3-1977

Controlled Traffic, Seedbed Tillage Practices, and Cotton Yield

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March 1977 Bulletin 566

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Controlled Traffic, Seedbed Tillage Practices, and Cotton Yield

J. A. Mullins, J. I. Sewell and J. S. Jablonski[1]

In 1973, tests were initiated at the Milan Field Station to evaluate the effects of controlled traffic and seedbed tillage practices on cotton yield and soil physical conditions. The tests were continued through the 1975 season. This work was supported by the Cooperative States Research Service[2] and the Tennessee Agricultural Experiment Station; and it contributed to a Southern Regional Research Project.[3]

The objectives of this study were to investigate the effects of traffic patterns, equipment size (number of rows), and various seedbed preparation practices on seed cotton yield, seedling emergence, tap root lengths, and soil physical conditions including soil crust strength, depth to traffic pan, bulk density, pore space, and moisture content.

Using controlled traffic on a Norfolk sandy loam in Alabama, Dumas et al (1972) achieved cotton yields which were 14 percent higher than those from plots with tractor traffic only and 21 percent higher than from plots with tractor and sprayer traffic. On a Dubbs silt loam in Mississippi, Williford et al (1974) reported no cotton yield differences between the wide-bed and other cultural systems. Six seedbed preparation systems using a variety of tillage depths were evaluated by Mullins et al (1974) on Memphis and Collins silt loams in Tennessee. Yields from plots tilled at all depths were generally similar; deep tillage with its high energy requirements did not increase yields.

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[2]CSRS Grant Tenn 316-15-92, "Optimizing Cotton Tillage."

[3]Tenn 294, "Engineering Systems for Cotton Production," contributing to Southern Regional Project S—69.

PROCEDURE

Test plots were established on three silt loam soils: Memphis, a well drained upland soil; Collins, a deep, moderately well drained alluvial soil on first bottoms; and Grenada, a moderately well drained upland soil with depth to fragipan varying with the degree of erosion. These plots were maintained on the same sites during the test period. Traffic in the no till and bedded plots was kept in the same middles as the previous season.

The plots were established by conventional, bedded, and no till (stubble planted) methods. The conventional or flat-planted plots were turned to a depth of 8 inches with a moldboard plow in late fall or early spring and disked well before planting in the spring. Immediately before planting, the plots were disked and tilled with a "do-all." Bedded plots were ripped in the fall and re-ripped in the early spring with a desk bedder. The rows were kept in the same location each year.

The no till plots were planted in stubble, and no tillage operations were performed before planting. A herbicide was applied about 2 weeks before planting to kill winter vegetation. After planting, the no till plots were cultivated the same day as the bedded and conventional flat-planted plots.

All plots were in multiples of the rows used; that is, 2-row plots were 6 rows wide and 6-row plots were 18 rows wide. All yield data were taken from the center third of the rows except where disturbing the soil was necessary to obtain data on soil properties. Then outside rows were used for obtaining yield data.

The conventional or flat-planted and the bedded plots were planted with a standard Allis Chalmers no till planter equipped with fluted coulters and zero-pressure rubber press wheels with center ribs. Acid delinted seeds were used in all tests.

Table 1 describes the eight treatments used with respect to seedbed preparation and equipment type. Traffic patterns for 2-row, 4-row, and 6-row equipment were controlled so that the same middles received the tractor wheel traffic in all operations. By using individual rows within plots, high and low traffic levels were studied in 1973. Four levels of traffic (high, medium, low, and no traffic) were studied in 1974 and 1975 (Table 2). While some rows were designated as no traffic, they (as all other rows) still received compaction from cultivator wheels, sweeps, and gage wheels; cotton picker; and 2-row rotary stalk cutter. Therefore, the no traffic plots received traffic in every other middle each year. All 6-row equipment was mounted on a rigid tool bar.

Table 1. Summary of treatments

Treatment	Description[1]
2-row conventional 4-row conventional 6-row conventional	Conventional seedbed preparation including break 8 inches, disk, and "do-all"
2-row bedded 4-row bedded 6-row bedded	Seedbed bedded on old beds prior to planting; beds "knocked off" on day of planting
2-row no till 4-row no till	Plots planted with no seedbed preparation; seed planted in cotton stubble in 1974 and 1975

[1]Within a given year, all plots received identical cultivations, herbicide and insecticide applications, defoliation treatments, and harvesting operations.

Table 2. Summary of 1974 and 1975 traffic frequency from planting to layby

	Trips through the middle			
	Tractor[1]		Sprayer	
Traffic Frequency	1974	1975	1974	1975
High traffic (Traffic middle on 2-row plots)	7	7	14	16
Medium traffic (Traffic middles on 4- and 6-row plots)	4	4	7	8
Low traffic (Center middle on all plots)	1	1	7	8
No traffic (Outside middle on 4- and 6-row plots)	1	1	0	0

[1]Includes planting.

