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Weed Control, Yield, and Economics of a One-Pass Land Preparation System for Cotton Production

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Abstract

A 3-year (2007–2009) study at Verona and Stoneville, Mississippi, evaluated weed control, yield, and returns above total specified costs (fixed and direct cost for tillage operations, herbicides, and herbicide application costs) for tillage and preplant-incorporated herbicides in cotton. The experimental design was a split plot with fall no-tillage and conventional tillage as main plots and Prepmaster or Prowl PRE (Prowl H2O, pendimethalin) applied preemergence after planting as subplot treatments. Conventional tillage at Stoneville was a fall in-row subsoil plus hip (bed) followed by (fb) spring rehip and roll. The conventional tillage at Verona was a fall deep under-the-row subsoil (Paratill®, Bigham Brothers, Lubbock, Texas) fb a fall bed-roller. Preplant herbicides Prowl and Treflan (trifluralin) were applied and incorporated with a one-pass land-preparation implement (Prepmaster®, Bigham Brothers, Lubbock, Texas).

There were two subplot treatments with an early-postemergence (EPOT) (applied to one- to three-leaf cotton) glyphosate application: (1) Prepmaster applied 4–6 weeks before planting (WBP); and (2) Prepmaster applied at planting. Six subplot treatments did not use EPOT glyphosate: (1) Prepmaster-Prowl applied 4–6 WBP; (2) Prepmaster-Prowl applied at planting; (3) Prepmaster-Treflan applied 4–6 WBP; (4) Prepmaster-Treflan applied at planting; (5) spring bed-roll fb Prowl PRE at Verona; and (6) spring hip and roll fb Prowl PRE at Stoneville. All treatments received a late-winter burndown, after-planting burndown, midseason postemergence (MPOT) (applied to four- to eight-leaf cotton) glyphosate application, and a layby application of glyphosate plus Direx (diuron).

Weed infestations at both locations were light to moderate. At both Verona and Stoneville, the Prepmaster treatments with an EPOT glyphosate application had higher levels of weed control at the MPOT glyphosate application timing than the Prepmaster-preplant herbicides (Prowl or Treflan) with no EPOT glyphosate or the Prowl PRE treatments with no EPOT glyphosate application. However, there were no differences in late-season weed control at either location among tillage systems and all Prepmaster or Prowl PRE treatments.

At Verona, early- to midseason crop stunting injury (8–10%) and some stand reduction (13%) was observed for Prepmaster-Treflan incorporated at planting, but it had no effect on lint yield. Low crop injury (3–8% stunting) was observed only in 2009 at Stoneville with Prepmaster-Treflan incorporated at planting. No differences were observed at Verona in yield, gross returns, or returns above total specified costs, and there were no interactions among tillage system and all Prepmaster or Prowl PRE treatments.

However, at Stoneville, there was an interaction between tillage and Prepmaster or Prowl PRE for lint yield, gross returns, and returns above total specified costs. Highest yields were produced by conventional tillage fb Prepmaster applied 4–6 WBP, fall no-tillage fb Prepmaster applied 4–6 WBP, conventional tillage fb Prepmaster-Treflan applied 4–6 WBP, and conventional tillage fb Prepmaster-Treflan applied at planting. These treatments were not significantly different from each other.

Total specified costs for all the Prepmaster or Prowl PRE treatments with conventional tillage were $9 per acre more at Verona and $34 per acre more at Stoneville than the Prepmaster treatments with no fall tillage. At Verona, there were no differences in returns above total specified costs among tillage systems (fall conventional tillage or no fall tillage) fb spring Prepmaster or Prowl PRE treatments. However, at Stoneville, highest returns above total specified costs were seen after fall no-tillage fb the Prepmaster 4–6 WBP with an EPOT glyphosate application. These returns in Stoneville were equal to returns from conventional tillage fb Prepmaster-Treflan applied 4–6 WBP or at planting with no EPOT glyphosate.

