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Field operations in seedbed preparation for cotton planting may vary in number from one to twenty. Cotton producers in the Yazoo-Mississippi Delta have for many years excessively tilled the sandy loam, silt loam and silty clay loam soils prior to planting. Excessive tillage is expensive and is probably responsible for the poor physical condition of our cotton soils. Soils of this region are low in organic matter, eroded, and severely compacted. Most of the cotton soils, especially the silt loams, must be subsoiled annually to produce highest yields. Because of these conditions, seedbed preparation for cotton should be limited to field operations necessary to eliminate weeds that interfere with planting and production.

Limited seedbed preparation for cotton in the Delta region is not new. Tests conducted on both loam and clay soils at the Delta Branch Experiment Station (2) from 1926-1932 showed no difference between various methods of seedbed preparation. Several studies, involving limited seedbed techniques for cotton, have been made in this region since 1932 (2, 4, 5, 6, 7). Limited seedbed preparation in these studies, as compared with conventional methods, did not reduce but in some cases slightly increased cotton yields.

This study included one phase of an overall effort to reduce cost and increase returns from cotton production and continued the seedbed studies (5) conducted from 1967-1969. The specific objective was to find a more economical and effective method of seedbed preparation for cotton.

Materials and Methods

An experiment was initiated in 1970 on a Bosket sandy loam soil. Stalks were cut and the field was subsoiled at a 45 or 90° angle to row direction in the fall or spring each year. All subsequent seedbed operations occurred in the spring from February 20 to planting. A completely randomized block experimental design with 5 treatments and 6 replications was used and plots were maintained in the same location each year. The plot size of each treatment was six rows 550' long. Three of the five treatments remained constant over the four-year period while two varied from year to year. The seedbed treatments for each year are shown in Table 1 through 4. Since stalk cutting, subsoiling and bed conditioning were the same for all treatments, they are not listed in the description of treatments.

Nitrogen, as a 32% urea-ammonium nitrate solution, was applied prior to planting at a rate of 80 lbs. N per acre. The variety Stoneville 213 was used each year and planted from April 23 to May 4.

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Diuron was applied preemergence each year on a 20-inch band at a rate of 0.7 lb/A, except in 1970 when the width of the diuron band varied for different seedbed treatments. Cultural practices common to this area were used each year for postemergence weed and insect control. All plots were hand hoed twice each year and hoe time was recorded to give some indication of the difference in weed populations between seedbed treatments. Equipment costs associated with all field operations were calculated on the basis of data reported in an earlier publication (1) for the economic analyses included in this report. The cotton was harvested twice each year with a mechanical picker, weights recorded, and a 15-20 pound composite sample of replications was obtained from each treatment for determination of lint percent, staple length and grades.

Results and Discussion

In 1970 there were no significant differences between seedbed treatments as reflected by yield, hoe labor, and returns (Table 1). Although not statistically significant, seedbed treatments of one and two hippings produced about 4% more cotton than the conventional treatment. The per acre value, compared to conventional seedbed preparation, was $15.25 and $11.57 for the seedbed treatments of one and two hippings, respectively.

In 1971 all limited seedbed treatments (treatments 2, 3, and 4), with the exception of treatment 5 where paraquat was used, produced significantly more cotton at first and total harvest than was obtained from the conventional seedbed (Table 2). Seedbed treatments of one and two hippings produced 11% more lint cotton than the conventional seedbed treatment.

There was no significant difference in hoe labor between treatments except where paraquat was used. Most of the hoe labor for the paraquat treatment was required for removal of late winter and early spring weeds that paraquat failed to kill. The rate of 0.25 lb/A of paraquat mixed with 0.7 lb/A of diuron and applied on a 20-inch band centered on the drill gave very poor control of winter weeds in 1971. Paraquat at 0.25 lb/A broadcast is excellent for killing small winter weeds. These winter weeds, which include several species, may attain considerable vegetative growth by the time cotton is planted. Under these conditions, paraquat at 0.25 lb/A broadcast failed to effectively control the winter weeds. The effectiveness of paraquat was apparently reduced by insufficient spray droplet coverage where a dense vegetative growth of weeds existed.