Field Plot Procedure, 1973

The purpose of the first year's study was to compare cotton yields among conventional, flat-planted plots cultivated with 2-row and those cultivated with 4-row equipment and to establish cotton stalks for the 1974 no till treatment. Six-row equipment (Figure 1) was not available until 1974. A randomized complete block design was used with each block being replicated three times on the Memphis silt loam soil. The 2-row treatments were designated as high traffic (sprayed six times during the season) and low traffic (sprayed two or fewer times during the season). Plots were planted with a conventional 4-row planter in 1973, but they were tracked by the tractor so that the final effect was 2- and 4-row traffic.

All plots were plowed 12 inches deep after the 1972 harvest. Conventional seedbed preparation, cultivation, and pest control techniques were used. All plots were cultivated on June 15, July 9,

Figure 1. Six-row planter mounted on a rigid tool bar and used on conventional and bedded plots in 1974 and 1975.

and July 27. High traffic, 2-row plots were trafficked with a high-clearance sprayer a total of six times during July and August. In addition, the 2-row, low traffic and the 4-row plots on Collins were trafficked by the high-clearance sprayer two times during the season. A defoliant was applied to all plots with the same sprayer. The plots were picked with a one-row picker and stalks were cut with a 2-row rotary mower. The number of trips each row received is given in Table 2.

Field Plot Procedure, 1974

The experimental plots were arranged as split plots with one block missing, that of the 6-row, no till plots (Table 1). All plots were fertilized on April 4. Also on April 4, the conventional plots were broken with a 4-bottom plow, and the 2- and 4-row bedded plots were bedded. The 6-row plots were bedded on May 8. On May 9, Roundup was applied on the no till plots planted in 1973 stubble. On May 17, all plots were run over with a "bed knocker" before planting (Figure 2).

On the day of planting, all plots were sprayed with Cotoran; and on June 4, all were sprayed with Bidrin. Plant counts were made on the 24th day after planting. All treatments, including the no till, were cultivated three times. Sprayer traffic for insect control occurred five times. A one-row picker was used to harvest all plots. The number of trips each row received is given in Table 2. Escape weeds were hand hoed as needed to reduce weed strees as completely as possible.

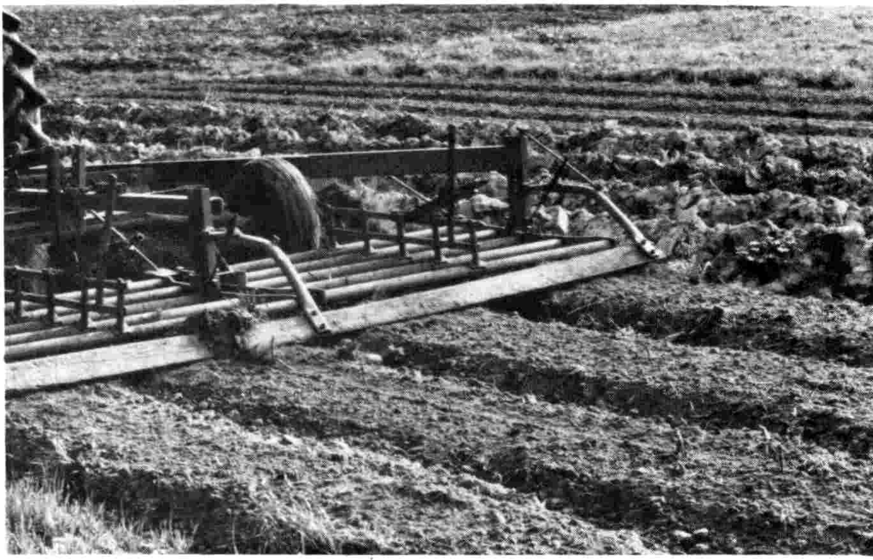

Figure 2. "Knocking off" beds before planting bedded plots in 1974 and 1975.

Soil Physical Properties and Soil Moisture, 1974

Soil cores for pore space determinations were taken for the Memphis soil on June 19, 1974 and March 5, 1975. The March, 1975 samples were taken before 1975 plot preparation. Bulk density cores were obtained for the Collins and Grenada soils on September 5 and August 23, respectively. Soil moisture data for the plots on the Memphis soil were taken on June 13, July 3, and July 19. Soil moisture determinations for Collins were made on June 24 and July 12; and for Grenada, on June 18 and July 15.

All pore space and bulk density determinations were made by Jablonski (1975) according to a procedure adapted from Richards (1954). Soil moisture determinations were made with a neutron moisture meter.

Infiltration rates were recorded in the Memphis soil for each type of traffic middle within each type of seedbed preparation before cultivation was begun and after all cultivation and sprayer traffic had ended for the season. These rates were obtained using a double-ring infiltrometer having an inner ring 12 inches in diameter and an outer ring 20 inches in diameter. Water to the inner ring was dispensed from a 5-gallon drum designed to keep a constant water depth of 3 inches within the inner ring. Water was kept in the outer ring to act only as a buffer zone so as to minimize the boundary effects between the inside ring and the dry soil outside the outer ring. The water in the outer ring was not kept at a constant head.