Results from this study indicate that the Prepmaster implement is an economical and effective method for applying and incorporating preplant herbicides, as well as forming beds for planting without further tillage. The Prepmaster-preplant incorporated herbicides system may also be used as a substitute for an EPOT glyphosate application, in a Roundup Ready Flex cotton weed management program.

Weed Control, Yield, and Economics of a One-Pass Land Preparation System for Cotton Production

Introduction

With the continuous use of glyphosate on extensive cropland acreages, the number of weed species resistant to this herbicide is expected to increase (Heap 2005). Glyphosate-resistant horseweed (*Erigeron candensis*) (Hayes and Steckel 2005; Heap 2011) and Palmer amaranth (*Amaranthus palmeri*) in Georgia, Arkansas, Tennessee, North Carolina, South Carolina (Culpepper et al. 2006; Heap 2011; Norsworthy et al. 2008; Scott et al. 2007; York et al. 2007), Louisiana, Alabama, and Mississippi (Heap 2011) illustrate the need to develop preventative glyphosate resistance management strategies. Such systems reduce the risk of weeds becoming resistant to glyphosate, reduce the number of glyphosate herbicide applications, and minimize production costs.

Residual preplant-incorporated herbicides, such as Treflan or Prowl, have several advantages: They do not require rainfall for incorporation, they cost about the same as one generic glyphosate application, they are less costly per acre than the generic Dual (S-metolachlor), and they can be applied at planting or up to 6 WBP. Therefore, preplant herbicides applied with an efficient herbicide application-incorporation system eliminate a trip across the field with a harrow or do-all at planting. This system improves planting efficiency and minimizes the potential for weeds to develop resistance to glyphosate. It also has the potential to improve farm revenue by reducing the number of tillage operations.

Prepmaster is a one-pass preplant herbicide applicator and incorporation implement equipped with a 16-inch sweep positioned on the center of each row, a small (7-inch) buster sweep (shapes the bed), rolling cutter bar, rolling basket (incorporate herbicides), and smooth metal roller to smooth the bed. It can be operated at 6–7 mph and creates a wide, smooth surface 4–6 inches in height. This implement leaves a smooth surface for planting cotton at a uniform depth and eliminates the need for a harrow or row conditioner at planting. Prepmaster requires about 15 horsepower per row unit, and each row unit weighs about 800 pounds. One research project used the Prepmaster implement after no fall tillage on a nonirrigated silty clay loam soil in late March or early April (with burndown herbicide applied 3–4 weeks before Prepmaster). This treatment produced 15% higher lint yields than no-tillage and was equivalent to the fall Paratill operated at a depth of 10–12 inches fb a bed-roller (Buehring et al. 2006; Dobbs et al. 2006; Harrison et al. 2009).

Cotton yield response to tillage has been inconsistent. In the Mississippi Delta, deep, in-row subsoiling on clay soil produced higher cotton yields and returns than reduced tillage (Wesley et al. 2001). In some studies, reduced or equivalent cotton yields have been observed with no-tillage compared with conventional tillage systems (Bauer and Busscher 1996; Brown et al. 1983; Stevens et al. 1992). Others have reported higher yields from conservation tillage compared with conventional tillage (Clark et al. 1996; Hunt et al. 1997; Wiese et al. 1994).

The objective of this study was to determine the effect of tillage systems with and without preplant herbicides applied with a one-pass incorporator-bed-roller on crop injury, weed control, lint yield, and returns above specified costs.

