Tech.; Ames, IA) installed on a John Deere Model 9965 4-row cotton picker (Deere and Co.). Cotton from each plot was weighed in the field using a boll buggy equipped with load cells (Short Line, Mfg.; Shaw, MS) to verify and calibrate the yield monitor data. Geo-referenced soil electrical conductivity (EC) and yield data were processed using AGIS geographical information system software (Delta Data Systems; Picayune, MS).

All other inputs were supplied consistently to all plots as normal production practices with commercial size equipment. Treatments were established with three replications of the five treatments. Treatments remained in the same plots throughout the duration of the study.

All production data were entered into the Mississippi State University Budget Generator in order to calculate net returns (Laughlin et. al., 2006). The budget generator is the program used to prepare the Mississippi State University enterprise planning budgets. Partial budgets were developed for each treatment over the 5 yr of the study. Within the partial budgets, both direct and total specified expenses per hectare for the specified tillage and cover crop practices were calculated. Total specified expenses included all direct and fixed production expenses (assuming full utilization of equipment) related to sub-soiling, seedbed preparation, cover crop planting, and pre-plant herbicide application, including interest expense, labor and fixed costs of equipment ownership (based on full utilization of equipment), but did not include any other general farming expenses. The 5-year average total specified costs for each of the treatments are shown in Table 1. Returns for each of the treatments were calculated using the national cotton loan rate of $0.236 per kilogram of lint, multiplied by the lint yield of each system (Table 1). Net returns were calculated as returns minus total specified costs.

Additionally, a mean–variance analysis was conducted for each of the systems to evaluate the risk-return levels associated with each of the production systems. Mean-variance analysis is often used to rank a set of alternatives based on the trade-off between returns and risk (Robison and Barry, 1987).

RESULTS AND DISCUSSION

Results from the 5-year average enterprise budgets suggest the highest returns above treatment costs were obtained from the no-till, no cover crop (NT) system (Table 1). The NT system had the lowest production costs (Table 1) because of fewer trips across the field (i.e. no tillage), as well as no cover crop expense. The CT treatment had the highest average yield (Table 1), but net returns were reduced by the cost of the fall and spring tillage. The lowest returns for any of the no cover crop treatments were obtained from the LTSS treatment. The LTSS also had the lowest average yield of any of the no cover crop systems.

Table 1. Partial budget of average specified costs, lint yields, and net returns per hectare for tillage treatments

	Tillage treatments[z]				
	CT	NT	LTSS	NTCC	LTCCSS
Direct costs	$61.97	$30.20	$41.61	$41.54	$52.95
Fixed costs	$28.37	$4.25	$12.92	$15.84	$24.51
Total specified costs	$90.34	$34.45	$54.54	$57.38	$77.47
Yield	2,436	2,360	2,301	2,350	2,318
Net returns	$1,186	$1,202	$1,151	$1,174	$1,137

[z] Treatments were conventional till (CT), no-till (NT), low-till sub-soiling (LTSS), no-till with winter wheat cover crop (NTCC), and low-till sub-soiling with winter wheat cover crop (LTSSCC).

The LTSSCC had the lowest net returns of any of the treatments. Net returns for the LTSSCC treatment were lower because of lower yield relative to the other treatments and the additional expenses of the cover crop and additional tillage. In general, the cover crop systems had relatively lower net returns primarily because of the increased expense of the cover crop establishment.

The two sub-soil treatments LTSS and LTSSCC had the lowest yields and net returns of the five treatments. The lower net returns resulted from low yields and the increased expense of sub-soiling. This is a similar to the finding of Pringle and Martin (2003), who indicated sub-soiling with irrigation had lower net returns than either irrigation or sub-soiling alone.

The mean-variance analysis of the five treatments revealed that the no-till treatment was likely to be the preferred system. The NT treatment had the highest mean returns above treatment costs with less variance than the CT treatment, which had the second highest mean returns of any of the treatments (Fig. 1). The other treatments LTSSCC, LTSS, and NTCC had lower variance (risk) but also had lower mean net returns. Because of this lower risk based on the mean-variance analysis, most individuals would prefer the NT system.

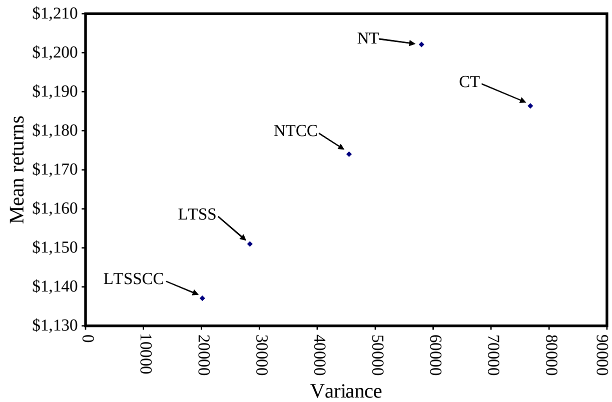

Figure 1. Mean returns versus variance analysis for tillage treatments. Tillage treatments were conventional till (CT), no-till (NT), low-till sub-soiling (LTSS), no-till with winter wheat cover crop (NTCC), and low-till sub-soiling with winter wheat cover crop (LTSSCC).

CONCLUSIONS

Five tillage cover crops systems were evaluated based on net returns over a 5-year period in the Mississippi Delta. Results indicated that the highest returns and lowest relative risk were obtained from a traditional no-till system among the systems studied. Cover crops did not increase yield enough to offset the expenses associated with cover crop establishment. Sub-soiling also did not increase returns enough to overcome the added expense and may have even reduced yields (Table 1). The conventional tillage system had relatively high returns but was among the riskiest (highest variance) of the treatments analyzed. Producers requiring a cover crop system to reduce soil erosion might choose the no-till cover crop system, since it had the highest mean net returns of the two cover crop systems evaluated. Environmental benefits, economic or non-economic, associated with cover crops might lead to different conclusions those derived from this analysis.

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