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Tillage and Weed Control Practices in Soybeans Grown on Sharkey Clay Soil

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Summary

Centennial soybeans were grown in 40-inch rows in 1978, 1979 and 1980 on Sharkey clay soil in plots that were either disked (3 to 4 inches deep), chisel plowed (4 to 5 inches deep) or superchisel plowed (7 to 8 inches deep) in the fall or spring before planting and treated with preplant herbicides. Soybean yields were 3.7 to 4.7 bu/acre lower on the spring-chisel or superchisel plowed plots than on plots that were fall or spring disked or fall chiseled in 1979. There were no significant differences in 1978 or 1980. A preplant incorporated fall application of trifluralin + metribuzin at 1.25 + 1.5 lb/acre gave about 12% less control of annual grasses than did preplant spring-applied treatments of paraquat + metribuzin or paraquat + metribuzin + alachlor. There were no consistent yield differences among the herbicide treatments during the three-year period.

Fall disking, chiseling or superchiseling followed by none, one or two diskings before planting indicated that method of fall tillage did not affect soybean yield. Yield response from the number of spring diskings was inconsistent. Soybean yields in 1978 averaged about 2.5 bu/acre more following one or two spring diskings than following no spring disking, while average yields were about 4 bu/acre less following one or two diskings in 1979.

A comparison of 12 different herbicide combinations applied in the spring before planting soybeans indicated that mixtures containing cyanazine were less effective for control of annual weeds than were mixtures containing metribuzin in two of three years. However, the mixture of paraquat + cyanazine + alachlor was as effective as were the mixtures containing metribuzin. There were no consistent soybean yield differences among the herbicide treatments.

Yields from soybeans planted without seedbed preparation in soybean stubble after treatment with any one of six different herbicide mixtures applied in the spring before planting were equal to or greater than yields from plots that were chisel plowed in the fall and treated preplant soil incorporated with trifluralin + metribuzin in the spring. Soybeans stubble-planted in 1980 (a dry year) produced higher yields than did any other tillage treatment in any of the four tests conducted.

More than 50% of the Delta of Mississippi is composed of clay (buckshot, gumbo) soils; Sharkey, Alligator and Dowling series (8). Problems associated with managing these soils for soybean production include providing surface and internal drainage and keeping the soils in a condition suitable for planting. The primary objective of preplant tillage is to provide a seedbed to insure a stand.

Pettiet (3) reported that soil acidity and compaction were primary contributors to restricted cotton and soybean plant growth on drought-prone silt loam and silty clay loam soils with a history of low yields.

Deep tillage (subsoiling, chiseling) is a common practice for many cotton producers. Tupper (6) recently reported a two-year average of 8.1 bu/acre soybean yield increase from chisel plowing a silty clay soil in early March before planting soybeans in mid-May. Yield response to tillage of heavy clay soils has been less encouraging. Heatherly (1) was unable to demonstrate soybean yield differences between disking, shallow chiseling (6 inches), deep chiseling (12 inches) or subsoiling (18 to 20 inches) Sharkey clay soil in the spring before planting.

Crop yield increases attributed to deep tillage usually have been in response to increased water intake by the soil profile (6). A parabolic subsoiler and chisel plow to permit deep (16 to 18 inches) and shallow (5 to 10 inches) tillage with reduced energy requirements was designed by Tupper (4, 5). More recently a parabolic super chisel was designed to provide 7- to 14-inch tillage (7). The super chisel was designed to decrease the soil lift problem of the parabolic subsoiler on heavy clay soils, thereby resulting in smaller clods that are more easily broken up for a suitable seedbed.

Four tests were conducted to evaluate soybean and weed response to (1) fall and spring tillage methods with herbicide treatments superimposed, (2) fall tillage method and number of spring diskings followed by a common spring herbicide treatment, (3) conventional fall tillage and several spring-applied preplant herbicides and (4) conventional fall tillage plus a spring preplant, soil-incorporated herbicide treatment compared to several preplant spring-applied treatments with no fall or preplant tillage.