Materials and Methods

One study was conducted on a site infested with Palmer amaranth (susceptible to glyphosate), pitted morningglory (*Ipomoea lacunosa*), and barnyardgrass (*Echinochloa crusgalli*) at the Delta Research and Extension Center (DREC) in Stoneville, Mississippi. A second study was conducted on a site infested with southern crabgrass (*Digitaria ciliaris*) and broadleaf signalgrass (*Urochloa platyphylla*) at the North Mississippi Research and Extension Center (NMREC) in Verona, Mississippi. The studies were conducted on a Dundee silt loam soil at DREC and a Marietta loam soil at NMREC. Both sites had been in conventional tillage before these studies. Both studies were designed as a split-plot in a randomized complete block design with four replications. Tillage systems (conventional tillage and no fall tillage) were main plots, and the one-pass Prepmaster or Prowl PRE treatments were subplot treatments. Two conventional tillage systems were used: (1) fall Paratill (under-row subsoil 10- to 12-inch depth) fb a fall bed-roller at NMREC; and (2) a fall in-row subsoil plus hip (bed) fb an early-spring re-hip and roll in February/March at DREC. Plot size was four rows—40 inch by 50 feet at DREC and 38 inch by 50 feet at NMREC.

Both sites received a burndown application of glyphosate at 0.75 pound (ae) per acre in late February to early March and at planting. At NMREC (2007–2009) and DREC (2007 and 2008), both Treflan and Prowl were applied and incorporated 4–6 WBP or at planting in early to late May. In 2009, wet weather at DREC delayed the glyphosate burndown application until March 15. All 3 years of the study, Phytogen PHY 485 WRF cotton was planted at DREC with a seeding rate of 45,000 seeds per acre and at NMREC with a seeding rate of 55,000 seeds per acre.

At both sites, the Prepmaster-Prowl, Prepmaster-Treflan, and Prowl PRE treatments did not receive an EPOT glyphosate application. The Prepmaster treatments, which included no preplant herbicides, received an EPOT glyphosate application at 0.75 pound (ae) per acre. All treatments received a burndown at planting, MPOT application of glyphosate at 0.75 pound (ae) per acre, and layby application of glyphosate at 0.75 pound (ae) plus Direx at 1 pound of active ingredient per acre. All other recommended agronomic production practices were the same for all treatments and locations. Dry growing conditions at DREC necessitated nine supplemental irrigations in 2008 and one supplemental irrigation in 2009 (approximately 1 inch of water per irrigation).

Defoliation and harvest weather conditions at both locations were favorable in 2007 and 2008. However, persistent wet weather in 2009 from early September through October at both locations resulted in some cotton sprouting in the boll, caused incidences of boll rot, and delayed defoliation until late October and harvest until early November.

Weed control and crop injury ratings were recorded at the MPOT glyphosate application stage and at harvest. Plant populations for the center two rows of each four-row plot were recorded 4 weeks after planting. The center two rows were harvested with a two-row spindle picker equipped with a bagging unit. Seedcotton grab samples were ginned with an eight-saw sample gin (without lint cleaners) to determine lint turnout and lint yield. Total specified costs (fixed and direct costs for tillage operations, herbicides, and herbicide application) and returns above total specified costs for each treatment and location were determined with the Mississippi State Budget Generator (Laughlin and Spurlock 2009). Gross revenue was calculated by multiplying the lint yield by a price of $0.52 per pound. Returns were calculated as gross revenue minus total specified costs.

All data for each location was analyzed using the PROC Mixed Procedure in Statistical Analysis Systems (SAS) software (SAS Institute 2008). When no tillage by Prepmaster-herbicide system interaction was detected, the data was pooled and reanalyzed. Means were separated using Fisher's Protected LSD at the 0.05% significance level.

Results and Discussion

Verona — Rainfall during the growing seasons was highly variable (Table 1). In 2007, rainfall was below the 30-year average (1971–2000) for April, May, June, and August and above the average for July and September. Rainfall in 2008 was above average for April, May, August, and September but below average for June and July. Rainfall in 2009 was below average for April and June but above average for May, July, August, and September. Plant population, crop injury, grass control, and lint yield response for tillage systems were not different, and there were no interactions of tillage by Prepmaster preplant herbicide or Prowl PRE treatment. Therefore, data were pooled over tillage systems and reanalyzed (Table 2). Prepmaster and Prowl PRE treatment populations ranged from 45,360 to 53,980 plants per acre. Prepmaster-Treflan applied at planting had the lowest plant population (45,360 plants), compared with all other Prepmaster or Prowl PRE treatment populations of 50,890 to 53,980 plants per acre. Prepmaster-Prowl applied at planting resulted in a population of 50,890 plants per acre, which was lower than Prowl applied PRE but not different from all other treatments. This one-pass Prepmaster reduced-tillage system had no stand establishment problems reported with no-till cotton production systems (Colyer and Vernon 1993; Hicks et al. 1989; Stevens et al. 1992).