After harvesting, the lengths of 30 taproots for each treatment in each soil type were determined by hand digging and measuring.

Field Plot Procedure, 1975

The plots were established by conventional, bedded, and no till methods. Cotton stalks were cut on all plots in the fall of 1974. The conventional and bedded treatments were broken with a four-bottom plow on April 3, 1975; and the disking and bedding was done on the same day. On April 29, the date of planting, the conventional plots were disced and the bedded plots were "knocked-off." Also on April 29, the no till plots were planted directly into the cotton stalk stubble remaining from the 1974 crop.

Roundup was applied on the no till plots 1 week before they were planted. Cotoran was applied to all plots on the day of planting. The conventional and bedded plots were cultivated three times, but all no till plots were abandoned because of poor seedling emergence. Plant counts were made on the 7th, 10th, 18th, and 37th days after planting. A high-clearance sprayer was used to apply insecticides for boll weevil control. After each cultivation, weeds were hand hoed as needed. The plots were harvested with a two-row mechanical picker. Traffic patterns, tractor trips, and sprayer trips are outlined in Table 2.

Soil Response to Treatments, 1975

Soil response to treatments on the three soils was evaluated by measuring soil crust rupture strengths and by determining the depths to traffic pans. Soil crust rupture strengths were evaluated by measuring the pressure required to rupture the soil crust with a penetrometer calibrated in pounds per square inch. Depths to traffic pans were determined by forcing (by hand) a penetrometer into the soil until a definitely discernible increase in resistance to penetration was encountered. A procedure outlined by the American Society of Agricultural Engineers (1976) was employed.

CULTURAL PRACTICES AND EVALUATIONS OF SOIL PROPERTIES

Plot Cultivation, 1974

No problems were encountered in cultivating the conventional and bedded plots. In the no till plots, however, the killed sod and grass collected on the cultivator sweeps to such an extent (Figure 3) that preventing damage to plants during the first and subsequent cultivations was difficult.

Figure 3. Killed sod and grass collected on cultivator sweeps during first cultivation of no till plots in 1974.

Soil Pore Space, 1974

For the Memphis soil during the growing season, the effect of traffic pattern (Table 2) on small pore space at the 6- to 9-inch soil depth was found to differ significantly among the four traffic patterns. Middles which received no traffic had less small pore space, 38.1%, compared with that in the high-, medium-, and low-traffic middles of 40.0%, 39.8%, and 39.5%, respectively. After layby, the succeeding traffic and winter had no effect on the small pore space.

Analysis of the large pore space at the 6- to 9-inch depth for the Memphis soil as determined two times during the growing season indicated a significant effect due to a time X seedbed preparation interaction. On June 19, the large pore space for samples decreased from the conventional plots (6.4%) to the bedded plots (5.1%) to the no till plots (4.5%). This trend appeared reasonable since the conventional plots were broken each year. However, during the following winter, a reverse trend developed with the no till plots having the greatest large pore space (11.6%), the bedded plots having the intermediate (9.3%), and the conventional plots having the least (8.4%).

Soil Moisture Content, 1974

Surface soil moisture measurements in percent by volume for the 0- to 6-inch soil depth were taken for Memphis, Collins, and Grenada soils on three, two, and two dates, respectively. Based on the limited data available, the treatments did not affect the soil moisture (Table 3) of the conventional and bedded plots in the Collins and Grenada to the extent that they affected the soil moisture

Table 3. Effects of plot tillage method and traffic pattern on soil moisture in 1974

Tillage method	Traffic frequency[1]	Soil moisture (% by volume) Memphis[2]	Collins[3]	Grenada[4]	Treatment mean[5]	Mean by plot establishment[5]
Conventional	High traffic	16.3	18.8	15.2	16.7 ab	
Conventional	Medium traffic	15.7	18.8	16.0	16.8 abc	
Conventional	Low traffic	14.5	17.2	16.1	16.9 a	
Conventional	No traffic	14.8	18.4	15.2	16.1 ab	
						16.4 x
Bedded	High traffic	16.1	18.8	18.3	17.7 abc	
Bedded	Medium traffic	16.5	19.1	17.5	17.7 abc	
Bedded	Low traffic	15.2	20.2	17.0	17.5 abc	
Bedded	No traffic	17.3	19.7	17.6	18.2 abc	
						17.8 y
No till	High traffic	18.0	21.4	18.0	19.1 c	
No till	Medium traffic	17.1	18.9	18.5	18.2 abc	
No till	Low traffic	17.2	19.4	17.2	17.9 abc	
No till	No traffic	18.9	19.6	16.4	18.3 bc	
						18.4 y
Soil mean		16.5	19.2	16.9		

[1]Traffic patterns described in Table 2.

[2]Data for 3 dates, 189 observations.

[3]Data for 2 dates, 126 observations.

[4]Data for 2 dates, 108 observations.

