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The Influence of Row Spacing on Cotton Variety Preformance

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Cotton is traditionally grown in ıe United States in single rows paced 38-42 inches apart. Howver, several reports from outside ıe Mississippi Delta have shown ıat certain varieties are better dapted to high population produc-on systems (5, 14, 15).

Ray (10) and Niles (9) have disıssed the development of varieties dapted to narrow row production nd have emphasized that the ma-ır hurdle in realizing the full otential of this type culture is the evelopment of a suitable variety. 'reviously, breeders have succeedd in developing cotton types to ıeet special situations in the past, nd will continue to develop new ypes as the economic need arises.

The spread of boll weevil, *Anthonomus grandis* Boh. over the 'otton Belt caused a widespread hange in the types of cotton grown ı different areas. The advent of he boll weevil made it difficult to row late-maturing varieties. The ate-maturing long staple varieties ommonly grown before the turn of he century were replaced by early-maturing, short staple varieties that allowed cotton to be grown profitably in spite of the boll weevil.

The heavy selection pressure for yield since the early 1900's has resulted in highly productive varieties (2). These varieties are usually not adapted to narrow row production. Yield continues to be the prime character of selective importance, but in recent years a great deal of breeding attention has been given to the development of cottons to meet special situations.

Research in the Texas High Plains has shown the potential for reduced production costs, increased yields, and improved fiber uniformity by using row widths narrower than 40-inches (1, 11, 12, 13, 16, 17). This does not mean that the same production practices in other areas would be equally successful, since environments are sometimes drastically different in various cotton producing areas.

To determine the effect of row spacing on the agronomic and fiber properties of cotton, we evaluated several varieties in 1970, 1971, 1972, and 1973 when planted in different row spacings. Eight varieties in 1970, five in 1971, and four in 1972 and in 1973 were evaluated. The varieties were planted in 20- and 40-inch rows in 1970 and in 15-, 30-, and 40-inch rows during 1971-73. Three varieties ('Coker 310', 'Deltapine 16', and 'Stoneville 213') were included over a 3-year period (1971-73).

A split-plot design with five replications was used each year. Main plots were varieties and subplots were row spacings. The plots consisted of six 40-inch rows, eight 30-inch rows, twelve 20-inch rows and fifteen 15-inch rows. Each plot was 75 feet long. The seeding rate was approximately 30 pounds of acid-delinted seed per acre with a final plant population of about 65,000 plants per acre. Nitrogen was applied at the rate of 80 pounds per acre. The plots were hand-picked to obtain a measure of earliness.

Results and Discussion

The response of cotton varieties o narrow row production has been ıomewhat inconsistent. Grissom ınd Spurgeon (6) grew cotton in 20-, 40-, 60-, and 80-inch rows at Stoneville and reported no difference in yield attributed to row spacings when averaged over four years. They observed that dry weather tended to affect cotton in 20-inch rows more quickly and more severely than on wider spaced rows.

In our study a drought stress was evident at a much earlier date for the 20-inch rows in 1970. The 20-inch rows tended to "cut-out" earlier and form more regrowth later in the season when moisture was available. This regrowth on 20-inch row plots actually caused them to mature later than 40-inch row plots. The same general trend was usually observed on 15-inch rows in 1971-73.

In 1970 the lint yield of Delta variety types was reduced 7% when planted in 20-inch rows (Table 1.). The storm-proof varieties commonly grown in Texas yielded 6 to 20% more when planted in 20-inch rows, but the lint yield of these varieties was lower than that of standard Delta types regardless of row spacing. 'Lockett 4789A', 'Arkansas 61-28', and 'Paymaster Dwarf' yielded 20, 14, and 6% more, respectively, when grown in 20-inch rows. The yield of Paymaster Dwarf and Arkansas 61-28 was partially confounded with grass control when planted in 40-inch rows. These short stature varieties did not provide enough shading to reduce grass growth. The low yield of these two varieties when planted in 40-inch rows was partially due to inadequate late season grass control.

