NO TILLAGE AND RIDGE TILLAGE EFFECTS ON YIELDS AND ECONOMICS

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Abstract

Conservation tillage practices including no-tillage and ridge-tillage are gaining popularity among producers in south Texas primarily due to reductions in input costs, moisture conservation, and economic benefits of reducing trips over the field with tillage equipment. Objectives of this study were to compare yields and economics of a conventional moldboard plow and disk system with no-tillage and ridge-tillage cotton production systems. Cotton lint yields were not different in 1997 between tillage systems. In 1998 lint yields of no-tillage were 29% less than conventional tillage. In 1999 lint yields were less in ridge tillage compared with moldboard tillage or no-tillage. Net returns for the moldboard plow and disc system were negative in all years and ranged from $-56/acre to $-116/acre. Net returns for the ridge tillage were greater than the moldboard tillage returns this treatment also had a net loss for each of the three years ($-8 to $-86/acre). Net returns were positive for the no-tillage in 1997 and 1999 ($8 and $4/acre). Even with a lower yield for the no-tillage in 1998 net returns were larger with no-tillage compared with conventional moldboard plow and disc system. Returns were the least with the moldboard plow and disc system and always at a net loss (negative returns). Net returns with the no-tillage system were $64, $28, and $91 more than with the conventional moldboard plow and disk system in 1997, 1998 and 1999, respectively.

Introduction

Use of conservation tillage by cotton, corn, and grain sorghum producers has increased greatly in south Texas over the past few years. Savings in time to prepare a seedbed and moisture conservation are primary reasons many producers say they are adopting conservation tillage practices. Several researchers have found energy savings when using conservation tillage (Burt, et al., Grisso, et al., 1997; Patterson et al., 1993). Other benefits of conservation tillage are reductions in soil erosion due to wind and water (Hagen et al., 1994; Mutchler et al., 1995), sandblasting, and wind damage to seedling cotton crops when crop residue from the previous crop is on the soil surface to protect the cotton seedlings. Economic benefits have been found using conservation tillage in the High Plains of Texas and other production areas for cotton (Paxton, et al., 1993; Segarra, et al., 1991; Wiese, et al., 1994), but few studies have been conducted in sub-tropical semi-arid environment such as the Lower Rio Grande Valley of Texas. Regardless of any perceived benefits, producers will not adopt conservation tillage practices and continue to use these practices if they are not economically sustainable. Objectives of this study were to compare yields and economics of a conventional moldboard plow and disk system with no-tillage and ridge-tillage cotton production systems.

Materials and Methods

The study was conducted as a randomized complete block design with four replications on a Hidalgo silty clay loam soil near Weslaco, Texas. Plot size was 45' by 400' long and the cotton crop always followed a fall corn crop. Three tillage systems, conventional moldboard plow and disc system, ridge tillage, and no-tillage were compared, beginning in 1992. Data for 1997, 1998, and 1999 are presented here. Specific tillage passes over the field and input costs for each tillage system are listed in Table 1. Cotton plant population were counted for each year of the study from six sub-samples per plot. Each sub-sample was two rows wide and 13.1 feet long. Cotton plant height and leaf stage were measured and counted on 20 random plants per plot. Six random sub-sample plots each six rows wide by 13.1 feet long were hand harvested. Seed cotton was weighed, ginned with a saw gin and separated seed and lint were weighed to determine percent lint. Total lint was calculated for each plot from an average of the six sub-samples per plot. Costs for machine harvest and associated commercial ginning costs were used for the economic calculations for each treatment. Gross returns were based upon local prices for lint at harvest time of $0.62/lb in 1997 and 1998 and $0.52/lb in 1999. Net returns were calculated by adding pre-harvest production costs from Table 1 with harvest and associated ginning costs and subtracting this value from the gross return for each treatment and year. Rates and prices for operations are based upon the Texas Crop Enterprise Budgets, South Texas District, 1998. Prices for fertilizer, herbicide, and insecticide prices are based upon the local three year average for these inputs.