[5]Treatment means followed by the same letter are not different ($p < 0.05$).

in the Memphis soil. This difference might be explained by soil characteristics; Collins is an alluvial soil, and Memphis and Grenada are upland soils. As the growing season progressed, soil moisture probably decreased more in the Memphis and Grenada than in the Collins soil.

The soil moisture of the no till plots varied little with soils. For the Memphis plots only, the average moisture contents of all tillage methods for the high-traffic (16.8 percent by volume) and no-traffic (17.0 percent) middles were significantly ($p < 0.05$) higher than those for the low-traffic (15.6 percent) middles. This result appeared reasonable since the small-pore space was found to be highest in the high-traffic middles, and available water is known to be found in the small pore space of a soil.

Bulk Density, 1974

Bulk densities after layby were determined for the plots in Collins and Grenada silt loam soils. Determinations were made in three replications for all four traffic patterns and at depths of 0 to 3 inches and 6 to 9 inches (Table 4). The bulk density means for the Collins soil did not differ significantly with respect to traffic pattern or depth, and the mean for all determinations was 1.58 gm/cc.

Table 4. Bulk density of Collins and Grenada Soils after layby in 1974

Traffic frequency[1]	Depth (inches)	Bulk density (g/cc)[2]	
		Collins[3]	Grenada[3]
High traffic	0 - 3	1.60 a	1.62 b
High traffic	6 - 9	1.59 a	1.54 c
Medium traffic	0 - 3	1.58 a	1.52 c
Medium traffic	6 - 9	1.56 a	1.51 c
Low traffic	0 - 3	1.57 a	1.53 c
Low traffic	6 - 9	1.62 a	1.51 c
No traffic	0 - 3	1.52 a	1.45 d
No traffic	6 - 9	1.58 a	1.54 c

[1]See Table 2.

[2]Each value is the mean of three replications.

[3]Means followed by the same letter are not significantly different ($p < 0.05$).

For the Grenada soil, the mean density for the high-traffic middles at the 0- to 3-inch depth (1.62 gm/cc) was significantly ($p < 0.05$) higher than means for all other traffic patterns and depths (Table 4). Likewise, the mean density for the no-traffic middles at the 0- to 3-inch depth was significantly ($p < 0.05$) lower at 1.45 gm/cc than the means for all other traffic patterns. High traffic did not increase soil bulk density at the 6- to 9-inch depth in this soil.

Infiltration, 1974

Infiltration rates were recorded in three replications for all treatments on Memphis soil in June (before cultivation) and in September (after layby). In the high-traffic middles, 50 percent of the rows had increased infiltration rates at the end of the cultivation season, while 50 percent showed decreased rates. For the medium- and low-traffic middles, 87 percent and 67 percent of the middles, respectively, exhibited decreased infiltration rates. On the no-traffic middles, only 55 percent of the middles had increased infiltration rates. Thus, traffic tended to decrease the infiltration in those middles receiving traffic.

Soil Crust Resistance, 1975

Soil crust resistance measurements by penetrometer were made on 12 dates (representative data for three dates are given in Table 5) for the three soils and the three methods of plot establishment. The moisture content of the soil crust is known to affect penetrometer measurements; however, in every case except for the Grenada soil on the 7th day after planting, the soil crust strengths of the no till plots were greater than those of plots tilled by conventional and bedded methods (Table 1). The early growing season rainfall is given in a footnote of Table 5.

Table 5. Mean strengths of soil crusts for three tillage methods on three soils and rainfall during early growing season in 1975

Days after planting[2]	Tillage method	Soil crust resistance (PSI)[1] Memphis	Collins	Grenada	Mean
7	Conventional	2.0	2.6	1.6	2.1
	Bedded	2.4	6.7	3.1	4.1
	No till	2.7	7.6	2.1	4.1
10[3]	Conventional	1.2	1.9	1.4	1.5
	Bedded	1.0	2.7	0.4	1.4
	No till	2.9	3.9	1.8	2.9
18[3]	Conventional	2.1	2.2	1.8	2.0
	Bedded	2.1	3.1	1.5	2.2
	No till	3.5	5.8	4.9	4.7

Rainfall during early growing season

Days after planting[4]	4	5	8	10	13	16	17	18	19	20
Rainfall (inches)	0.21	0.02	1.60	1.30	0.09	0.33	0.21	1.48	1.01	0

[1]Soil crust resistance was determined by a penetrometer calibrated in pounds resistance per square inch.

[2]All plots were planted on April 29.

[3]Soil crust strength measurements were made in mornings before rain which occurred in the afternoons.

[4]No rain fell on dates not presented.

On the 10th and 18th days after planting, the overall mean crust strengths (independent of soil type) for the conventional and bedded plots did not differ greatly. However, for the same days, the overall mean crust strengths for the no till plots were about twice those of the conventional and bedded plots. The highest crust strengths were associated with the Collins soil.