Materials and Methods

The four tests were conducted in the same area of a field of Sharkey clay soil (6.0, 27.6, 66.4 and 1.7% sand, silt, clay and organic matter, respectively, pH 6.1) in 1978, 1979 and 1980. Soybeans had been grown on the area before the tests. The fall treatments were initiated in 1977. Table 1 describes the experimental design, number of replications, treatment composition and abbreviations of treatments for each of the four tests. All treatments except trifluralin + metribuzin were applied with 0.5% (v/v) X-77® surfactant. Tillage, herbicide application, planting and harvest dates by test are listed in Table 2. An experimental unit consisted of four 40-inch-wide rows 50 ft long. Each test was cultivated three or four times during each growing season to a 14-inch band centered on the row.

Disking and herbicide incorporation were accomplished with a 14-ft tandem disk harrow equipped with 18-inch disc blades set to disk 3 to 4 inches deep. The parabolic chisel (or the parabolic super chisel) was operated perpendicular to row direction in Tests 1 and 3 and parallel to the row direction in Tests 2 and 4. Chiseling depth was 4 to 5 inches and the super chiseling depth was 7 to 8 inches. A bed conditioner was used on all plots just ahead of the planter in Tests 1, 2 and 3. Centennial soybeans were planted 1.5 to 2.5 inches deep at a seeding rate of 50 lb/acre, using a planter equipped with double-disk openers.

All herbicides were applied as tank mixes and broadcast in 20 gal water/acre. Percentage weed control (0 = none, 100 = excellent) and soybean stand (calculated from the number of plants in 10 ft of row from the center two rows of each plot) were determined four weeks after soybean planting. Weed counts by species were made on March 20 just before the spring tillage and herbicide treatments in 1978. Only the major species were counted in 1979 and 1980. Plots were combine-harvested for yield determination, and recorded yields were adjusted to 13% moisture. The weight of 100 seed was determined within three weeks after harvest.

Table 1. Description of tests 1 through 4 conducted on Sharkey clay soil, MAFES Delta Branch, 1978, 1979 and 1980.

Test No.	Experimental Design	No. Reps.	Treatment Composition					
1	Split plot	5	Main plots		Subplots			
			Tillage	Abbr.	Herbicides	Rate-lb/A	Time applied	Abbr.
			Disk - Fall	D-F	Trifluralin + metribuzin	1.25 + 1.5	Fall	TMF[1]
			Disk - Spring	D-S	Paraquat + metribuzin	0.5 + 0.75	Early spring	PMES[2]
			Chisel - Fall	C-F	Paraquat + metribuzin	0.5 + 0.75	Late spring	PMLS[2]
			Chisel - Spring	C-S	Paraquat + metribuzin	0.5 + 0.75		
			Super chisel - Fall	SC-F	+ alachlor	+ 2.5	Early spring	PMAES[2]
			Super chisel - Spring	SC-S	Paraquat + metribuzin + alachlor	0.5 + 0.75 + 2.5	Late spring	PMALS[2]
2[3]	Split plot	6	Main Plots		Subplots			
			Fall tillage	Abbr.	Number spring diskings			
			Disk	D	0			
			Chisel	C	1			
			Super chisel	SC	2			

Continued

Table 1. (Continued)

Test No.	Experimental Design	No. Reps.	Treatment Composition		
			Treatment[2]		
3[4]	Randomized complete block	6	Herbicide	Rate-lb/A	Abbr.
			paraquat + metribuzin	0.5 + 0.75	PM
			paraquat + cyanazine	0.5 + 1.8	PC
			paraquat + metribuzin + alachlor	0.5 + 0.75 + 2.5	PMA
			paraquat + cyanazine + alachlor	0.5 + 1.8 + 2.5	PCA
			glyphosate + metribuzin	1.0 + 0.75	GM
			glyphosate + cyanazine	1.0 + 1.8	GC
			glyphosate + metribuzin + alachlor	1.0 + 0.75 + 2.5	GMA
			glyphosate + cyanazine + alachlor	1.0 + 1.8 + 2.5	GCA
			2,4-D + metribuzin	1.0 + 0.75	2M
			2,4-D + cyanazine	1.0 + 1.8	2C
			2,4-D + metribuzin + alachlor	1.0 + 0.75 + 2.5	2MA
			2,4-D + cyanazine + alachlor	1.0 + 1.8 + 2.5	2CA
			cultivated check	----	U
			Treatment Composition		
4	Randomized complete block	5	Herbicides	Rate lb/A	Abbr.
			paraquat + metribuzin	0.5 + 0.75	PM[2]
			glyphosate + metribuzin	1.0 + 0.75	GM[2]
			2,4-D + metribuzin	1.0 + 0.75	2M[2]
			paraquat + metribuzin + alachlor	0.5 + 0.75 + 2.5	PMA[2]
			glyphosate + metribuzin + alachlor	1.0 + 0.75 + 2.5	GMA[2]
			2,4-D + metribuzin + alachlor	1.0 + 0.75 + 2.5	2MA[2]
			trifluralin + metribuzin	1.0 + 0.50	TM[5]