The value of lint, seed, total returns, returns above specified costs, and net returns were significantly increased by seedbed treatments of one and two hippings (treatments 2 and 3, Table 2) as compared with the conventional seedbed. The per acre value compared to conventional seedbed preparation was $34.12 and $34.52 for the hip once and hip twice seedbed treatments, respectively.

The 1972 treatments and results are shown in Table 3. Treatments 4 and 5 were modified in 1972. Studies in the Delta and other areas of the country had indicated some yield increase from planting cotton in twin drills or rows. Therefore, treatment 4 was modified to include this practice with seedbed preparation identical to treatment 2 (hip twice, condition beds and plant).

Since the method of paraquat application was ineffective for treatment 5 in 1971, the technique of application was changed in 1972. The price of paraquat prohibits use of more than 0.25 lb/A. At $32.00 per 2 lbs, the use of 0.25 lb/A costs $4.00 compared to the cost for two hippings with a 6-row hipper at less than $2.00 per acre. In 1972 0.125 lb/A of paraquat was broadcast early (2-29-72) when the winter weeds were small and another 0.125 lb/A was broadcast at planting (4-27-72). This treatment also failed to control the winter weeds. Due to excessive winter weeds and poor cotton stands the plots were hipped twice and replanted May 15.

Yields of the twin row cotton (treatment 4) were significantly greater than those of the conventional and paraquat seedbed treatments in 1972. There were no significant differences in yields between any of the other seedbed treatments. However, the hip once treatment produced 3.6 and the hip twice treatment 7.7% more cotton than the conventional seedbed method.

The hoe labor required was significantly more for the twin row and paraquat treatments as compared with the conventional seedbed. The twin row cotton was physically harder to hoe and may partially account for the extra hoe labor required. The effect of seedbed treatment on lint and seed value, total returns, returns above specified costs and net returns (Table 3) was similar to the effect on yield. The per acre value of one hipping, two hippings and twin row treatments as compared to the conventional seedbed, was $18.45, $23.84 and $46.04, respectively.

The 1973 treatments and results are shown in Table 4. In 1973 glyphosate was used on treatment 5 in an attempt to eradicate winter weeds prior to planting. Glyphosate is a new herbicide, not yet labelled, produced by the Monsanto Company. A broadcast application of 1.0 lb/A of glyphosate with surfactant was used approximately one month prior to planting. Activity of this herbicide was slow and no effect was visible on the winter weeds until 10 days after application. However, after 20 days all winter weeds were completely dead and the plots were free of weeds when planted (5-4-73). The advantage of glyphosate for this purpose will be dependent upon the market price.

There were no significant differences in yields and returns between any of the seedbed treatments in 1973. The hoe time required was significantly greater for all limited seedbed treatments as compared to the conventional treatment. Visual observation of more abundant vegetation and the extra hoe time required indicated that winter weeds gradually increased with the use of limited seedbed preparation. However, this may be more beneficial than harmful since they serve as a form of winter cover crop and help reduce erosion of the cotton soils of this region.

The four-year average yields, hoe labor and returns for the three treatments (1, 2, and 3) are shown in Table 5. The lint cotton yields at first and total harvest were significantly increased by the one and two seedbed treatments.

The four-year average hoe time was significantly greater for the two limited seedbed treatments, but the extra time required (0.25 hr/acre) is of minor economic importance.

The value of lint, total returns, returns above specified costs and net returns were significantly increased by the limited seedbed treatments. The per acre value, compared with conventional seedbed, of the one and two hipping seedbed treatments was $20.59 and $18.09, respectively. The 5 to 6% yield increase accounts for most of the extra returns from the reduced seedbed practices. Compared with the conventional seedbed, the one and two hipping seedbed treatments reduced operational costs by approximately $6.00 and $5.00 per acre, respectively.