Depth to Traffic Pan, 1975

The depths to the traffic pan were determined for all soils after planting but before cultivation (Table 6). For the high-traffic middles in all soils, the mean depth to traffic pan for the conventional plots was about twice that of the bedded plots. All depth measurements were recorded with reference to the existing surface level of the soil. For the conventionally established plots of all soils, traffic patterns had little effect on the depths to traffic pans. In the bedded and no till plots, however, increased traffic in middles definitely was associated with traffic pans which had formed nearer the soil surface.

Depths to traffic pan were significantly ($p < 0.05$) greater (Table 6) for all tests in conventional plots than for the same patterns in the no till plots. For all soils, overall mean depths to traffic pans were greatest (13.1 inches), intermediate (8.4 inches), and least (4.9

inches) for plots tilled by the conventional, bedded, and no till methods, respectively. By traffic pattern, mean depths to traffic pan were 10.6, 9.8, 7.7, and 7.1 inches for the no, low, medium, and high traffic middles, respectively. By analysis of variance, the effects of treatment, soil type, and treatment X soil type interaction on traffic pan depth were significant ($p < 0.05$). For the no till plots, traffic pans were encountered at about the 4-inch depth.

Table 6. Effect of tillage method on traffic frequency between planting and cultivation

Tillage methods	Traffic frequency[1]	Depth to traffic pan (inches) Memphis[2]	Collins[2]	Grenada[3]	Treatment Mean[4]	Seedbed mean
Conventional	High traffic	16.4	8.0	13.6	12.7 a	
Conventional	Medium traffic	16.0	9.7	14.4	13.4 a	
Conventional	Low traffic	14.5	10.0	15.6	13.4 a	
Conventional	No traffic	16.0	9.9	13.2	13.0 a	
						13.1
Bedded	High traffic	7.1	4.7	6.2	6.0 cd	
Bedded	Medium traffic	5.0	4.6	6.0	5.2 cd	
Bedded	Low traffic	16.4	8.2	9.5	11.4 ab	
Bedded	No traffic	14.3	8.1	10.5	11.0 ab	
						8.4
No till	High traffic	1.5	4.8	1.9	2.7 d	
No till	Medium traffic	2.5	8.5	2.8	4.6 cd	
No till	Low traffic	4.7	6.5	2.6	4.6 cd	
No till	No traffic	6.7	10.1	6.7	7.8 bc	
						4.9

[1]Traffic patterns are described on Table 2.

[2]Means of 3 replications.

[3]Means of 2 replications.

[4]Means followed by the same letter are not different ($p < 0.05$).

COTTON PLANT RESPONSE

Taproot Lengths, 1974

An analysis of variance showed that the various treatments had no significant ($p < 0.05$) effect on the taproot lengths (Table 7) of mature cotton plants after harvesting. The longest taproots (mean of 8.75 inches) were associated with conventional seedbed preparation; intermediate lengths (7.95 inches) were found in the bedded plots; and the shortest taproots (7.63 inches) were in the no till plots.

Seedling Emergence, 1974 and 1975

In 1974, excellent seedling emergence was obtained for all plot tillage methods and all soils (Table 8). For all soils combined, the highest mean count—59,400 plants per acre 24 days after planting—was for the no till plots.

Table 7. Cotton taproot lengths for three tillage methods in three soils in 1974

Treatment	Mean[1] taproot length (inches)			Overall mean[2]
	Memphis	Collins	Grenada	
2-rwo conventional[3]	9.9	7.9	8.7	
4-row conventional[4]	8.7	8.3	8.7	
6-row conventional[4]	9.5	7.9	8.3	
6-row (NT) conventional[5]	8.3	8.3	8.3	
				8.57
2-row bedded	8.7	7.1	7.5	
4-row bedded	8.7	6.9	7.9	
6-row bedded	8.7	7.9	7.9	
6-row (NT) bedded	8.7	8.7	6.7	
				7.95
2-row no till	8.3	7.1	7.1	
4-row no till	8.7	7.5	7.1	
				7.63

[1]Means are averages of 30 determinations for Memphis and Collins, 20 for Grenada.

[2]Mean taproot length by seedbed preparation method.

[3]Double traffic occurred in one middle adjacent to the rows from which the taproots were sampled.

[4]Single traffic occurred in one middle adjacent to the rows from which the taproots were sampled.

[5]No traffic occurred adjacent to the rows from which the taproots were sampled (NT).

Table 8. Summary of 1974 and 1975 plant population means

Tillage Method	Observations per year	Mean plant count[1]	
		1974	1975[2, 3]
	Memphis Silt Loam		
Conventional	9	60,200	24,400
Bedded	9	51,700	35,200
No till	6	68,800	3,000
	Collins Silt Loam		
Conventional	9	50,500	17,600
Bedded	9	44,200	25,600
No till	6	51,600	8,450
	Grenada Silt Loam		
Conventional	6	60,900	32,500
Bedded	6	55,000	38,700
No till	4	57,900	5,200

[1]Plants per acre 24 days after planting in 1974 and 18 days after planting in 1975.

[2]In 1975, at least one-half the seedlings in all no till plots died between the 18th and 37th days after planting; other plots were not similarly affected.