Prepmaster-Treflan applied at planting resulted in 12% and 6% early- and late-season crop stunting injury, respectively. These amounts were higher than all other Prepmaster and Prowl PRE treatments, which produced up to 3% crop stunting injury (Table 2). The Prepmaster applied 4–6 WBP or at planting fb EPOT glyphosate applications resulted in 95–96% midseason grass control (Table 2). This level of control was higher than the Prowl PRE (82%), Prepmaster-Prowl and Prepmaster-Treflan incorporated 4–6 WBP (77–78%), and Prepmaster-Prowl and Prepmaster Treflan applied at planting (84%). However, late-season grass control with all treatments was excellent (more than 95%), with no differences among treatments. Lint yields ranged from 1,329 to 1,390 pounds per acre (Table 2). Neither tillage systems nor Prepmaster or Prowl PRE treatments showed any yield response differences. These results are comparable to other reports (Buehring et al. 2006; Dobbs et al. 2006; Harrison et al. 2009), which indicated that the cotton yields for no fall tillage fb spring Prepmaster was equivalent to conventional deep tillage (Paratill). These findings are in contrast to reports of higher lint yields with deep tillage (Wesley et al. 2001), as well as reports of reduced or equivalent yields for conventional systems compared with no-till (Bauer and Busscher 1996; Brown et al. 1985; Stevens et al. 1992).

Total specified cost for the fall conventional tillage fb spring Prepmaster or Prowl PRE treatments ranged from $105 to $114 per acre, which was $9 per acre more

Table 1. Monthly rainfall from April through September in 2007, 2008, and 2009, Verona, Mississippi.

Day	April	May	June	July	Aug.	Sept.	Total
	in	*in*	*in*	*in*	*in*	*in*	*in*
				2007			
1-10	1.11	0.72	0.77	1.84	0.55	1.29	6.28
11-20	1.41	0.82	1.15	2.75	0.26	2.95	9.34
21-30	0.11	0.03	0.77	2.58	1.17	0.03	4.69
Total	**2.63**	**1.57**	**2.69**	**7.17**	**1.98**	**4.27**	**20.31**
				2008			
1-10	3.07	2.20	0.25	0.60	3.24	3.55	12.91
11-20	1.70	2.06	0.11	0.19	1.06	1.89	7.01
21-30	0.87	2.70	0.10	1.42	2.50	0.00	7.59
Total	**5.64**	**6.96**	**0.46**	**2.21**	**6.86**	**5.44**	**27.51**
				2009			
1-10	1.36	6.22	0.20	1.72	2.03	1.25	12.78
11-20	1.73	3.80	1.85	0.25	2.00	4.25	13.88
21-30	0.00	1.47	0.05	3.80	0.83	3.80	9.95
Total	**3.09**	**11.49**	**2.10**	**5.77**	**4.86**	**9.30**	**36.61**
30-yr. avg. (1971–2000)	**5.20**	**4.84**	**4.56**	**3.58**	**3.80**	**4.09**	**26.07**