Seedbed preparation methods had no measured effect on lint percent, staple length and grades of cotton.

One hipping operation, when properly timed (early while winter weeds are small), adequately controls winter weeds but it does leave quite a number of weeds on the shoulder of the beds. This has not been detrimental to yield but it is unsightly and may, therefore, be difficult for a farmer to accept. It is also conceivable that, under certain climatic conditions, one hipping operation would not adequatley control these weeds. Two hipping operations properly timed, one early while winter weeds are small and another approximately two weeks prior to planting, gave good control in these studies and should effectively control winter weeds under most climatic conditions. Two hipping operations resulted in better winter weed control and a more uniform seedbed.

There are both advantages and disadvantages for limited seedbed preparation. Some of the advantages are:

1. Reduced cost of inputs for labor and equipment.
2. Reduced fuel usage.
3. Convenience and timing of operations are easier, seedbed preparation faster and simpler.
4. Increased yields and returns per acre are probably the most important advantages. Seven years of research at the Delta Branch Experiment Station has not shown a decrease in yields or net returns.
5. Less soil erosion during winter and early spring rains, also less soil compaction due to reduced and restricted tractor and implement traffic.
6. More early cotton which usually brings a better price.
7. Fewer tractors are required for a given size of farm organized in a given manner.

Some disadvantages are:

1. If a broadcast application of a pre plant herbicide is *needed* it canno be effectively incorporated into the soil in an exclusive hipping opera tion.
2. Should not be used on fields moderately to heavily infested with perennial weeds, such as johnson-grass, bermudagrass and redvine.
3. Should not be used on fields where verticillium wilt is a problem.
4. Less attractive than conventional seedbed.

Based on the results of seven years research, the following seedbed preparation is recommended for sandy loam, silt loam and silty clay loam cotton soils. It is not recommended for fields moderately to severely infested with perennial weeds and verticillium wilt.

1. Cut stalks.
2. Subsoil in fall at a 90° or preferably 45° angle to row direction. If weather does not permit fall subsoiling it should be done in the same manner in the spring.
3. Hip once over old beds in early spring or while winter weeds are small (February 20 - March 10).
4. Rehip and apply fertilizer about 10-14 days prior to planting.
5. Condition beds and plant using the recommended herbicide.

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Table 1. Effect of limited seedbed preparation on cotton yield, hoe time and returns in 1970.

Seedbed treatment	Pounds lint/acre			% Yield	Hrs/acre	Returns in dollars per acre					
	1st pick	2nd pick	Total	increase	hoe time	Lint[1]	Seed	Total	Above specified costs	Net	Above conventional
1. Conventional – disk twice, chisel twice, hip twice	1059	125	1184	--	0.71	259.70	51.72	311.42	205.87	118.67	--
2. Hip twice	1144	86	1230	3.9	0.84	269.86	53.75	323.61	223.23	130.24	11.57
3. Hip once	1123	109	1232	4.1	0.76	270.30	53.84	324.14	227.03	133.92	15.25
4. Condition old beds, plant using a 12" band of diuron	1100	84	1184	0	0.79	259.73	51.73	311.46	212.78	121.46	2.79
5. Condition old beds, plant using a 16" band of diuron	1043	123	1166	-1.5	0.70	255.78	50.95	306.73	208.66	117.99	- 0.68
	N.S.[2]	N.S.	N.S.		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

[1] Based on cotton lint value of $23.72 per hundred wt. the average price received by farmers in this area for SLM 1-1/16 inch grade in 1970.

[2] Not significant at the .05 level.

Table 2. Effect of limited seedbed preparation on cotton yield, hoe labor, and returns in 1971.