[3]1975 rainfall data are presented in Table 5.

In 1975, by the 7th day after planting, few seedlings had emerged in any of the plots. By the 10th day, almost all plants that were to emerge had emerged. Between the 10th and 18th days, some seedlings died in the bedded and no till plots on Collins. On the 18th day, the mean plant count (Table 8) for all soils was 24,800, 33,200, and 5,550 for the conventional, bedded, and no till plots, respectively. The final stand count, on the 37th day after planting, showed the overall mean plant populations for the three soils to be 24,000, 30,300, and 1,700 plants per acre for the conventional, bedded, and no till plots, respectively. Due to poor seedling emergence and survival (Figure 4), no till plots were abandoned in 1975.

In a combined analysis for 1974 and 1975, plant counts were significantly higher ($p < 0.01$) in 1974 than in 1975. The effect of tillage method on seedling emergence was significant ($p < 0.05$) with no till plots having the poorest emergence, although they were highest in 1974.

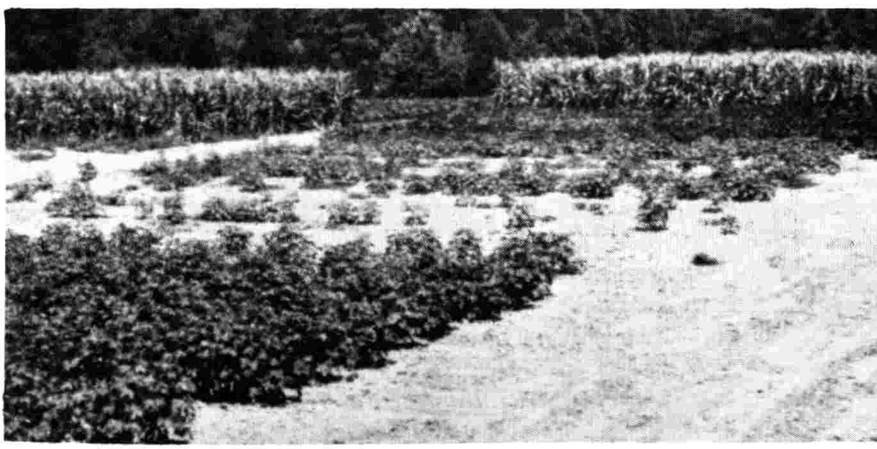

Figure 4. In 1975, no till plots (center) failed because of poor seedling emergence.

In the Memphis and Grenada soils, the bedded plots had higher final stand counts than the conventionally established plots; however, this was not reflected in yields. The increase in stand probably resulted because, during the wet early 1975 growing season, bedding provided the seedbed with more favorable growing conditions.

The very poor seedling emergence in all 1975 no-till plots could have been caused by soil being washed into the drills by a heavy rain (1.6 inches) which fell on the 8th day after planting. On the 10th and 18th days after planting, the soil crust resistance for the no till plots was twice that of the conventional and bedded plots. Also, the Cotoran which was applied on the day of planting could have been washed into the furrows and come in contact with the seeds, further inhibiting seedling emergence. Thus, soil crusting combined with additional soil coverage or Cotoran coming into contact with the seed probably caused the poor seedling emergence.

COTTON YIELD

2-Row and 4-Row Yield, 1973

Mean yields (Table 9) from 2-row and 4-row treatments were almost the same at 2,363 and 2,348 pounds seed cotton per acre, respectively. The effects of treatment on yield were not significant; however, the highest yields were obtained from the 2-row plots which received the least traffic. Lowest yields were on the 2-row plots receiving the most traffic with the 4-row plots being intermediate. This was especially true for the Collins.

Mean yields for the Memphis, Collins, and Grenada soils were 2,620, 2,406, and 2,046 pounds seed cotton per acre, respectively.

Table 9. 1973 yields

		Mean Yield[1] (pounds seed cotton/acre)			
Treatment	Traffic[2]	Memphis[3]	Collins[4]	Grenada[5]	Treatment mean
2-row conventional	High	2476	2174	2004	2218
2-row conventional	Low	2792	2664	2064	2507
2-row mean		2634	2419	2034	2363
4-row conventional		2592	2381	2070	2348
Soil mean		2620	2406	2046	

[1]Differences between means within a soil type are not significant ($p < 0.05$).

[2]The 2-row conventional treatments are designated as high traffic (sprayed six times during the season) and low traffic (sprayed two or fewer times during the season).

[3]Means of 3 replications.

[4]Means of 3 replications.

[5]Means of 2 replications.

Yield by Soil Type, 1974

Due to late maturity, all plots were machine picked only once on November 21 and 22. Row-by-row yields were combined to obtain treatment yields (Table 10). A cool, wet August and September delayed maturity, and yields were below normal for all plots. The 4-row bedded treatment yielded more (1,821 pounds seed cotton per acre) than any other on the Collins soil, and no yield differences were found on the Grenada soil. Significant differences for the Memphis soil as determined by Duncan's New Multiple Range Test are given in Table 10.

