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Harvesting 40-Inch Row Cotton with an Experimental Cotton Combine and a Spindle Picker

Cotton in the humid regions of te Cotton Belt is harvested almost tirely with spindle pickers. cceptance of spindle pickers in te Mississippi Delta has been rgely due to their ability to rvest cotton under a wide range plant and weather conditions. he spindle picker can harvest a mber of varieties with bolls of rying size, shape, and storm sistant characteristics (10). owever, they are expensive and mplicated machines with latively low total seasonal use bout 200 hours are available for ld work in the Mississippi Delta ring a given harvest season) and gh maintenance costs (8).

Several attempts, with varying degrees of success, have been made to introduce new types of harvesters into the humid region of the Cotton Belt. Stripper harvesters, using stripper rolls or finger-type headers, have met with limited acceptance in the Mississippi Delta. Their use has been limited in tall, rank cotton and because of hazards of once-over harvesting occasioned by uncertain weather (4, 7, 11).

An experimental "cotton combine" was introduced in 1969 (6) and demonstrated across the Cotton Belt in 1970 (3) by the Ben Pearson Mfg. Co., Pine Bluff, Arkansas. This combine uses a 13-foot wide header to cut stalks and two tandemly-operated horizontally-oriented spindle picking units to remove seed cotton from stalks as they are conveyed through the harvester (Figure 1).[1] A rear-mounted stalk shredder chops the residue and distributes it over the field.

The objectives of this study were: (1) to compare the performance of the cotton combine with that of a spindle picker used to harvest rank, high-yielding cotton grown in solid 40-inch rows and (2) to study the influence of this harvesting method on cotton quality and net returns.

Materials and Methods

Bosket fine sandy loam soil was lected for this four-year study 971-74) because of its previous istory of producing relatively tall nd high-yielding cotton. Four arvesting treatments were rranged in a randomized complete lock design with four replications. lots were 20 ft wide and 100 ft ng. The initial treatment of each lot was repeated in each of the llowing three years. All plots ere treated alike each year, except r differences in harvesting eatments.

Seedbeds were prepared by subiling in fall or spring and hipping wice over the old stubble in spring, llowing the guidelines of reduced illage outlined by Spurgeon *et al* (9). Nitrogen, as a 32 percent urea-ammonium nitrate solution, was applied at a rate of 80 lb N/A after the first hipping. The seedbed was conditioned with a "Do-all" seedbed conditioner ahead of the planter.

All treatments were planted with a six-row Burch planter equipped with 5/8-inch wide experimental sword openers. Twenty pounds per acre of 'Stoneville 213' acid delinted seed were planted on April 21, April 27, May 8, and April 26 in 1971, 1972, 1973 and 1974, respectively. Diuron was applied in a 20-inch band each year for preemergence weed control. Conventional cultivations and postemergence weed control practices were used on all plots. Insecticides were applied by air as needed. The tests were defoliated at maturity on October 1, October 3, September 25, and September 30 in 1971, 1972, 1973 and 1974, respectively.

Harvest treatments were: (1) twice-over with a conventional spindle picker, (2) once-over with a conventional spindle picker, (3) once-over with a conventional spindle picker and scrapped with a cotton combine, and (4) once-over with a cotton combine.

The solid 40-inch row spacing produced large plants that tended to crowd the sickle area of the combine when traveling in the row direction. Because of the large

[1] *Improvements in later models of the prototype harvester are not reflected by data in this report.*