Seedbed treatment	Pounds lint/acre			%Yield increase	Hrs/acre hoe time	Returns in dollars per acre					
	1st pick	2nd pick	Total			Lint[1]	Seed	Total	Above specified costs	Net	Above conventional
1. Conventional – disk twice, chisel twice, hip twice	804bc[2]	183	987b	--	0.71a	289.53bc	49.43a	338.96bc	231.68b	146.92b	--
2. Hip twice	874ab	222	1096a	11.0	0.80a	320.32a	51.72a	372.04a	269.87a	181.44a	34.52
3. Hip once	869ab	227	1096a	11.0	0.85a	321.38a	49.89a	371.27a	269.67a	181.04a	34.12
4. Hip once with modified hipper	892a	171	1063a	7.7	0.97a	310.85ab	50.75a	361.60ab	260.14a	172.89a	25.97
5. Paraquat 0.25 lb/A combined with diuron and applied on 20" band at planting	757c	202	959b	- 2.9	2.17b	281.30c	45.17b	326.47c	223.00b	139.25b	- 7.67
		N.S.[3]									

[1]Based on cotton lint value of $29.24 per hundred wt. the average price received by farmers in this area for SLM 1-1/16 inch grade in 1971.

[2]Means within columns with the same letter are not significantly different at the .05 level.

[3]Not significant at the .05 level.

Table 3. Effect of limited seedbed preparation on cotton yield, hoe labor, and returns in 1972.

Seedbed treatment	Pounds lint/acre			%Yield	Hrs/acre hoe	Returns in dollars per acre					
	1st pick	2nd pick	Total	increase	time	Lint[1]	Seed	Total	Above specified costs	Net	Above conventional
1. Conventional – disk twice, chisel twice, hip twice	1042b[2]	38	1080b	--	0.41a	286.39b	42.04b	328.42b	207.20bc	118.67bc	--
2. Hip twice	1118ab	45	1163ab	7.7	0.59ab	305.41ab	45.67a	351.08ab	233.81ab	142.51ab	23.84
3. Hip once	1069b	50	1119ab	3.6	0.59ab	300.93ab	43.99ab	344.93ab	226.90bc	137.12bc	18.45
4. Hip twice, plant twin drills 7" apart	1170a	37	1207a	11.8	0.64bc	323.58a	46.85a	370.43a	257.34a	164.71a	46.04
5. Paraquat 0.125 lbs early and 0.125 lb/A broadcast at planting	1036b	53	1089b	1.0	0.80c	292.75b	41.52b	334.27b	203.59c	114.69c	- 3.98
		N.S.[3]									

[1]Based on cotton lint value of $26.91 per hundred wt. the average price received by farmers in this area for SLM 1-1/16 inch grade in 1972.

[2]Means within columns with the same letter are not significantly different at the .05 level.

[3]Not significant at the .05 level.

Table 4. Effect of limited seedbed preparation on cotton yield, hoe labor and returns in 1973.

Seedbed treatment	Pounds lint/acre 1st pick	Pounds lint/acre 2nd pick	Pounds lint/acre Total	%Yield increase	Hrs/acre hoe time	Returns in dollars per acre: Lint[1]	Seed	Total	Above specified costs	Net	Above conventional
1. Conventional – disk twice, chisel twice, hip twice	777	252	1029	--	1.06a[2]	429.74	85.48	515.22	404.10	320.81	--
2. Hip twice	783	245	1028	0	1.61b	429.47	84.23	513.70	406.73	323.24	2.43
3. Hip once	797	253	1050	2.0	1.69b	438.52	87.26	525.77	419.23	335.37	14.56
4. Hip twice, plant twin drills 7" apart	791	252	1043	1.4	1.90b	435.80	85.40	521.20	416.61	333.00	12.19
5. Glyphosate 1# per acre broadcast	835	245	1080	5.0	1.62b	451.05	90.15	541.20	419.86	334.32	15.51
	N.S.[3]	N.S.	N.S.			N.S.	N.S.	N.S.	N.S.	N.S.	