Table 10. 1974 yields by treatment

Treatment	Yield (pounds seed cotton/acre)[1]				
	Memphis[2]	Collins[2]	Grenada[3]	Treatment mean	Seedbed mean[4]
2-row conventional	1543 bcd	1306 h	1521 i	1457	
4-row conventional	1728 abc	1255 h	1527 i	1503	
6-row conventional	1492 cde	1043 h	1288 i	1244	
					1401
2-row bedded	1860 ab	1169 h	1643 i	1557	
4-row bedded	2008 a	1821 g	1519 i	1783	
6-row bedded	978 f	906 h	1145 i	1010	
					1450
2-row no till	1103 ef	780 h	995 i	959	
4-row no till	1178 def	825 h	1096 i	1033	
					996
Soil mean	1475	1138	1342		

[1]Yields followed by the same letter are not significantly different ($p \leq 0.05$).

[2]Statistical comparisons between means may be made only within a soil type; means of three replications.

[3]Means of two replications.

[4]Mean yields by seedbed preparation method.

Analyses of variance (not shown) were performed within each soil type. For the Memphis soil, a significant effect on yield ($p < 0.05$) was found for tillage method and the tillage method X equipment intereaction; a highly significant ($p < 0.01$) effect was due to equipment type. The highest yield (2,008 pounds seed cotton per acre) was from the bedded 4-row plots. Lowest yields by treatment were from the 2- and 4-row no till plots (mean of 1,140 pounds).

For the Collins soil, a significant difference was found only among the tillage methods with the three types of bedded plots producing the highest mean yield (1,299 pounds). No till plots yielded least, averaging 803 pounds. For the Grenada soil, no yield differences were significant.

In another analysis, the 4-row conventional treatment was considered as a check, and a least significant difference comparison (not shown) was made. For the Memphis soil, the yields from both no till treatments and the 6-row bedded treatments were less ($p < 0.05$) than the check. For the Collins soil, the 4-row bedded treatments yielded significantly more than the 4-row conventional treatments with no other treatments being significantly lower in yield than the check.

An analysis of yields by traffic pattern and tillage method (Table 11) showed significant ($p < 0.05$) differences between some treatment means in Memphis but not in Collins and Grenada soils. In Memphis, pooled means for the high, medium, low, and no traffic treatments were 1,582, 1,495, 1,441, and 1,311 pounds seed cotton

Table 11. 1974 yields by traffic pattern

Tillage method	Traffic frequency[1]	Yield (pounds seed cotton per acre)[2] Memphis	Collins	Grenada
Conventional	High traffic	1624 abc	1387 d	1582 e
Conventional	Medium traffic	1539 abc	1191 d	1435 e
Conventional	Low traffic	1692 ab	1205 d	1554 e
Conventional	No traffic	1497 abc	1139 d	1219 e
Bedded	High traffic	1959 a	1242 d	1721 e
Bedded	Medium traffic	1640 abc	1541 d	1387 e
Bedded	Low traffic	1458 abc	1373 d	1409 e
Bedded	No traffic	1124 c	892 d	1140 e
No till	High traffic	1162 c	827 d	1035 e
No till	Medium traffic	1305 bc	769 d	1027 e
No till	Low traffic	1174 bc	950 d	1254 e

[1]Traffic patterns described in Table 2.

[2]Yields followed by the same letter are not significantly different ($p < 0.05$).

per acre. However, differences among the pooled means are not significant.

Results of the 1974 studies suggest that the treatments which received less traffic tended to produce lower yields. For the Memphis soil, the 6-row bedded treatment yielded less than all other treatments. The 1974 season was relatively wet, receiving 3.6, 11.1, and 3.7 inches of rainfall in July, August, and September, respectively. This rainfall pattern and higher infiltration may have created excessively high soil moisture conditions, which in turn probably caused lower yields.

Yield by Treatment, 1975

In the Memphis soil, the 6-row conventional and bedded plots yielded less than the similar 2-row and 4-row plots in 1975 (Table 12). For plots in Collins soil, the 4-row bedded treatments outyielded all others. In Grenada, the 4-row bedded plots yielded highest at 500 pounds seed cotton per acre more than the 4-row conventional plots. Differences among treatment means for all conventional and bedded plots in all soils were not significant.

Pooled Yields, 1974 and 1975

Pooled yields from the 1974 and 1975 conventional and bedded treatments were statistically analyzed by soil type (Table 13). For the Memphis soil, yields from the 6-row bedded treatments were less ($p < 0.05$) than those for all other treatments except the 6-row conventional plots. Yields from the 6-row conventional plots in Memphis were less, althought not significantly less, than those of the 2- and 4-row conventional plots. For the Collins soil, the 4-row bedded treatment produced greater ($p < 0.05$) yields than all other treatments. Treatment means on Grenada were not statistically different.

