2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

COTTON REDUCED TILLAGE AND ROTATION EFFECT ON WHOLE FARM PROFITABILITY

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Abstract

The operating cost and revenue data from the 7 tillage systems in a whole farm net returns analysis indicated that the Delta farm (1800 acre) had approximately twice the Northeast Mississippi farm (1200 acre) whole farm net returns with all tillage and crop mix systems. The 50% cotton/corn rotation maximized whole farm net returns for both Delta and Northeast Mississippi farms. This crop acreage-mix for both farms indicated all of the reduced tillage systems showed more whole farm net returns than the conventional tillage system. Net returns for ridge-till Fb do-all (row conditioner, applied at planting) and the fall disk + paratill-bed-roller Fb do-all were similar with the highest whole farm net returns for both farms. Both of these systems showed at least 7% more than the fall disk + bed-roller Fb do-all system and 10% more than fall terratill-bed-roller Fb do-all system for both farms. These systems also had 40 and 28% higher net return than conventional tillage for the Northeast and Delta farms, respectively.

Introduction

Maximizing whole farm net returns is essential in a global farm market system. Cotton following high residue crops have shown increased yield (Buehring et al. 1998; Spurgeon and Grissom 1963; Keeling et al. 1988; Wesley et al. 1993). Research also indicated that corn-cotton rotation was more profitable than continuous cotton (Martin et al. 2002). Others reported whole farm analysis was necessary to determine the amount of equipment necessary for a given farm size (Parvin and Cooke 1999). However, very little information is available on the impact reduced tillage systems in a continuous cotton or a cotton-corn rotation system have on whole farm net returns. The objective of the study was to evaluate the effect reduced tillage systems in a continuous cotton or cotton-corn rotation had on the corn and cotton acreage mix for maximum whole farm net return.

Materials and Methods

A non-irrigated reduced tillage study was conducted on a Marietta silt loam soil in 1999-2002. The study was conducted as a split plot with rotation as main plot and tillage as subplot with 4 replications. Plot size was 8 30-inch rows by 85 foot long. The tillage systems evaluated are listed in Table 1. The corn in the rotation following the cotton tillage systems was planted no-till and had one ridge-till cultivation during the growing season. Rates of inputs used and operations performed on each treatment were recorded. All seed cotton from each plot was ginned with a mini-gin (a state of the art small scale cotton gin equivalent to a commercial gin) to determine the percent gin turnout and lint yield. Treatment gross returns were based on gin turnout, lint yield, and the 2001 USDA National Commodity Credit Corporation base loan price of 52.91¢ lb with adjustments for treatment HVI fiber quality (staple length, grade, micronaire, fiber color, strength, and uniformity). The cottonseed gross return was derived from lint yield x 1.54 x $0.05/lb (cottonseed price). Corn gross returns were based on treatment yield and the state average loan rate of $1.99/bu.

Eight-row and 12-row equipment complements listed in Table 2 were used to develop crop budgets for each tillage system to simulate a Northeast Mississippi and a Mississippi Delta farm for a whole farm maximum net return analysis, respectively. The Mississippi State University Agricultural Economics Department Budget Generator was used to develop cost and return budgets for each tillage treatment (based on yield, gross returns, inputs used and operations performed on each treatment). These budgets [annual and 3-yr (2000, 2001, 2002) average] determined the fixed and direct costs, total specified costs per acre, and return above specified costs per acre for each tillage treatment. The corn and cotton yield and revenue data from the 7 tillage systems were then used to determine the appropriate tillage system and corn-cotton acreage mix for maximum whole farm net returns above total operating and capital recovery costs (included all costs except land, management, and overhead cost).

Another important feature of the whole farm analysis was the use of harvest equipment under the different crop mixes evaluated. The designated harvesting capacity for the Northeast farm was 800 acres for each crop and 1200 acres of each crop for the Delta farm. If the specified acreage of a crop was less than it capacity (800 or 1200 acres), it was assumed that the excess capacity was used to custom harvest a neighboring farm, and thus generate some additional net revenues. However, the net return per acre from custom harvesting was generally much lower than production of the crop.