[1]Based on cotton lint value of $41.74 per hundred wt. the average price received by farmers in this area for SLM 1-1/16 inch grade in 1973.

[2]Means within columns with the same letter are not significantly different at the .05 level.

[3]Not significant at the .05 level.

Table 5. Effect of limited seedbed preparation on cotton yield, hoe time and returns (1970-1973, 4-year average, Bosket sandy loam soil, DBES).

Seedbed treatment	Pounds lint/acre			%Yield increase	Hrs/acre hoe time	Returns in dollars per acre					
	1st pick	2nd pick	Total			Lint[1]	Seed	Total	Above specified costs	Net	Above convention
1. Conventional – disk twice, chisel twice, hip twice	921b[2]	150	1070b	--	0.72b	316.34b	57.17	373.51b	262.21b	176.27b	--
2. Hip twice	980a	150	1130a	5.6	0.96a	331.26a	58.84	390.11a	283.41a	194.36a	18.09
3. Hip once	965a	160	1124a	5.0	0.97a	332.78a	58.75	391.53a	285.71a	196.86a	20.59
		N.S.[3]					N.S.				

[1]Based on cotton lint value of $30.40 per hundred wt. the average price received by farmers in this area for SLM 1-1/16 inch grade over the 4-year period.

[2]Means within columns with the same letter are not significantly different at the .05 level.

[3]Not significant at the .05 level.

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f plants infested by 3rd-generation lar-ae. The in-furrow treatment with carbo-uran at planting and the foliar applica-ions of carbofuran against 3rd-generation outhwestern corn borers may have some dvantage over the 4 foliar applications of arbofuran applications, particularly since ve have had some difficulty in the timing f the applications against the 2nd-gener-tion (light trap data or dissection of talks infested with 1st-generation orers). This difficulty occurs primarily ecause so few 1st-generation moths are aken in blacklight traps and because in-estation of corn by the 1st generation is o low in many fields. We have not ex-erienced any difficulty in timing applica-ions against the 3rd-generation because irge numbers of moths can be caught in ight traps and plants infested with nd-generation borers are easy to find.

Summary:

At both test sites, the in-furrow treat-ients with carbofuran at planting were enerally as effective for control of nd-generation southwestern corn borers s the foliar applications of carbofuran med to coincide with moth emergence. lso, at Holly Springs, some in-furrow treatments were as effective in reducing damage from 3rd-generation southwestern corn borers and in increasing yield of corn as the foliar treatments. However, at Mississippi State, the in-furrow treatments were not as effective in controlling 3rd-generation borers as the foliar treatments. Thus, response to in-furrow treatments appeared to vary from location to location, probably because of differences in soil types and local climatic conditions.

A combination of in-furrow treatment with carbofuran at planting plus 2 foliar applications timed to coincide with the 3rd-generation southwestern corn borers was as effective in reducing the percentage of plants infested with this insect at harvest as the standard 4 foliar applications timed to coincide with the moth flights of the 1st and 2nd-generations.

The in-furrow treatments with carbofuran were not as effective in reducing the infestations of European corn borer as the foliar treatments at mid-season or at harvest. We did achieve some control of European corn borers with foliar applications timed for control of the southwestern corn borer, but this degree of control may not be considered satisfactory.

Table 1. Summary of results[1] of field tests with carbofuran used for control of 2nd and 3rd-generation southwestern corn borers at Mississippi State in 1970-72.