Table 2. Plant population, percent crop injury, grass control, and lint yield as influenced by spring Prepmaster-herbicide systems, averaged over tillage systems and years (2007–2009), Verona, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide application	Plants per acre x 1000	Crop injury		Grass control		Lint yield
			Early	Late	Mid	Late	
					%	%	*lb/A*
Prepmaster glyphosate	4–6 WBP EPOT	53.22	2	2	96	96	1367
Prepmaster glyphosate	At planting EPOT	52.92	2	1	95	96	1333
Prepmaster - Treflan	4–6 WBP PPI	52.07	2	1	78	96	1352
Prepmaster - Treflan	At planting PPI	45.36	12	6	84	96	1329
Prepmaster - Prowl H2O	4–6 WBP PPI	53.64	2	2	77	96	1390
Prepmaster - Prowl H2O	At planting PPI	50.89	3	1	84	97	1375
Bed-roll Prowl H2O	4–6 WBP PRE	53.98	2	2	82	97	1388
Mean		51.73	4	2	85	96	1362
LSD		3.03	2	3	7	NS	NS

[1]Abbreviations: "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "At planting" — Prepmaster operation applied just before planting cotton; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "PRE" — preemergence herbicide applied after planting before the crop emerges; "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application; and "NS" — no significant differences between treatments.

than the fall no-tillage fb spring Prepmaster or Prowl PRE treatments (Table 3). Since there was no interaction of tillage with Prepmaster or Prowl PRE treatment, the gross returns and returns above total specified costs for all treatments were averaged over tillage systems. Returns above total specified costs ranged from $623 to $660 per acre, with no difference between Prepmaster and Prowl PRE treatments. Fuel costs for the subplot spring Prepmaster or Prowl PRE treatments were $2 per acre more with the fall conventional tillage than with the fall no-tillage (Table 4). Labor cost for the spring Prepmaster or Prowl PRE subplot treatments with the conventional tillage were $1 to $2 per acre more than with the fall no-tillage system. These results indicated fall conventional tillage had no economic advantage over fall no-tillage, and the Prepmaster could be used as a one-pass land-preparation implement in combination with a preplant-incorporated herbicide.

Stoneville — Rainfall during the growing seasons from 2007 to 2009 was highly variable (Table 5). In 2007, rainfall was below the 30-year average (1971–2000) for April, May, and June and above average for July, August, and September. In 2008, rainfall was below average for June and July and above average for April, May, August, and September. In 2009, below-average rainfall occurred in April, June, and August with above-average rainfall in May, July, and September.

With regard to plant population and weed control, there were no interactions of tillage system with Prepmaster or Prowl PRE. Therefore, data were pooled and reanalyzed (Table 6). Plots had light to moderate infestations of pitted morningglory, Palmer amaranth, and barnyardgrass. There were differences in midseason weed control (MPOT glyphosate application stage) for Prepmaster and Prowl PRE treatments. Prepmaster fb EPOT glyphosate application resulted in excellent control (87–94%) of pitted morningglory, Palmer amaranth, and barnyardgrass. Weed control across all weed species was higher than Prepmaster-preplant-herbicides or Prowl PRE treatments, which did not receive the EPOT glyphosate application, and only provided 16–73% control for all three species. However, at harvest all treatments were 96–97% weed-free, with no differences among Prepmaster or Prowl PRE treatments. Early-season crop stunting injury occurred only in 2009 (data not shown) and ranged from 3–8%. Treflan incorporated 4–6 WBP resulted in the highest crop stunting injury (8%), with no late-season crop injury. Plant populations ranged from 42,350 to 43,270 plants per acre, with no differences among treatments. These

Table 3. Total specified costs and returns above total specified costs for tillage and Prepmaster-herbicide systems, Verona, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide	Total specified cost		Gross returns	Returns[2]
		Fall conv. till	Fall no-till		
		$/A	*$/A*	*$/A*	*$/A*
Prepmaster glyphosate	4–6 WBP EPOT	114	105	752	642
Prepmaster glyphosate	At planting EPOT	114	105	733	623
Prepmaster - Treflan	4–6 WBP PPI	105	96	744	643
Prepmaster - Treflan	At planting PPI	105	96	731	630
Prepmaster - Prowl H2O	4–6 WBP PPI	108	99	764	660
Prepmaster - Prowl H2O	At planting PPI	108	99	756	652
Bed-roll Prowl H2O	4–6 WBP PRE	107	98	763	660
Mean		109	100	749 (NS)	645 (NS)

[1]Abbreviations: "Conv. till" — conventional tillage (Paratill + bed-roller) applied in the fall; "No-till" — no tillage applied in the fall; "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "At planting" — Prepmaster operation applied just before planting cotton; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "PRE" — preemergence herbicide applied after planting before the crop emerges; "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application; and "NS" — no significant differences between treatments.
[2]Returns above total specified cost.

