Assessing the Value of Pre-Plant and Post-Plant Tillage for Full-Season Soybeans on Clayey and Silt Loam Soils

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Abstract

Studies were conducted in 1992, 1993, and 1994 on Sharkey silty clay and Calloway-Loring-Henry silt loam soil. Pre-plant tillage consisted of disking once or twice with a finishing disk harrow and following this operation with a Do-All. Post-plant tillage consisted of plowing with a cultivator as necessary to control weeds or to break up soil crusting. The treatment design was 2 x 2 factorial with pre-plant tillage or no-till prior to planting and with post-plant tillage. No interaction was found between pre-plant and post-plant tillage. Neither pre-plant nor post-plant tillage affected the yield on Sharkey clay. Both pre-plant and post-plant tillage affected the yield on the Calloway-Loring-Henry silt loam during a dry growing season, pre-plant tillage having four times the effect of post-plant tillage. During a wet season, neither pre-plant nor post-plant tillage affected yields on the Calloway-Loring-Henry soil.

Introduction

Many experiments have been performed in which no-till production systems are contrasted with tilled systems. These production systems are compared in total usually to decide which are the most profitable. Compliance with the Farm Bill has also impacted on adaptation of reduced tillage. On soils that have a poor internal drainage or impermeable layers close to the surface (less than 22 inches deep), pre-plant tillage that produces a surface mulch may conserve soil moisture by preventing conductance to the soil surface and subsequent evaporation. This would be especially true in regions of the humid South. In the spring, soils such as those described above will have a profile that is full of water. It is conceivable that a surface mulch of dead plant debris could have the same moisture-conserving effect as pre-plant tillage. A similar moisture conservation scenario could also be operational after planting.

Other than moisture loss, soil compaction, infiltration, and aeration may be impacted by tillage. The infiltration rate of swelling clay or crusting silt loam soils may be increased dramatically by mechanical plowing or cultivation. Surface mulches also can be a contributing factor for increased infiltration (Langdale et al., 1994). Aeration is also a factor that may limit plant root growth and moisture uptake. Poor root growth could also be the result of soil density or compaction that can be ameliorated by tillage operations. The basic question of the value of pre-plant and post-plant tillage is difficult to address. The objective of the studies in this report was to assess the effect of conventional flat seedbed preparation and post-plant tillage on soybean production on a Sharkey silty clay and Loring-Calloway-Henry silt loam soil.

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Materials and Methods

Experiments were conducted in 1992, 1993, and 1994 at the Northeast Research and Extension Center ((NEREC), Keiser, AR; in 1992 and 1993 at Cotton Branch Experiment Station (CBES), Marianna, AR; and in 1994 at Pine Tree Experiment Station, (PTES) Colt, AR. Main plots were pre-plant tillage, and subplots were post-plant cultivation. Pre-plant tillage consisted of disking once or twice with a finishing disk and following the disking operation with a Do-All. Post-plant tillage consisted of cultivating as necessary to control weeds or break up soil crusts.

The treatment design was a 2 x 2 factorial of pre-plant (yes or no) and post-plant (yes or no) tillage. Selected cultural practices and site characteristics are described in Table 1.

Grain yields were adjusted to 13% moisture. Costs and profits were estimated using the Mississippi State University budget generator (Spurlock, 1992) and a soybean price of $6.02/bu. Component analysis for various crop inputs is obtained by using no-till as the base. The addition of a component is then calculated by averaging over all treatments where one tillage component is added to the system.

Results and Discussion

Yield results obtained from the duration of the study are presented in Table 2. It should be pointed out 1992 and 1994

Table 1. Selected site characteristics, cultural practices, and temporal log for tillage experiments at NEREC, Keiser; CBES, Marianna; and PTES, Colt.

	Soil Type	
	Sharkey[1] silty clay	**Loring-Calloway-Henry[2] silt loam**
Planting Date	(1) 6/24/92 (2) 5/26/93 (3) 5/23/94	(1) 6/18/92 (2) 5/27/93 (3) 5/19/94
Conventional Seedbed Preparation	(1) 6/24/92 (2) 5/26/93 (3) 5/20/94	(1) 6/16/92 (2) 5/27/93 (3) 5/19/94
Chemical Burndown[3]	(1) 6/24/92 (2) 5/26/93 (3) 5/20/94	(1) 6/16/92 (2) 5/29/93 (3) 5/19/94
Variety	1992 - Asgrow A5403 1993 - Pioneer P9592 1994 - Northrup King S5960	1992 - Asgrow A5403 1993 - Northrup King S5960 1994 - Northrup King S5960
Seeds/row-foot	3-5	3-5
Harvest Date	(1) 10/29/92 (2) 10/27/93 (3) 11/04/94	(1) 10/19/92 (2) 10/26/93 (3) 11/23/94

[1] 3 years same location NEREC, Mississippi County
[2] 2 years Lee County plus 1 year St. Francis County
[3] Burndown was with Roundup at 1.5 pt/A of 4.7 lb. ai/gal formulation.

were years of adequate moisture, and 1993 was an extremely dry growing season. Under dryland conditions, a significant pre-plant tillage-by-year interaction was found on the silt loam soil but no interaction was measured on the silty clay.

Three-year average economic returns for each treatment combination are presented in Table 3. Production costs generally increase as tillage inputs increase. However, profits are decreased with the increased tillage at NEREC on the silty clay soil.

A component analysis is presented in Table 4. It is informative to note the loss in profit associated with pre- and post-plant tillage at NEREC. These data strongly suggest that shallow pre-plant and post-plant tillage does not improve crop yields on clay soils. Shallow tillage operations may be desirable for surface smoothing, low-cost weed control, herbicide incorporation, etc., none of which are included in the scope of this study.