[1]Applied in the fall and double-disked incorporated - two passes in opposite directions.

[2]Applied preplanting in the spring over-the-top to existing weed cover.

[3]Entire test was treated preplanting with a mixture of paraquat + metribuzin + alachlor at 0.5 + 0.75 + 2.5 lb/A.

[4]Test area was chisel plowed and double-disked in the fall.

[5]Applied preplanting in the spring and double-disked incorporated - two passes in opposite directions. Plot was chiseled plowed in the fall parallel to row direction.

Table 2. Tillage, herbicide application, planting and harvest dates and test number, MAFES Delta Branch, 1978, 1979 and 1980.

Practice	Test number[1/]	Year 1978	1979	1980
		Dates		
Tillage				
Fall (F)	1 thru 4	Nov. 15,1977	Nov. 4, 1978	Nov. 21, 1979
Spring (S)	1	Mar. 23	Apr. 21	Feb. 22
	2	Mar.23, Apr.21	Apr.21, May 15	Apr.8, Apr.22
Herbicide application				
Fall (F)	1 and 4	Nov. 15, 1977	Nov. 4, 1978	Nov. 21, 1979
Early Spring (ES)	1	Mar. 28	Apr. 21	Apr. 8
Late Spring (LS)	1	Apr. 20	May 15	Apr. 25
	2	Apr. 27	May 15	May 8
	3	Apr. 27	May 15	May 9
	4	Apr. 20	May 15	May 9
Planting	1 thru 4	May 19	June 11	June 2
Harvest	1 thru 4	Oct. 31	Oct. 25	Nov. 12

1/ See Table 1 for test description.

Results

Weed populations. The major winter weeds in all tests were buttercup in 1978, little barley in 1979 and both in 1980 (Table 3). The fall-tilled plots in Test 1 had about 90% fewer weeds in 1978 and 1979 and 37 to 97% fewer weeds in 1980 than did the spring-tilled plots. There were fewer weeds in the fall-disked plots than in the fall-chiseled or fall-super chiseled plots each year in Tests 1 and 2. The treatments in Test 4 that did not receive fall tillage had nearly 10 times more weeds than the treatment that was chisel plowed the previous fall. The counts were made before spring tillage; therefore, the above differences actually compared fall tillage to no tillage from the previous fall to mid-March of each year.

Table 3. Major winter weeds by test number, MAFES Delta Branch, 1978-80.

Test number[1/]	Year and major weed			
	1978	1979	1980	
	Buttercup	Little barley	Buttercup	Little barley
	No./3 ft^2			
Test 1				
Tillage Plot				
DF	1.6	3.2	0.2	0.1
DS	28.8	21.8	6.8	2.4
CF	12.8	9.6	1.6	2.4
CS	82.4	71.2	10.6	8.9
SCF	7.8	8.2	3.2	4.6
SCS	83.8	91.6	12.2	10.8
Test 2				
D	2.1	4.1	0.7	0.3
C	13.5	17.5	5.2	3.6
SC	9.7	11.2	3.5	2.8
Test 3				
Entire area Average	1.1	4.1	0.3	0.4
Test 4				
Fall Chisel Plot	8.7	10.8	2.2	3.2
All other plots	89.1	110.3	14.3	11.2

[1/] See Table 1 for test description.