Table 4. Fuel and labor costs for tillage and spring Prepmaster-herbicide systems, averaged over years (2007–2009), Verona, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide application	Fuel cost		Labor cost	
		Fall conv. till	Fall no-till	Fall conv. till	Fall no-till
		$/A	*$/A*	*$/A*	*$/A*
Prepmaster glyphosate	4–6 WBP EPOT	9	7	7	6
Prepmaster glyphosate	At planting EPOT	9	7	7	6
Prepmaster - Treflan	4–6 WBP PPI	9	7	7	5
Prepmaster - Treflan	At planting PPI	9	7	7	5
Prepmaster - Prowl H2O	4–6 WBP PPI	9	7	7	5
Prepmaster - Prowl H2O	At planting PPI	9	7	7	5
Bed-roll Prowl H2O	4–6 WBP PRE	9	7	6	5
Mean		9	7	7	5

[1]Abbreviations: "Conv. till" — conventional tillage (Paratill + bed-roller) applied in the fall; "No-till" — no tillage applied in the fall; "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "At planting" — Prepmaster operation applied just before planting cotton; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "PRE" — preemergence herbicide applied after planting before the crop emerges; and "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application.

Table 5. Monthly rainfall from April through September in 2007, 2008, and 2009, Stoneville, Mississippi.

Day	April	May	June	July	Aug.	Sept.	Total
	in	*in*	*in*	*in*	*in*	*in*	*in*
				2007			
1-10	0.22	1.18	0.24	5.58	0.00	1.24	8.46
11-20	2.42	0.59	2.13	1.95	0.00	2.14	9.23
21-30	0.74	0.00	1.18	0.21	3.43	0.51	6.07
Total	**3.38**	**1.77**	**3.50**	**7.74**	**3.43**	**3.89**	**23.76**
				2008			
1-10	5.69	0.96	0.25	0.52	1.05	10.44	18.91
11-20	0.41	2.86	0.00	0.60	4.46	1.74	10.07
21-30	1.88	3.07	0.17	0.52	0.52	0.00	6.16
Total	**7.98**	**6.89**	**0.42**	**1.64**	**6.03**	**6.16**	**35.14**
				2009			
1-10	1.21	6.19	0.16	0.89	0.74	0.00	9.19
11-20	2.69	2.70	0.00	3.83	0.00	4.31	12.53
21-30	0.07	4.62	0. 11	4.01	0.68	0.75	10.24
Total	**2.97**	**13.51**	**0.27**	**8.23**	**1.42**	**5.06**	**31.96**
30 yr. avg. (1971–2000)	**5.44**	**5.25**	**4.02**	**3.86**	**2.05**	**3.19**	

Table 6. Plant population and weed control averaged over tillage system and years; lint yield averaged over years (2007–2009), Stoneville, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide application	Plants per acre x 1000	Midseason control			Pct. weed free[2]	Lint yield	
			Pitted morningglory	Palmer amaranth	Barnyard-grass		Conv. till	Fall no-till
			%	%	%	%	*lb/A*	*lb/A*
Prepmaster glyphosate	4–6 WBP EPOT	42.35	87	90	89	97	1139	1172
Prepmaster glyphosate	At planting EPOT	43.27	93	92	94	97	1084	1090
Prepmaster - Treflan	4–6 WBP PPI	42.54	24	16	19	96	1163	1060
Prepmaster - Treflan	At planting PPI	42.77	54	36	70	97	1158	1032
Prepmaster - Prowl H2O	4–6 WBP PPI	42.64	27	35	65	96	1094	1081
Prepmaster - Prowl H2O	At planting PPI	42.78	39	20	69	96	1089	1046
Hip-roll Prowl H2O	4–6 WBP PRE	42.95	25	37	73	96	1103	1084
Mean		42.76	50	47	68	97	$LSD_{0.05}$ within/across	68
		NS	19	15	18	NS		