The estimated annual capital recovery charge for the equipment required by each of the farms was included in the analysis (Table 3). These figures were computed with a 5% annual interest rate. The annual amount of capital listed in Table 3 would need to be covered in the long run in order to maintain the complement of equipment over time at the assumed purchase price (10% less than manufacturer retail price) and useful life.

Results and Discussion

The annual estimated capital recovery for each tillage system indicated that the ridge-till system had the lowest annual recovery cost of $86,011 and $105,258 for the Northeast and Delta farm, respectively (Table 3). Conventional tillage had the highest annual recovery charge of $91,059 and $111,808 for the Northeast and Delta farm, respectively. As tillage treatment operations were reduced, so did the annual capital recovery cost. We recognize in a real farming situation, the annual recovery charges could vary widely among farms because of the variation in machinery ownership patterns and practices.

Whole farm analysis indicated similar results for both Northeast and Delta farms (Table 4). The major difference was the Delta farm showed similar but higher maximum net returns than the Northeast farm. The Delta farm produced 2 to 3 times more net returns than the Northeast farm in continuous monoculture (crop mix 1, 2, and 3) and at least 2 times more with the cotton-corn crop rotation systems. These results indicate farm size has a major impact on total farm net returns.

The six corn-cotton acreage mix treatments chosen in this analysis indicated corn in the rotation always increased whole farm annual net returns across all tillage systems. All reduced tillage systems on both farms, except in a monoculture crop system, showed higher whole annual farm net returns than conventional tillage. In the monoculture systems (crop mix 1, 2, and 3), ridge-till (treatment 7), and fall paratill-bed-roller (treatment 6) had lower whole farm net returns than all other tillage systems, including the conventional. However, when part of the acreage was in a cotton-corn rotation (crop mix 4), ridge-till Fb do-all showed more whole farm net return than conventional tillage. The 50% cotton/corn acreage in a continuous rotation maximized annual net returns on both farms across all tillage systems. The fall disk + terratill bed-roller (one-pass operation) Fb do-all at planting and ridge-till Fb do-all at planting showed $110,553 and $113,555/year returns in a 50% corn/cotton rotation for the Northeast farm, respectively, and had the highest net returns. These same treatments provided the highest whole farm returns of $220,301 and $221,472 for the Delta farm, respectively. The fall disk + bed-roller Fb do-all (treatment 2) in a 50% corn/cotton rotation provided $103,091 and $205,605 whole farm net return for the Northeast and Delta farms, respectively. The fall paratill-bed-roller Fb do-all (treatment 5) at planting with 50% corn/cotton rotation provided $99,470 and $201,948 whole farm net return for the Northeast and Delta farms, respectively.

In summary, the Delta whole farm net returns was about 2 times more than the Northeast farm's highest whole farm net return treatments. Whole farm net returns for ridge-till Fb do-all and the fall disk + terratill-bed-roller Fb do-all were similar with the highest net returns in a 50% cotton-corn rotation acreage mix. Both of these systems showed at least 7% more than fall disk + bed-roller Fb do-all and 10% more than the fall terratill-bed-roller Fb do-all for both farms; and with at least 40 and 28% higher return than conventional tillage for the Northeast and Delta farm, respectively.

Acknowledgement

The research was funded in part by the Mississippi Cotton Incorporated State Support Program.

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Table 1. Annual tillage operations performed in cotton in a corn-cotton rotation study on a Marietta silt loam soil in 1999-2002, Verona, MS.

	Tillage Treatment #						
Season/Tillage	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fall							
Disk	X[1]	X	X				
Chisel Harrow	X						
Coulter-Chisel Harrow				X			
Bed	X						
Bed with Rollers		X					
TerraTill-Bed with Rollers			X	X	X	X	
Spring							
Field Cultivate	X						
Bed	X						
Row Conditioner (do-all)	X	X	X	X	X		X
Conv.Cult.+Band Herb.	2X						
Ridge-Till Cult.+ Band Herb.							2X

[1] Denotes tillage operations performed.