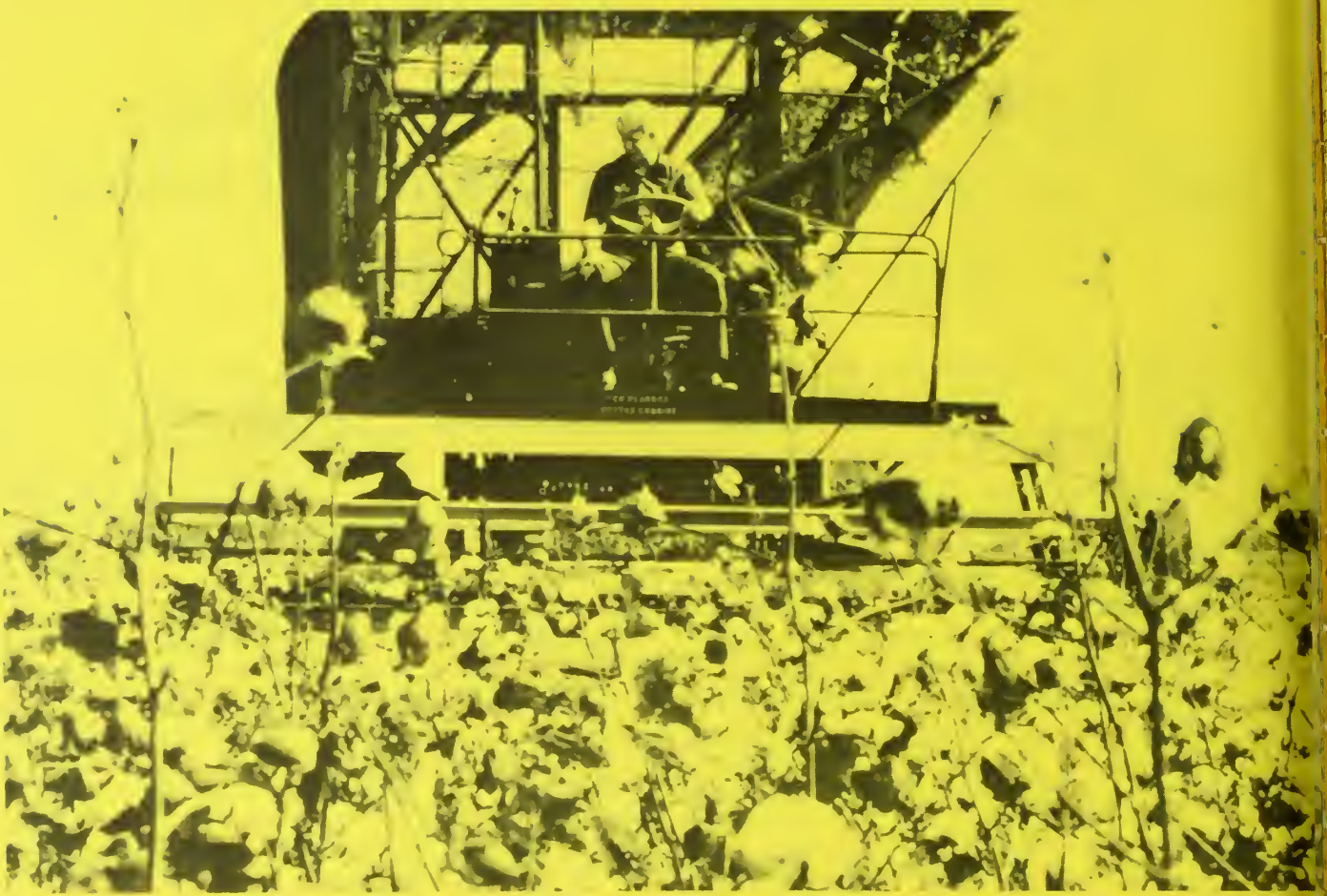

Figure 1. Experimental cotton combine harvesting cotton at the MAFES Delta Branch.

volume of plant material, reduction in ground speed of the combine was necessary when plants were taller than four feet and yield was as high as two or more bales per acre.

The first spindle picking in 1971 was on October 8. Second spindle picking, once-over spindle picking and harvest with the cotton combine were on November 4.

The first spindle picking in 1972 was on October 10. Second spindle picking and once-over spindle picking were on October 25. Harvest with the cotton combine was scheduled for October 25, but was interrupted by heavy rains until November 3.

The combine was modified in 1973 by placing a shield on the top side of the stalk guards at the rear of the picking unit, to help remove larger stalks from the spindles and to prevent them from reentering the picking unit. The first spindle picking in 1973 was on October 15. Second spindle picking, once-over spindle picking and harvest with the cotton combine were on October 30.

The first spindle picking in 1974 was on October 14. Second spindle picking, once-over spindle picking, and harvest with the cotton combine were on November 12.