Data are not shown on an individual plot basis, but the fall-applied treatment of trifluralin + metribuzin in Test 1 controlled the winter weeds each year. The summer weeds were seedling johnsongrass, barnyardgrass, hemp sesbania, prickly sida and morningglory. Johnsongrass increased in severity during the three-year period in plots that were not treated with trifluralin or alachlor. Prostrate knotweed increased in plots in Test 1 where trifluralin + metribuzin was applied in the fall.

All herbicides applied preplant to weeds provided effective control of the winter vegetation. Paraquat combinations gave effective foliage burn down within four to five days while about two weeks were required for the glyphosate or 2, 4-D mixtures to control weeds. 2, 4-D was less effective on little barley than was paraquat or glyphosate.

Test 1 - Fall and spring tillage and herbicides. Summer annual weed control did not differ among tillage treatments in any year (Table 4). Fall-applied trifluralin + metribuzin gave good control but less than that provided by the spring-applied preplant treatment combinations in 1979 and 1980. Paraquat + metribuzin and paraquat + metribuzin + alachlor applied preplant in late spring of 1978 gave better control than did the other treatments. A soybean stand response occurred only in 1980 when the stand after spring chiseling was better than the stands in all other tillage treatments except spring super chiseling. All of the stands in 1980, however, were within the range necessary for maximum yield (2).

A yield difference due to tillage was obtained only in 1979. Both disking treatments and both fall chiseling treatments produced the highest yields. Spring chisel plowing reduced yields.

There were yield differences among the herbicide treatments each year, but the pattern was not consistent. Yields produced on the plots treated with a late-spring application of paraquat + metribuzin + alachlor in 1978 were higher than those produced from plots treated with an early spring application of paraquat + metribuzin or a fall application of trifluralin + metribuzin. Yields from the paraquat +metribuzin treatment applied in late spring were higher than from all other treatments in 1979. The trifluralin + metribuzin treatment applied in the fall resulted in lower yields in 1980 than did the paraquat + metribuzin treatment applied in early spring. However, the extremely low yields ($\leq$8.5 bu/acre)

and small yield differences between treatments ($\leq$1.4 bu/acre) in the dry year of 1980 tend to reduce the usefulness of the 1980 data.

Test 2 - Fall tillage and number of spring diskings. No "practical" weed control differences among fall tillage practices or number of spring diskings occurred any year. (Table 5). Soybean plant populations in 1979 were 8 to 12 thousand plants per acre higher in the plots with no spring disking than in plots with two diskings. All stands, however, bordered on the low side for optimum yields (2). Yields from the plots receiving no spring diskings were significantly lowest and highest in 1978 and 1979, respectively. Fall tillage method did not influence yield significantly.

Test 3 - Spring-applied preplant herbicides. All treatments gave better weed control than the cultivated check in 1978, 1979 and 1980 (Table 6). Weed control in 1979 and 1980 was significantly lower from treatments containing cyanazine than from those containing metribuzin, except for the combination of paraquat + cyanazine + alachlor.

There were no consistent soybean-stand differences among the treatments over the three-year period. Stands in 1979 were lower than desired for yield potential. All herbicide treatment means for soybean stand in 1980 were higher than for the cultivated check. The cultivated check also had significantly lower yields in 1978 (3 to 6 bu/acre) and 1980 (2 to 4 bu/acre). Yields in these two years were extremely low.

Table 4. Weed control, soybean stand, seed weight and soybean yield, by tillage and herbicide treatments, Test 1, MAFES Delta Branch, 1978-80.[1/,2/]