Discussion

Equipment passes over the field and associated costs with fertilizer, irrigation, herbicide, and tillage costs for each of the three tillage systems are listed in Table 1. The conventional moldboard plow and disc system had an estimated pre-harvest production cost of $241/acre, ridge tillage $192/acre, and the no-tillage $177/acre. Reduced production costs of the ridge tillage and no-tillage were primarily due to reduced tillage passes over the field. Cotton plant population varied somewhat from year to year but was not different for tillage treatments within a crop year (Table 2). Cotton plant height (Table 3) was not different between tillage treatments in 197, was 15% and 9% less in ridge

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tillage and no-tillage in 1998 compared with the moldboard plow system and 15% and 13% less in the ridge tillage and no-tillage in 1999. Cotton plant leaf stage (Table 4) followed a pattern similar to plant height. Tillage treatments did not affect percent lint (Table 5) for any of the three years and lint percentages ranged from 34% to 39%. Tillage treatments did not affect lint yields in 1997 (Table 6). Lint yields were reduced in 1998 in the no-tillage 29% compared with the moldboard tillage. In 1999 the greatest lint yield was with the no-tillage treatment at 1025 lbs/acre compared with 916 with the moldboard tillage and only 831 lbs/acre with the ridge tillage treatment (Table 6). Harvest and ginning costs for each treatment are listed in Table 7 with standard rates provided by the 1998 edition of the Texas Crop Enterprise Budget for South Texas (Texas Agricultural Extension Service paper #B-124-C12). Gross returns per acre were calculated using average local prices for cotton at harvest for each of the years (Table 8). Harvest and ginning costs were added to the pre-harvest production costs and this value was subtracted from the gross returns to calculate the net returns for each tillage treatment each year of the study. Net returns for the moldboard plow and disc system were negative in all years and ranged from $-56/acre to $-116/acre. Net returns for the ridge tillage were greater than the moldboard tillage returns. This treatment also had a net loss for each of the three years ($-8 to $-86/acre). Net returns were positive for the no-tillage in 1997 and 1999 ($8 and $4/acre). Even with a lower yield for the no-tillage in 1998 the net returns were still larger with the no-tillage compared with the conventional moldboard plow and disc system.

Summary

Net returns were least with the moldboard plow and disc system and always at a net loss (negative returns). Net returns were greatest with the no-tillage system and were $64, $28, and $91 more than the conventional moldboard plow and disk system in 1997, 1998, and 1999, respectively.

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Table 1. Equipment passes and associated costs per acre for conventional moldboard plow and disc system (CT), ridge-tillage (RT), and no-tillage (NT) cotton production following a fall corn crop.

Operation	CT		RT	NT
shred residue	$10.08		$10.08	--------
disc (tandem)	$ 6.53		--------	--------
moldboard plow	$22.00		---------	--------
disc 2X	$16.08		---------	--------
form beds	$ 9.77		---------	--------
shape beds	$ 7.00		---------	--------
spray weeds & appl.	-------		$ 9.04	$ 9.04
planting	$11.62		$11.62	$11.62
seed	$18.10		$18.10	$18.10
herbicide w/planting	$ 6.00		$ 6.00	$ 6.00
fert & appl.	$27.00		$27.00	$27.00
Irrigation 2X	$18.00		$18.00	$18.00
irrigation labor 2X	$13.00		$13.00	$13.00
spray weeds	--------		$ 9.04	$ 9.04
cultivation 3X	$21.00	2X	$14.00	--------
hooded sprayer	--------		--------	$ 9.04
pesticide & appl. 4X	$42.00		$42.00	$42.00
defoliation & appl.	$13.86		$13.86	$13.86
Total pre-harvest costs	$241.34		$191.74	$176.70

Prices derived from the Texas Crop Enterprise Budgets, South Texas District, 1998. Publication # B-1241 (C12)

Table 2. Cotton plant population in plants per acre as affected by tillage at Weslaco, Texas in 1997-1999.