[1]Abbreviations: "Conv. till" — conventional tillage (fall subsoil + hip [bed] followed by spring rehip followed by a roller) applied each fall; "No-till" — no tillage applied in the fall; "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "At planting" — Prepmaster operation applied just before planting; "PRE" — preemergence herbicide applied after planting before the crop emerges; "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application; and "NS" — no significant differences between treatments.
[2]Percent weed free at harvest.

results are in contrast to reported stand establishment problems with no-till cotton production (Colyer and Vernon 1993; Hicks et al. 1989; Stevens et al. 1992).

Lint yields ranged from 1,032 to 1,172 pounds per acre, and tillage did interact with Prepmaster and Prowl PRE treatment (Table 6). The fall no-tillage fb Prepmaster (no Treflan or Prowl) applied 4–6 WBP fb EPOT glyphosate had the highest numerical yield (1,172 pounds per acre). However, it was not different from conventional tillage fb Prepmaster-Treflan incorporated 4–6 WBP or at planting, and it was not different from the conventional tillage fb Prepmaster 4–6 WBP fb EPOT glyphosate. Conventional tillage fb Prepmaster-Treflan incorporated either 4–6 WBP or at planting produced higher yields than conventional tillage fb Prepmaster-Prowl at planting, fall no-tillage fb Prepmaster-Prowl 4–6 WBP or at planting, fall no-tillage fb Prepmaster-Treflan incorporated either 4–6 WBP or at planting, conventional tillage fb Prepmaster at planting fb EPOT glyphosate, and fall no-tillage fb spring hip and roll fb Prowl PRE. However, observed yields were not different from conventional tillage fb spring hip and roll fb Prowl PRE, conventional tillage fb Prepmaster-Prowl applied 4–6 WBP, or fall no-tillage fb Prepmaster at planting. All Prepmaster treatments, except Prepmaster-Treflan treatments, resulted in no significant yield differences between tillage systems. These results are in contrast with reports in the literature of higher cotton yields from in-row subsoiling (Wesley et al. 2001) and reduced or equivalent yields for conventional systems compared with no-tillage (Bauer and Busscher 1996; Brown et al. 1985; Stevens et al. 1992).

Total specified cost for conventional tillage fb Prowl PRE or Prepmaster treatments ranged from $126 to $139 per acre (Table 7). Conventional tillage fb Prowl PRE had the lowest total specified cost ($126 per acre). This amount was higher than total specified costs for fall no-tillage fb Prowl PRE or Prepmaster treatments, which ranged from $96 to $105 per acre. These results indicated a reduction of $28 to $34 per acre in total specified costs for fall no-tillage fb spring Prepmaster or Prowl PRE treatments. Fall no-tillage fb Prepmaster applied 4–6 WBP fb EPOT glyphosate had

Table 7. Total specified costs and returns above total specified costs for tillage and Prepmaster-herbicide systems, averaged over years (2007–2009), Stoneville, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide application	Total specified cost		Returns[2]	
		Conv. till	Fall no-till	Conv. till	Fall no-till
		$/A	*$/A*	*$/A*	*$/A*
Prepmaster glyphosate	4–6 WBP EPOT	139	105	488	539
Prepmaster glyphosate	At planting EPOT	139	105	457	495
Prepmaster - Treflan	4–6 WBP PPI	130	96	510	487
Prepmaster - Treflan	At planting PPI	130	96	507	472
Prepmaster - Prowl H2O	4–6 WBP PPI	133	99	469	495
Prepmaster - Prowl H2O	At planting PPI	133	99	466	476
Hip-roll Prowl H2O	4–6 WBP PRE	126	98	481	498
Mean		133	114	483	494
				LSD .05	37
				Within/across	