On a silt loam soil, pre-plant tillage usually was the most profitable practice, (Table 4). In 1993, an extremely dry year, one trip with a disk and Do-All increased profits dramatical-

Table 2. Pre- and post-plant tillage effects on soybean *grain* yield on Sharkey and Loring-Calloway-Henry soils.

		Tillage					
		Re-plant			Post-Plant		
Location	**Year**	**Yes**	**No**	**Diff.**	**Yes**	No	**Diff.**
		bu/A					
Sharkey silty clay	1992-94	48.1	48.9	0.8	48.4	48.7	0.3
Loring-Calloway-Henry silt loam	1992	30.0	28.1	1.9	30.2	28.0	2.2
	1993	26.8	15.9	10.9	22.6	20.0	2.6
	1994	37.2	36.6	0.6	36.7	37.0	–0.3
	1992-94	31.1	27.0	4.1	29.9	28.1	1.8

Table 3. Economic returns[1] based on 3-year average yield estimated for various tillage regimes for soybeans.

Tillage	**Replant**	**Yes**		No	
	Post-plant	**Yes**	**No**	**Yes**	No
		Sharkey silty clay			
Operating Cost[2]		$ 64.19	$ 61.58	$ 58.43	$ 56.55
Total Cost[3]		92.90	87.83	82.97	78.63
Profit[4]		$194.25	$202.95	$210.81	$217.13
		Loring-Calloway-Henry silt loam			
Operating Cost		$ 59.25	$ 56.33	$ 57.30	$ 57.16
Total Cost		87.86	82.30	80.97	78.20
Profit		$103.99	$102.69	$ 86.20	$ 77.89

[1] No charge was issued for land, risk, overhead labor, other overhead, crop insurance, real estate taxes, and management.
[2] Operating costs are taken from published crop production budgets with modifications to reflect changed production practices.
[3] Total costs are taken from published crop production budgets with modifications to reflect changed production practices.
[4] Profit computed as soybean yield times $6.02/bu minus total costs. This price selected as the average from 1981-1990 over the last 10 years for Arkansas.

ly, (Table 5). This indicates the importance of pre-plant tillage on these soils during dry, growing seasons. During the wet season of 1992 and 1994, tillage made no difference. Tillage could help stabilize yields on these soils. Additionally, in this study only 1 year in 3 was dry. If 3 years in 5 were droughty, then tillage could be even more profitable.

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Table 4. Component analysis1 for pre- and post-plant tillage operations for 3-year average yield.

	Yield bu	Operating Cost[2]	Total Cost[3]	Profit[4]
		$/A		
Sharkey silty clay				
Base = No Tillage	49.1	56.55	78.63	217.13
Add Pre-plant Tillage	(0.8)	5.03	9.20	(14.20)
Add Post-plant Tillage	(0.6)	2.61	5.07	(8.68)
Add Both Pre- & Post-Plant Tillage	47.7	64.19	92.90	194.25
Loring- Calloway-Henry silt loam				
Base = No Tillage	25.9	57.76	78.20	77.89
Add Pre-plant Tillage	1.2	2.92	5.36	1.30
Add Both Pre- & Post-Plant Tillage	31.9	59.25	87.86	103.99

[1] No charge was issued for land, risk, overhead labor, other overhead, crop insurance, real estate taxes, and management.
[2] Operating costs are taken from published crop production budgets with modifications to reflect changed production practices.
[3] Total costs are taken from published crop production budgets with modifications to reflect changed production budgets with modifications to reflect changed production practices.
[4] Profit computed as soybean yield times $6.02/bu minus total costs. This price selected as the average from 1981-1990 over the last 10 years for Arkansas.

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2. Spurlock, S.R. 1992. Mississippi State. University budget generator. Miss. St. Univ. Agric. Econ. Tech. Publ. No. 88.

Table 5. Component analysis[1] for pre- and post-plant tillage operations.

	Loring-Calloway-Henry silt loam			
	Yield (bu)	Operating Cost[2]	Total Cost[3]	Profit[4]
Adequate Moisture Crop Year 1992				
Base No-Tillage	26.5	$ 52.74	$74.38	$ 85.15
Add Pre-plant Tillage	1.9	1.97	7.35	4.09
Add Post-plant Tillage	2.4	1.49	4.83	9.62
Add Both Pre- & Post-Plant Tillage	30.8	$56.20	$86.56	$ 98.86
Drought Crop Year 1993				
Base No-Tillage	13.7	$54.39	$74.34	$ 6.14
Add Pre-plant Tillage	11.0	(8.55)	(7.02)	83.46
Add Post-plant Tillage	2.7	(3.66)	(2.19)	(2.03)
Add Both Pre- & Post-Plant Tillage	21.4	$42.18	$67.13	$ 87.57
Adequate Moisture Crop Year 1994				
Base No-Tillage	37.6	$66.01	$85.83	$140.34
Add Pre-plant Tillage	(1.2)	(2.53)	1.52	(8.69)
Add Post-plant Tillage	1.5	1.89	3.13	6.02
Add Both Pre- & Post-Plant Tillage	37.9	$65.37	$90.48	$137.67

[1] No charge was issued for land, risk, overhead labor, other overhead, crop insurance, real estate taxes, and management.
[2] Operating costs are taken from published crop production budgets with modifications to reflect changed production practices.
[3] Total costs are taken from published crop production budgets with modifications to reflect changed production practices.
[4] Profit computed as soybean yield times $6.02/bu minus total costs. This price selected as the average from 1981-1990 over the last 10 years for Arkansas.