Tillage system	1997	1998	1999
moldboard plow & disk	39,300 a	42,600 a	36,800 a
ridge tillage	41,700 a	40,600 a	43,500 a
no-tillage	42,100 a	47,000 a	36,000 a

Comparisons are made within a column, numeric values followed by a common letter are not significantly different ($\propto = 0.05$) as determined by a Waller-Duncan *k*-ratio *t*-test.

Table 3. Cotton plant height (cm) as affected by tillage at Weslaco, Texas in 1997-1999.

Tillage system	1997	1998	1999
	(71 DAP)	(76 DAP)	(74 DAP)
moldboard plow & disk	80 a	60 a	63 a
ridge tillage	77 a	51 c	53 b
no-tillage	75 a	55 b	55 c

Comparisons are made within a column, numeric values followed by a common letter are not significantly different ($\propto = 0.05$) as determined by a Waller-Duncan *k*-ratio *t*-test. DAP is an abbreviation for days after planting.

Table 4. Cotton plant leaf stage as affected by tillage at Weslaco, Texas in 1997-1999.

Tillage system	1997	1998	1999
	(71 DAP)	(76 DAP)	(74 DAP)
moldboard plow & disk	15.5 a	16.0 a	16 a
ridge tillage	14.7 ab	14.6 b	14 c
no-tillage	14.3 b	15.7 ab	15 bc

Comparisons are made within a column, numeric values followed by a common letter are not significantly different ($\propto = 0.05$) as determined by a Waller-Duncan *k*-ratio *t*-test. DAP is an abbreviation for days after planting.

Table 5. Cotton percent lint at harvest as affected by tillage at Weslaco, Texas in 1997-1999.

Tillage system	1997	1998	1999
moldboard plow & disk	35.5 a	35.2 a	39.3 b
ridge tillage	35.5 a	35.9 a	39.4 b
no-tillage	34.1 a	36.5 a	39.7 ab

Comparisons are made within a column, numeric values followed by a common letter are not significantly different ($\propto = 0.05$) as determined by a Waller-Duncan *k*-ratio *t*-test.

Table 6. Cotton lint yield in lbs/acre as affected by tillage at Weslaco, Texas in 1997-1999.

Tillage system	1997	1998	1999
moldboard plow & disk	689 a	466 a	916 b
ridge tillage	684 a	393 ab	831 c
no-tillage	629 a	330 b	1025 a

Comparisons are made within a column, numeric values followed by a common letter are not significantly different ($\propto = 0.05$) as determined by a Waller-Duncan *k*-ratio *t*-test.

Table 7. Cotton harvest costs based on a custom pick and module cost of $21.67/cwt, gin, bag, ties $0.135/lb, and labor for a total costs of $0.38.17/lb total harvest costs.

Tillage system	1997	1998	1999
moldboard plow & disk	$242.32	$163.89	$322.16
ridge tillage	$240.56	$138.22	$292.26
no-tillage	$221.22	$116.06	$360.49

Table 8. Gross returns/acre based on $0.62/lb in 1997 and 1998 and $0.52/lb in 1999.

Tillage system	1997	1998	1999
moldboard plow & disk	$ 427	$ 289	$ 476
ridge tillage	$ 424	$ 244	$ 432
no-tillage	$ 390	$ 205	$ 533

Table 9. Net returns/acre as affected by tillage treatments based on $0.62/lb in 1997 and 1998 and $0.52/lb in 1999.

Tillage system	1997	1998	1999
moldboard plow & disk	$(-56)	$(-116)	$ (- 87)
ridge tillage	$ (- 8)	$ (- 86)	$ (- 52)
no-tillage	$ 8	$ (- 88)	$ 4)