Seed cotton samples were collected from each plot for all first pickings and once-over harvests. Seed cotton samples were collected from all second spindle pickings and combine scrappings and blended into a composite sample for each treatment.

All samples were ginned on a 20-saw gin with a standard equipment sequence (1).[2] Large sticks in combine-harvested samples wer removed by hand before ginning

Lint samples were graded b personnel of the Cotton Division o the Agricultural Marketing Se vice, USDA, Greenwood, Mississi pi.

Costs and returns were based o prices of production inputs an cotton during the test period and d not necessarily reflect curren market conditions. Equipmen costs and methods of calculatio have been reported for equipmen currently in use in the Delta are (5). Supplementary calculations o operating costs, repairs, annua hours of use, length of life, an performance rates of the cotto combine were made from informa tion obtained from field obser vations on a cooperating farm (12)

[2]*Cotton was ginned at the U. S. Cotton Ginning Research Laboratory at Stoneville, Mississippi.*

Results and Discussion

eld, gin turnout, lint grade and e returns in 1971 did not differ ificantly by method of harvest ble 1). Staple lengths were ificantly longer for spindle king followed by combine scrapg than for either once-over vests. Staple lengths also were ificantly longer for plots vested twice-over with the spinpicker than for those harvested e-over with the spindle picker. vest total costs were obtained h once-over combining (Table Total returns from spindle king were significantly higher n for the once-over harvest with cotton combine.

he delay in once-over harvest h the cotton combine in 1972 sed significant reductions in yield, gin turnout, grade and ple length---resulting in nificantly lower total and net urns than from other harvest thods (Table 2). The only signifit difference in once-and twicer spindle picking was in total costs. There were no significant differences in the two methods of twice-over harvesting.

Seed cotton yields in 1973 were higher for once-over picking followed by combine scrapping than for either once-over method of harvest (Table 3). Seed cotton yields also were higher for twice-over spindle picking than for once-over spindle picking. A significantly lower lint yield was harvested by once-over combining than by the other harvesting methods. Gin turnout was higher when only the spindle picker was used. Lint grade for once-over spindle picking was higher than for all other treatments. Both twice-over harvest methods produced higher lint grades than once-over combining.

Total costs were lower for once-over harvesting than for twice-over harvesting. Total cost was significantly lower for once-over combining than for once-over spindle picking. Combine harvesting resulted in significantly lower total and net returns than the other three harvest methods, because of lower lint yield and composite grade. More regrowth than usual occurred in 1973, reducing grades from combine harvesting more than those from spindle picking.

Seed cotton yield for once-over spindle picking was lower than for other harvest methods in 1974 and lint yield from once-over spindle picking was significantly lower than from twice-over spindle picking or once-over combine harvesting (Table 4). Gin turnout was significantly higher from once-and twice-over spindle picking than from once-over combining or spindle picking followed by scrapping with the combine. Excellent defoliation and very little regrowth occurred in 1974 and lint grades were significantly lower only when the combine was used for scrapping. The combine harvester picked up considerably more trash when used for scrap-

Table 1. Yield, Gin turnout, grade, staple length, costs and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, 1971.

Harvest Method	Yield		Gin	Composite	Staple	Total	Total	Net
	Seed cotton	Lint	turnout	grade	length	costs	returns	returns
	--lbs./Acre--		percent	index	32nd inch	-----dollars/Acre-----		
Spindle Pick (10/8)	2592	862	33.0	94.0[1]	34.8			
Spindle Pick (11/4)	784	273	34.8	97.0	35.0			
Total	3377	1135	33.6	94.7	34.9 ab[2]	217.87 c	391.91 a[3]	174.05
Spindle Pick (11/4)	3227	1130	35.0	99.5	34.0 c	206.32 b	391.48 a	185.16
Spindle Pick (10/8)	2533	863	34.0	95.6	35.0			
Combine (11/4)	732	237	32.4	94.0	35.0			
Total	3266	1100	33.7	95.3	35.0 a	218.34 c	381.24 ab	162.89
Combine (11/4)	3142	1041	33.2	94.8	34.3 bc	199.59 a	357.71 b	158.12

[1]Composite grade index for white cotton: Middling = 100; Strict low middling plus = 97; and Strict low middling = 94.