[1]Abbreviations: "Conv. till" — conventional tillage (fall subsoil + hip [bed] followed by spring rehip followed by a roller) applied each fall; "No-till" — no tillage applied in the fall; "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "At planting" — Prepmaster operation applied just before planting; "PRE" — preemergence herbicide applied after planting before the crop emerges; and "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application.
[2]Returns above total specified cost.

the highest returns above total specified costs ($539 per acre). This amount was higher than all other treatments, except conventional tillage fb Prepmaster-Treflan applied either 4–6 WBP or at planting (Table 7). However, conventional tillage fb Prepmaster-Treflan 4–6 WBP or at planting treatments were different only from conventional tillage fb Prepmaster-Prowl applied 4–6 WBP or at planting, as well as and conventional tillage fb Prepmaster applied at planting fb EPOT glyphosate. Conventional tillage fb Prowl PRE or Prepmaster treatments also resulted in $11 per acre more fuel cost and $4 to $6 per acre more labor cost than the fall no-tillage fb Prepmaster or Prowl PRE treatments (Table 8). These results are in contrast with reports in the literature that returns for in-row subsoiling were higher than reduced tillage (Wesley et al. 2001).

Table 8. Fuel and labor costs for tillage and spring Prepmaster-herbicide systems, averaged over years (2007–2009), Stoneville, Mississippi.[1]

Spring preplant tillage/herbicide	Herbicide application	Fuel cost		Labor cost	
		Fall conv. till	Fall no-till	Fall conv. till	Fall no-till
		$/A	*$/A*	*$/A*	*$/A*
Prepmaster glyphosate	4–6 WBP EPOT	18	7	11	6
Prepmaster glyphosate	At planting EPOT	18	7	11	6
Prepmaster - Treflan	4–6 WBP PPI	18	7	11	5
Prepmaster - Treflan	At planting PPI	18	7	11	5
Prepmaster - Prowl H2O	4–6 WBP PPI	18	7	11	5
Prepmaster - Prowl H2O	At planting PPI	18	7	11	5
Hip-roll Prowl H2O	4–6 WBP PRE	18	7	9	5
Mean		18	7	11	5

[1]Abbreviations: "Conv. till" — conventional tillage (fall subsoil + hip [bed] followed by spring rehip followed by a roller) applied each fall; "No-till" — no tillage applied in the fall; "4–6 WBP" — preplant tillage (Prepmaster or bed-roller) performed 4 to 6 weeks before planting; "PPI" — herbicide applied and incorporated with the Prepmaster at 6 mph, 4–6 WBP; "At planting" — Prepmaster operation applied just before planting; "PRE" — preemergence herbicide applied after planting before the crop emerges; and "EPOT" — early (1- to 3-leaf cotton) postemergence herbicide application.

Conclusion

Conventional tillage at both locations demonstrated no economic advantage over fall no-tillage. The Prepmaster herbicide incorporator implement can be used successfully alone or to incorporate Prowl or Treflan herbicides as a one-pass operation, 4–6 WBP, or at planting on light-textured soils, such as sandy loam, loam, and silt-loam soils. This one-pass operation reduces input costs by $34 per acre and forms a uniform bed to plant on without additional tillage. However, this operation needs to be performed 3–4 weeks after a burndown herbicide has been applied and 4–6 WBP or at planting. With light to moderate weed infestations, preplant-incorporated herbicides may also substitute for an EPOT glyphosate application in a Roundup Ready Flex cotton weed management program without a negative effect on late-season weed control or yield. The Prepmaster-Treflan system also may be used as part of an intensive weed management system for controlling glyphosate-resistant Palmer amaranth, which is becoming a major problem in the Mississippi Delta.

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