Treatments		% Plants	At harvest		
Method of application[2]	Carbofuran Lb AI/Acre[3]	infested at mid-season	Yield (bu/acre)	% Plants infested	% Plants girdled
		1970			
IF	2	5.5 b	-	-	-
IF	3	2.5 b	-	-	-
IF	4	1.0 b	-	-	-
Untreated check		32.0 a			
		1971			
IF	1	9.0 b	65.0 a	36.5 a	21.5 a
IF	2	2.0 c	74.8 a	41.0 a	26.0 a
IF	3	3.6 c	78.0 a	37.5 a	24.0 a
FOL					
Granules	0.5/appl.	0.0 c	72.4 a	12.0 b	6.5 b
Spray	0.5/appl.	0.0 c	72.4 a	11.5 b	5.0 b
Untreated check		21.6 a	66.5 a	58.5 a	32.0 a
		1972			
IF	2	0.0 b	61.8 a	33.0 ab	10.0 a
IF + 1 FOL (mid 3rd gen.)	2 + 0.5/appl.	1.5 b	60.0 a	22.5 c	7.0 a
IF + 2 FOL (3rd gen.)	2 + 0.5/appl.	2.0 b	56.3 a	14.0 d	6.0 a
2 FOL (1 mid-2nd gen. + 1 mid 3rd gen.)	0.5/appl.	2.0 b	43.6 a	26.0 bc	8.5 a
2 FOL (2nd gen.) + 2 FOL (3rd gen.)	0.5/appl. 0.5/appl.	2.0 b	52.7 a	14.5 d	5.0 a
Untreated check		10.5 a	53.6 a	39.0 a	12.0 a

[1] Any 2 means not followed by the same letter are significantly different at the % level of probability by Duncan's new multiple range test.

[2] IF = in-furrow treatment at planting; FOL = foliar treatments timed to coince with moth emergence.

[3] The amounts applied per acre were calculated on the basis of linear feet of row r acre.

Table 2. – Summary of results[1] with carbofuran used for control of 2nd and 3rd-generation southwestern corn borers (also effect on European corn borer) at Holly Springs in 1970-71.

Treatments		% Plants infested		At harvest			
Method of application	Carbofuran Lb AI/acre[2]	at mid-season SWCB[3]	ECB[3]	Yield Bu/acre	% Plants infested SWCB	ECB	% Plants girdled by SWCB
				1970			
IF[4]	2	0.0 b	45.0 ab	73.0 a	13.0 ab	100 a	3.5 b
IF	3	0.0 b	17.5 b	73.0 a	15.5 ab	99 a	8.0 b
IF	4	5.0 b	20.0 b	77.1 a	12.5 b	77 a	5.0 b
Untreated check		53.0 a	85.0 a	58.0 b	50.0 a	100 a	18.5 a
				1971			
IF	1	25.0 a	40.0 a	80.3 bc	32.0 c	94.0 a	19.6 c
IF	2	10.0 b	32.5 a	106.8 a	16.5 b	82.5 a	9.6 b
IF	3	0.0 b	37.5 a	88.7 ab	6.4 c	76.0 ab	3.6 d
FOL (granuless)[3]	0.5/appl.	2.5 b	10.0 b	93.8 a	2.4 c	57.0 b	1.0 d
FOL (spray)	0.5/appl.	0.0 b	7.5 b	90.5 a	3.6 c	57.0 b	2.0 d
Untreated check		22.5 a	50.0 a	72.9 c	57.6 a	93.6 a	34.0 a

Table 2 continued.

1/ Any 2 means not followed by the same letter are significantly different at the 5% level of probability as judged by Duncan's new multiple range test.

2/ The amounts applied per acre were calculated on the basis of linear feet of row per acre.

3/ SWCB = southwestern corn borer, ECB = European corn borer.

4/ IF = in-furrow treatment at planting; FOL = foliar treatments timed to coincide with moth emergence.

FOOTNOTES

1/Lepidoptera: Pyralidae

2/ This paper reports the results of research only, mention of a pesticide or proprie-ty product in this paper does not constitute a recommendation or an endorsement of t s product by the USDA.

3/ In cooperation with the Mississippi Agricultural and Forestry Experiment Station, ssissippi State, Miss. 39762. Received for publication.

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