[2]Values in a column followed by the same letter are not significantly different ($P < .05$) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season.

Table 2. Yield, gin turnout, grade, staple length, costs and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, 1972.

Harvest Method	Yield: Seed cotton	Yield: Lint	Gin turnout	Composite grade	Staple length	Total costs	Total returns	Net returns
	--lbs./Acre--		percent	index	32nd inch	-----dollars/Acre-----		
Spindle Pick (10/10)	3251	1142	35.1	93.0[2]	35.0			
Spindle Pick (10/25)	275	92	33.6	85.0	35.0			
Total	3526	1234 a[1]	35.0 a	92.4 a	35.0 a	224.85 c	378.78 a[3]	153.93 a
Spindle Pick (10/25)	3729	1247 a	33.4 a	93.0 a	35.0 a	214.03 b	386.36 a	172.33 a
Spindle Pick (10/10)	3373	1163	34.5	93.0	34.8			
Combine (11/3)	313	89	28.5	70.0	34.0			
Total	3686	1252 a	34.0 a	92.2 a	34.7 a	227.55 c	383.04 a	155.49 a
Combine (11/3)	3422	1013 b	29.6 b	82.8 b	34.0 b	201.21 a	288.40 b	87.19 b

[1]Values in a column followed by the same letter are not significantly different (P<.05) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[2]Composite grade index for white cotton: Strict low middling = 94; Low middling = 85; Strict good ordinary = 76; and Good ordinary = 70.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season.

Table 3. Yield, gin turnout, grade, staple length, cost and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, 1973.

Harvest Method	Yield: Seed cotton	Yield: Lint	Gin turnout	Composite grade	Staple length	Total costs	Total returns	Net returns
	--lbs./Acre--		percent	index	32nd inch	------dollars/Acre-----		
Spindle Pick (10/15)	3257	1071	32.9	93.0[4]	35.0			
Spindle Pick (10/30)	364	130	35.7	85.0	35.0			
Total	3621 ab[3]	1201 a	33.2 a	92.2 b	35.0	189.68 c	598.41 a[5]	408.74 a
Spindle Pick (10/30)	3307 c	1179 a	35.7 a	94.0 a	35.0	177.40 b	588.09 a	410.69 a
Spindle Pick (10/15)	3346	1079	32.3	94.0	35.0			
Combine (10/30)	359	110	30.6	70.0	34.0			
Total	3704 a	1189 a	32.1 b	91.8 b	34.9	191.14 c	598.46 a	407.31 a
Combine (10/30)	3488 bc	1107 b	31.8 b	85.0 c	35.0	171.39 a	546.15 b	374.76 b

[1]Values in a column followed by the same letter are not significantly different (P<.05) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[2]Composite grade index for white cotton: Strict low middling = 94; Low middling = 85; Strict good ordinary = 76; and Good ordinary = 70.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season. Adjustments were made to reflect the high degree of forward contracting that occurred. Average price for SLM, 1-3/32 inch cotton was assumed to be 41.77 cents per pound.

ping than when used for once-over harvesting.

Total costs were significantly different for each method of harvesting and were lowest f once-over harvesting with the spi

le picker. The difference in total osts for once-over spindle picking nd once-over combining can be ttributed to ginning costs, which ere affected by differences in quantity of cotton harvested.

Total and net returns were higher for the combine harvester and twice-over spindle picking treatments than for once-over spindle picking treatments (Table 4). Net returns for the once-over combine harvest were also higher than for the treatment using the combine for scrapping.

Table 4. Yield, gin turnout, grade, staple length, costs and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, 1974.