Item	Weed control			Soybean stand			Seed weight			Soybean yield		
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
	--%--			--1000 plants/Acre--			--g/100--			--bu/Acre--		
Tillage[2]												
D-F	91 a	96 a	94 a	153 a	58 a	73 bc	10.9 a	14.4 c	13.8 a	18.6 a	44.3 a	8.4 a
D-S	88 a	97 a	93 a	143 a	58 a	76 bc	10.8 a	14.5 bc	14.1 a	20.3 a	44.4 a	9.8 a
C-F	93 a	97 a	93 a	137 a	60 a	66 c	11.3 a	14.7 abc	13.9 a	19.4 a	44.2 a	8.2 a
C-S	94 a	97 a	93 a	145 a	57 a	112 a	10.9 a	15.1 a	14.0 a	19.4 a	39.7 b	8.4 a
SC-F	91 a	93 a	93 a	121 a	52 a	85 bc	11.0 a	14.9 abc	14.2 a	18.5 a	41.4 ab	9.7 a
SC-S	92 a	97 a	94 a	126 a	54 a	100 ab	10.9 a	14.9 ab	13.9 a	18.7 a	40.6 b	8.0 a
Herbicides[2]												
TM-F	88 b	82 b	85 b	138 a	58 a	82 a	17.0 a	14.8 a	13.8 a	18.1 c	41.7 b	7.1 b
PM-ES	88 b	99 a	94 a	134 a	60 a	80 a	11.0 a	14.8 a	13.9 a	18.7 bc	42.6 b	8.5 a
PM-LS	95 a	99 a	98 a	142 a	58 a	95 a	10.9 a	14.7 a	13.9 a	19.3 abc	44.3 a	8.3 ab
PMA-ES	91 b	99 a	94 a	133 a	58 a	85 a	11.0 a	14.6 a	14.2 a	19.6 ab	42.1 b	8.1 ab
PMA-LS	96 a	99 a	96 a	139 a	57 a	85 a	11.0 a	14.8 a	14.2 a	20.0 a	42.0 b	8.3 ab

[1]Means within columns followed by the same letter do not differ at P = 0.05.

[2]See Table 1 for test description and abbreviation meaning and Table 2 for dates.

Table 5. Weed control, soybean stand, seed weight and soybean yield, by fall tillage method and number of spring diskings, Test 2, MAFES Delta Branch, 1978-80.[1/,2/]

Item	Weed control			Soybean stand			Seed weight			Soybean yield		
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
	--%--			--1000 plants/Acre--			--g/100--			--bu/Acre--		
Tillage[2]												
D	91 b	95 a	93 a	129 a	55 a	71 b	10.1 a	15.1 a	13.6 a	18.2 a	42.6 a	8.3 a
C	94 a	57 a	95 a	126 a	53 a	87 a	10.2 a	15.3 a	13.4 a	16.6 a	41.2 a	8.3 a
SC	94 a	95 a	95 a	132 a	57 a	83 a	10.4 a	15.1 a	13.5 a	18.8 a	41.2 a	8.3 a
No. of Diskings												
0	89 b	95 a	92 a	125 a	62 a	73 a	10.1 a	14.9 b	13.7 a	16.3 b	44.1 a	8.7 a
1	95 a	96 a	96 a	131 a	54 b	87 a	10.1 a	15.3 a	13.4 a	18.7 a	40.5 b	8.7 a
2	96 a	95 a	96 a	130 a	50 b	80 a	10.4 a	15.3 a	13.4 a	18.5 a	40.3 b	7.5 a

[1]Means within columns followed by the same letter do not differ at P = 0.05.

[2]See Table 1 for test description and abbreviation meaning and Table 2 for dates.

Test 4 - Conventional fall tillage and incorporated herbicide versus herbicide treatments with no preplant tillage. Except in 1979 when trifluralin + metribuzin was not applied in the spring, all treatments provided 88 to 99% weed control (Table 7). Differences in soybean stands among treatments were not consistent, but there were differences between years. The 1978 stands were higher than those reported for maximum yields while stands in 1979 and 1980 were possibly too low (2).

Soybean yields were not different among treatments in 1978 or 1979. The conventionally treatment (fall chiseling + trifluralin + metribuzin incorporated in the spring) had lower yields in 1980 than did treatments with 2,4-D + metribuzin, 2,4-D + metribuzin + alachlor, and glyphosate + metribuzin + alachlor. There were no significant yield differences among the six treatments without preplant tillage.