Table 12. 1975 yields

Treatment	Yield (pounds seed cotton/acre) Memphis[1]	Collins[1]	Grenada[2]	Treatment mean	Seedbed mean[3]
2-row conventional	2314	1541	1808	1888 a[6]	
4-row conventional	2387	1453	1458	1766 a	
6-row conventional	1954	1277	1586	1606 a	
					1753
2-row bedded	2251	1289	1639	1726 a	
4-row bedded	2133	1839	1956	1976 a	
6-row bedded	1694	1408	1868	1657 a	
					1786
2-row no till[4]	0	0	0	0	
4-row no till	0	0	0	0	
Soil mean[5]	2122	1468	1719		

[1]Means of 3 replications.

[2]Means of 2 replications.

[3]Mean yields by seedbed preparation method.

[4]No till plots were abandoned because of poor seedling emergence.

[5]Soil means do not include zero yields from no till plots.

[6]Differences between treatment means for conventional and bedded plots were not significant.

Table 13. Means for 1974 and 1975 yields by treatment and soil type

Treatment[1]	Mean[2] yields (pounds seed cotton/acre) Memphis	Collins	Grenada	Mean[3]
2-row conventional	1929 a	1424 d	1664 e	
4-row conventional	2057 a	1354 d	1493 e	
6-row conventional	1678 ab	1160 d	1437 e	
				1577
2-row bedded	2055 a	1229 d	1641 e	
4-row bedded	2071 a	1830 c	1738 e	
6-row bedded	1336 b	1157 d	1506 e	
				1618
Mean[4]	1854	1359	1580	

[1]Since no till plots failed in 1975, yields for no till are not presented.

[2]Statistical comparisons of means can be made within a soil type only; means (within a soil type) followed by the same letter are not different ($p < 0.05$).

[3]Means by plot establishment method.

[4]Means by soil type.

For Tables 9-13, many apparently large yield differences between treatments were not statistically significant ($p < 0.05$). The failure of such differences to be significant can be explained in part by the few replications (no more than three) and short duration of data (one or two seasons). Also, in many cases, variations between replications were large.

DISCUSSION AND SUMMARY

Using multi-row equipment and controlled traffic in middles did not give yield increases in the silt-loam soils of this study. Little yield difference was found between the conventional and bedded plots except for 4-row treatments in Collins. The Memphis soil produced the greatest yields (1,854 pounds seed cotton per acre) followed by the Grenada (1,580 pounds per acre) and Collins soils (1,359 pounds per acre). This soil-yield grouping indicates that the experiments were run during a time of above normal moisture conditions which would tend to minimize tillage differences.

Heavier tractor wheel traffic tended to increase the soil bulk density from the 0- to 6-inch depth but not at the 6- to 9-inch depth in the Grenada soil. This was not true for the Collins soil. Also higher moisture levels were found in the heavier trafficked middles in all soils studied. The middles with heavier traffic may have dried slower than the others. This higher level of moisture may not have been available to the plants because the trafficked middles had a smaller percentage of large pore space than the middles which received less traffic.

For all traffic patterns, conventional tillage methods and bedding (to a lesser degree) were associated with greater depths to traffic pans. This suggests that tillage largely eliminated traffic pans in the tilled zone.

In 1974, excellent stands were obtained by all tillage methods; however, early-season rainfall was favorable. In 1975, which had a wet early growing season, better stands were obtained for cotton planted on beds than flat-planted cotton. Cotton planted in no till seedbeds failed in 1975, possibly because almost no cotton seedlings broke through a crust that developed after heavy rain which fell 8 days following planting. Cotoran applied on the day of planting could also have affected germination.

In the no till plots, average penetrometer readings of the soil crust resistance directly over the seeds were twice those for crust over conventional planted cotton. The no till planter slit left a slight depression over the seed. The zone of maximum water entry into the no till soil is the planter slit. Since the herbicide was soluble, it could have been concentrated in this area. Heavy rains caused puddling and crusting in this critical area. This points out a risk associated with no till planting of cotton in soils having a high tendency to crust. Because of varying climatic conditions which occurred during the tests, the results might not be representative of long-term climatic averages.

In all soils during 1974 and 1975, the 4-row bedded and conventional plots yielded an average of 375 pounds more seed cotton per acre than the comparable 6-row plots. Possibly 2- and 4-row equipment was more precise and better adapted to the topography of the soils studied. The 6-row equipment was mounted on a rigid tool bar and could not adjust to changes in topography. Little yield difference was found between most plots tilled conventionally and by bedding. A notable exception was the 4-row bedded treatments on Collins soil which yielded 515 and 298 pounds more seed cotton per acre than any other treatment in 1974 and 1975, respectively.

The higher seedling emergence count of 1974 compared with 1975 was not reflected in increased yields.

Reducing compaction by using 6-row commercial equipment did not give yield increases in the three silt loam soils studied. This suggests that controlled tractor traffic with existing 6-row equipment could not, on all soil types, be expected to significantly affect cotton yields. During the 3-year study, tillage systems requiring fewer trips through the field without sacrificing yield were not developed.

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