Harvest Method	Yield		Gin	Composite	Staple	Total	Total	Net
	Seed cotton	Lint	turnout	grade	length	costs	returns	returns
	--lbs./Acre--		percent	index	32nd inch	-----dollars/Acre-----		
Spindle Pick (10/14)	2406	753	31.3	92.8[2]	35.0			
Spindle Pick (11/12)	633	203	32.1	94.0	35.0			
Total	3039 a[1]	956 a	31.5 a	93.0 a	35.0	229.48 d	573.49 a[3]	344.01 ab
Spindle Pick (11/12)	2711 b	861 b	31.8 a	94.0 a	35.0	192.24 a	520.20 b	327.96 c
Spindle Pick (10/14)	2333	718	30.8	91.5	35.0			
Combine (11/12)	778	207	26.6	85.0	35.0			
Total	3111 a	925 ab	29.7 b	90.1 b	35.0	222.17 c	558.35 ab	336.18 b
Combine (11/12)	3155 a	951 a	30.1 b	94.0 a	35.0	202.73 b	577.48 a	374.75 a

[1]Total values in a column followed by the same letter are not significantly different (P < .05) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[2]Composite grade index for white cotton: Strict low middling = 94; and Low middling = 85.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season.

Four-Year Averages

Lint yields, gin turnout, grade, staple length, total costs, total returns and net returns were significantly lower for once-over combining than for the other harvesting methods (Table 5). Differences in seed cotton yield, lint grade and total costs were significantly different for once-over and twice-over spindle picking. Similar results were obtained by Barker, *et al,* in a three-year test at Stoneville (2). Differences in net returns were not significantly different for twice-over spindle picking, once-over spindle picking and once-over spindle picking followed by combine scrapping.

Three-Year Averages

Eliminating data for 1972 permitted comparing results of combine-harvesting with results of once-over spindle picking on the same date. Averaging results (Table 6) for 1971, 1973, and 1974 revealed the following:

Seed cotton yields for the two methods of twice-over harvest were significantly higher than for either method of once-over harvest. Seed cotton yield was significantly higher for once-over combining than for once-over spindle picking.

Differences in lint yield were not significant for once-over spindle picking and once-over combining or for the two twice-over methods of harvest.

Differences in total costs and total returns were not significantly different for once-over combining and once-over spindle picking. Net returns did not differ significantly by harvesting method.

Table 5. Yield, gin turnout, grade, staple length, cost and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, 1971-74 average.

Harvest Method	Yield: Seed cotton	Yield: Lint	Gin turnout	Composite grade	Staple length	Total costs	Total returns	Net returns
	--lbs./Acre--		percent	index	32nd inch	-----dollars/Acre-----		
First Spindle Pick	2877	957	33.3	93.2[2]	35.0			
Second Spindle Pick	514	175	34.1	90.3	35.0			
Total	3390 a[1]	1131 a	33.3 ab	93.0 b	35.0 a	215.47 c	485.65 a[3]	270.18 a
Once-over Spindle Pick	3243 b	1104 a	34.0 a	95.1 a	34.8 a	197.50 b	471.53 a	274.04 a
First Pick, Spindle	2896	956	33.0	93.5	35.0			
Second Pick, Combine	546	161	29.5	79.8	34.5			
Total	3442 a	1116 a	32.4 b	92.3 b	34.9 a	214.80 c	480.27 a	265.47 a
Once-over, combine	3302 b	1028 b	31.2 c	89.1 c	34.6 b	193.73 a	442.43 b	248.70 b

[1]Values in a column followed by the same letter are not significantly different ($P < .05$) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[2]Composite grade index for white cotton: Strict low middling plus = 97; Strict low middling = 94; Low middling = 85; and Strict good ordinary = 76.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season.

Table 6. Yield, gin turnout, grade, staple length, cost and returns, 'Stoneville 213' cotton harvested by different methods, MAFES Delta Branch, averages of 1971, 1973 and 1974 tests.

Harvest Method	Yield: Seed cotton	Yield: Lint	Gin turnout	Composite grade	Staple length	Total costs	Total returns	Net returns
	--lbs./Acre--		percent	index	32nd inch	-----dollars/Acre-----		
First Spindle Pick	2752	895	32.5	93.3[2]	34.9			
Second Spindle Pick	594	202	34.0	92.0	35.0			
Total	3346 a[1]	1097 a	32.8 b	93.0 b	34.9	212.09 b	521.27 a[3]	308.93
Once-over Spindle Pick	3082 c	1057 ab	34.3 a	95.8 a	34.7	191.99 a	499.92 b	307.93
First Pick, Spindle	2737	887	32.4	93.7	35.0			
Second Pick, Combine	623	185	29.7	83.0	34.7			
Total	3360 a	1072 ab	31.9 b	91.9 b	34.9	210.55 b	512.68 ab	302.13
Once-over, Combine	3262 b	1033 b	31.7 b	91.3 b	34.8	191.24 a	493.78 b	302.54

[1]Total values in a column followed by the same letter are not significantly different ($P < .05$) as determined by Duncan's New Multiple Range Test. Only treatment totals are analyzed.