Table 6. Weed control, soybean stand, seed weight and soybean yield, by preplanting herbicide treatments, Test 3, MAFES Delta Branch, 1978-80.[1,2]

Preplanting[3] herbicides	Weed control			Soybean stand			Seed weight			Soybean yield		
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
	--%--			--1000 plants/Acre--			---g/100---			---bu/Acre---		
PM	97 a	100 a	99 a	133 ab	43 ab	66 a	10.5 a	15.5 ab	13.3 b	11.0 ab	32.2 b	6.3 a
PC	90 a	83 c	88 b	125 ab	45 ab	55 a	10.7 a	15.5 ab	13.7 ab	8.4 b	31.6 b	4.7 ab
PMA	97 a	98 a	98 a	147 a	46 ab	71 a	10.7 a	15.2 b	13.7 ab	9.3 ab	34.6 ab	6.1 a
PCA	94 a	97 a	96 a	124 ab	54 a	67 a	10.5 a	14.9 b	13.6 ab	10.7 ab	41.2 a	5.4 ab
GM	97 a	98 a	97 a	142 ab	48 ab	68 a	10.5 a	15.0 ab	13.6 ab	10.7 ab	35.0 ab	5.0 ab
GC	92 a	85 c	86 b	120 ab	51 ab	70 a	10.7 a	14.9 b	13.6 ab	9.0 ab	37.9 ab	3.8 b
GMA	97 a	99 a	97 a	141 ab	49 ab	73 a	10.7 a	15.4 ab	14.1 ab	10.8 ab	32.4 b	5.5 ab
GMC	90 a	56 e	83 c	124 ab	48 ab	63 a	10.4 a	15.6 a	13.7 ab	10.6 ab	31.0 b	5.1 ab
DM	95 a	97 a	96 a	136 ab	49 ab	72 a	10.5 a	15.4 ab	13.9 ab	10.3 ab	34.1 ab	5.0 ab
DC	90 a	72 d	88 b	119 ab	54 a	76 a	10.7 a	15.5 ab	13.7 ab	10.4 ab	35.3 ab	4.8 ab
DMA	96 a	91 b	94 a	123 ab	50 ab	60 a	10.7 a	15.1 ab	13.6 ab	10.1 ab	31.7 b	5.1 ab
DCA	94 a	81 c	86 b	130 ab	34 b	62 a	10.5 a	15.3 ab	14.5 a	11.2 a	35.7 ab	4.4 ab
U	24 b	34 f	27 d	110 b	38 ab	14 b	10.2 a	14.9 ab	13.1 b	5.2 c	30.5 b	2.0 c

[1]Field area chiseled and double-disked in fall prior to preplant sprays and planting.

[2]Means within columns followed by the same letter do not differ at P = 0.05. See Table 1 for test description.

[3]See Table 1 for abbreviation meanings and rates.

Table 7. Weed control, soybean stand, seed weight and soybean yield, by preplant herbicide treatments of stubble or conventionally planted soybeans, Test 4, MAFES Delta Branch, 1978-80.[1,2]

Treatment[3]	Weed control			Soybean stand			Seed weight			Soybean yield		
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
	--%--			--1000 plants/Acre--			---g/100---			---bu/Acre---		
PM	94 a	94 a	94 a	152 a	31 b	60 ab	11.3 a	14.6 a	13.9 a	19.1 a	38.6 a	10.8 ab
GM	95 a	98 a	94 a	146 a	40 ab	62 ab	11.4 a	14.8 a	14.5 a	17.6 a	37.7 a	9.6 ab
2M	94 a	98 a	94 a	140 a	39 ab	66 ab	11.5 a	14.7 a	14.9 a	18.4 a	41.9 a	12.0 a
PMA	91 a	98 a	91 a	140 a	59 a	65 ab	11.4 a	14.5 a	14.3 a	18.0 a	41.6 a	12.0 a
GMA	97 a	99 a	95 a	145 a	45 ab	67 a	11.3 a	14.6 a	14.6 a	18.5 a	35.0 a	13.7 a
2MA	94 a	97 a	96 a	138 a	50 ab	54 ab	11.6 a	14.8 a	14.1 a	19.3 a	34.7 a	8.6 ab
TM[4]	88 a	50 b	98 a	139 a	50 ab	46 b	11.3 a	14.6 a	14.5 a	20.1 a	33.5 a	5.9 b

[1]Means within columns followed by the same letter do not differ at P = 0.05.

[2]See Table 1 for test description.

[3]See Table 1 for abbreviation meanings.

[4]Trifluralin + metribuzin was unintentionally omitted in 1979. Plot was chiseled plowed and double-disked in the fall.

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