Table 2. Equipment complements used for a Delta and Northeast Mississippi crop acreage mix whole farm returns analysis in 2000-2002.

	Farm size	
Equipment	**1200 acre**	**1800 acre**
	- - - - - Description - - - - -	
Tractor	MFWD 150	MFWD 170
Tractor	MFWD 190	Track 225
Cotton picker	4R-30	6R-30
Disk harrow	24 ft	32 ft
Chisel harrow	21.5 ft	27.5 ft
Coulter-chisel-harrow	21.5 ft	27.5 ft
Terratill bed w/roller	4R-30	6R-30
Ridge-till cultivator	8R-30	12R-30
Conventional till cultivator	8R-30	12R-30
Hooded sprayer	8R-30	12R-30
No-till planter	8R-30	12R-30
Disk bedder	8R-30	12R-30
Row conditioner (d0-all)	21 ft	32 ft

Common equipment used on both whole farm	**Size**
Boll buggy	4 bale
Module builder	32 ft
Rotary cutter	12 ft
Combine corn	8R-30
Grain cart	500 bu
Granular fertilizer spreader	5 ton
Boom sprayer	60 ft (400 gal)

Table 3. Annual capital recovery charge for each tillage system. Equipment on the Northeast Mississippi and Delta Mississippi farm.

Tillage Treatment #	Northeast MS farm (1,200 acres)	Delta MS farm (1,800 acres)
	----------$/year----------	
1	91,059	111,808
2	89,248	109,449
3	89,326	109,092
4	88,430	108,474
5	87,347	107,113
6	86,519	105,602
7	86,011	105,258

Table 4. Three-year (2000-2002) average whole farm returns above total specified costs for a modeled 1200-acre farm in Northeast and 1800-acre Delta farm in Mississippi[1].

Crop	Continuous		Rotation		Tillage treatments						
Mix #[2]	Cotton	Corn[3]	Cotton	Corn	1	2	3	4	5	6	7
						----------Net returns----------					
	---Acres produced---					----------Northeast Mississippi Farm (1200 ac)[2] ----------					
1	800	400	0	0	46,974	57,149	55,996	48,062	54,338	34,363	25,973
2	600	600	0	0	48,570	56,654	55,770	50,043	55,021	40,247	34,081
3	400	800	0	0	50,166	56,159	55,544	52,024	55,704	46,130	42,189
4	400	0	400	400	67,192	88,107	92,518	85,737	83,971	65,518	78,955
5	0	400	400	400	70,384	87,117	92,066	89,699	85,337	77,285	95,172
6	0	0	600	600	78,897	103,091	110,553	106,556	99,470	86,979	113,555
						----------Mississippi Delta Farm (1800 ac)[2] ----------					
1	1200	600	0	0	127,571	140,106	141,209	129,158	136,757	106,051	89,079
2	900	900	0	0	122,967	132,958	133,875	124,991	131,030	108,379	95,735
3	600	1200	0	0	118,364	125,810	126,541	120,824	125,304	110,706	157,878
4	600	0	600	600	160,746	188,537	198,827	188,503	184,036	155,632	172,903
5	0	600	600	600	151,538	174,242	184,158	180,169	172,583	160,287	186,216
6	0	0	900	900	172,729	205,605	220,301	214,008	201,948	182,749	221,472

[1] Whole farm net return is the gross return/acre minus the total specified costs include expenses for operating inputs, labor, machinery repairs and maintenance, interest on operating capital, and an annual capital recovery charge for owned machinery. Expenses for land, management, and general farm overhead are not included. Corn price was $1.99/bu and cotton price was the 2001 National Commodity Credit Corporation base loan rate of 51.92¢/lb with premium or discount adjustments for fiber quality.

[2] If the farm's crop mix produced less than 800 acres for Northeast and 1200 acre for Delta farm of a crop, the farm used its harvest equipment to custom harvest a neighboring farm's crop, until a total of 800 or 1200 acres was reached.

[3] Continuous ridge till corn yields were used in determining the net returns.