[2]Composite grade index for white cotton: Strict low middling plus = 97; Strict low middling = 94; Low middling = 85; and Strict good ordinary = 76.

[3]Based on grade and staple length, USDA Classing Office, Greenwood, Mississippi, and upon prevailing prices at Greenwood for a given grade and staple length during the harvest season.

Conclusions

Results from the 1971, 1973 and 1974 trials indicate that cotton grown in solid 40-inch rows can be harvested with the cotton combine. However, results in 1972 point to the greater risk of total dependence on a once-over harvest system because of the probability of weather-caused delay of harvest. Even with the delay in scrapping with the combine in 1972, spindle picking followed by combining was as satisfactory as twice-over spindle picking except for difficulty in ginning.

Once-over combine-harvested cotton contained about eight percent more trash than spindle-picked cotton and gins equipped for ginning spindle-picked cotton had some difficulty in removing it---particularly the higher stick content. Improvements in the mechanical reliability, field performance and harvesting efficiency of later models of the prototype combine may have a sizable impact upon its relative merits as a cotton harvester.

Literature Cited

1. Anthony, W. S. 1972. Development of a model cotton ginning system. Presented to the Southern Regional Meeting ASAE, Richmond, VA.
2. Barker, G. L., K. E. Luckett, F. T. Cooke, Jr., R. O. Thomas, and E. B. Williamson. 1972. Comparison of cotton preharvest and harvest methods in the Mid-South. ARS 42-194. Jan.
3. Barnes, H. H., Jr. 1971. Narrow-row, high-population cotton. The Farm Quarterly 26(2):82-86. Mar.-Apr.
4. Colwick, R. F., G. L. Barker, J. A. Friesen, and K. E. Luckett. 1972. Stripper-type cotton harvest study. Miss. Agric. and Forest. Exp. Sta. Info. Sheet No. 1199. Sept.
5. Cooke, F. T., Jr., J. M. Anderson, and A. M. Heagler. 1972. Crop budgets and planning data for major farm enterprises in the Yazoo-Mississippi Delta. Miss. Agric. and Forest. Exp. Sta. Bul. 794. July.
6. Griffin, T. 1969. Producers eye narrow-row cotton as way to cut costs. Farm Weed-Delta 2(44):1, 3. Nov. 6.
7. Luckett, K. E., G. R. Tupper, and W. E. Garner. 1975. Evaluation of once-over harvesters in the Mississippi Delta. 1975 Proc. Beltwide Cotton Prod. Res. Conf., p. 114.
8. Parvin, D. W., Jr., J. M. Anderson, F. T. Cooke, Jr., A. M. Heagler, and S. M. Toney. 1975. Specific inputs and prices associated with cotton production costs for the Mississippi Delta. Miss. Agric. and Forest. Exp. Sta. Bul. 831. April.
9. Spurgeon, W. I., J. M. Anderson, G. R. Tupper and F. T. Cooke, Jr. 1974. Limited seedbed preparation for cotton. Miss. Agric. and Forest. Exp. Sta. Bul. 813. May.
10. Tupper, G. R., E. J. Matthews, and C. Hughes. (1961-63 Summary of spindle picker harvesting data). Published in Ark. Agric. Exp. Sta. Mimeograph Series 114, 128, and 138.
11. Tupper, G. R. 1966. Stripper harvesting vs. spindle picking of openboll and experimental stripper varieties of cotton. Trans. of ASAE 9(1):110, 111 and 113.
12. Tupper, G. R., J. M. Anderson, and W. I. Spurgeon. 1974. Harvesting cotton with an experimental combine. Miss. Agric. and Forest. Exp. Sta. Info. Sheet 1250.