In 1971 the lint yield of Delta varieties was 4 to 10% higher in 30-inch rows than in 40-inch rows (Table 2.). One Delta type, Coker 310, showed a 13% increase in yield

Table 1: Influence of row-spacing on eight cotton varieties, Stoneville, Mississippi, 1970

Variety	Row width	Lint per acre	40-in. rows	Lint	Boll size	Length		Fiber Properties		
								Strength*	Elongation**	Micronaire
	in	*lb*	*%*	*%*	*Grams*	*2.5%*	*50%*	*g/tex*		
Stoneville 213	40	873		38.2	5.53	1.14	.55	18.64	7.44	5.17
Stoneville 213	20	823	94	37.7	5.27	1.13	.55	19.04	7.68	5.21
Deltapine 16	40	795		37.6	5.86	1.15	.55	19.18	8.72	5.01
Deltapine 16	20	741	93	37.5	5.60	1.16	.56	19.40	8.36	4.94
Stoneville 7A	40	717		38.4	5.50	1.16	.56	18.80	6.12	5.15
Stoneville 7A	20	662	92	38.7	5.14	1.15	.55	18.94	6.10	5.02
Stoneville 7A Okra	40	668		37.7	5.29	1.14	.54	17.98	5.90	4.99
Stoneville 7A Okra	20	541	81	36.9	4.79	1.13	.54	18.30	6.20	5.02
Auburn M	40	642		34.9	6.12	1.11	.54	18.32	7.26	4.64
Auburn M	20	637	99	35.1	5.96	1.10	.54	18.92	7.26	4.73
ARK 61-28	40	612		34.2	6.67	1.06	.52	20.64	5.88	5.14
ARK 61-28	20	701	114	34.9	6.04	1.06	.53	20.76	5.94	5.20
Lockett 4789A	40	582		34.4	6.52	1.12	.56	19.96	6.72	4.78
Lockett 4789A	20	698	120	35.1	5.95	1.12	.55	19.74	6.98	4.60
Paymaster Dwarf	40	496		37.4	5.74	1.03	.53	19.34	8.44	4.74
Paymaster Dwarf	20	525	106	36.1	5.67	1.03	.50	19.82	8.46	4.92

Planted: May 6, 1970.

***Is the fiber strength of a bundle of fibers measured on the stelometer with the jaws holding the fiber bundle separated by a 1/8-inch spacer, expressed in grams-force per tex. Tex is the linear density of fibers, filaments, and yarns, expressed as the weight, in grams, of 1,000 meters of fiber or yarn.**

****Is the percentage elongation at break of the center 1/8-inch of the fiber bundle measured for T, strength on the stelometer.**

when grown in 15-inch rows. The lint yields of Stoneville 213, Deltapine 16, and 'Stoneville 817' were reduced 2, 3, and 2%, respectively, when grown in 15-inch rows, compared with 40-inch rows. In the 1971 study, 15-inch row plots were usually later in maturity than 30- and 40-inch rows. There were no consistent differences in maturity between 30- and 40-inch rows. Plant height was significantly reduced for 15-inch rows in 1971, but there was no significant difference in plant height for 30- and 40-inch rows. The highest yielding treatments in 1972 were Stoneville 213 grown in 30-inch rows and Coker 310 grown in 15-inch rows.

In 1972, lint yields were 4 to 19% higher when grown in 30-inch rows and 1 to 26% higher in 15-inch rows, compared to standard 40-inch rows (Table 3). Deltapine 16, Stoneville 213 and Coker 310 had 18, 9, and 4% increases in yield, respectively, when grown in 30-inch rows and 1, 4, and 2% yield increases, respectively, when grown in 15-inch rows. 'Stoneville 7A Super Okra Leaf' showed a 19 and 26% increase in yield, respectively, in 15- and 30-inch rows, but these yields were lower than those of the standard Delta varieties regardless of row spacing. There was very little difference in maturity between row spacings except that Deltapine 16 matured later when grown in 30-inch rows. The highest yielding treatment in 1972 was Deltapine 16 grown in 30-inch rows.

In 1973 lint yield of Delta varieties was 2 to 17% higher when grown in 30-inch rows and 6 to 19% higher when grown in 15-inch rows, compared to standard 40-inch rows (Table 4.). There were no consistent differences in maturity between 30- and 40-inch row spacings, but 15-inch rows matured significantly earlier than either 30- or 40-inch rows in 1973.

Three varieties (Stoneville 213, Deltapine 16, and Coker 310) were evaluated over a 3-year period (1971-73) when planted in 15-, 30-, and 40-inch rows (Table 5). The response of these Delta type varieties to narrow row production was inconsistent. The presence of a significant variety by year by location interaction for lint yield indicated that this type culture was very sensitive to environments

Table 2: Influence of row-spacing on five cotton varieties, Stoneville, Mississippi, 1971.

Variety	Row width	Lint Per Acre				Lint	Seed index	Boll size	Fiber Properties				
		Total	First pick	First pick	40-in. rows				Length		Strength*	Elongation**	Micronaire
	in	*lb*	*lb*	*%*	*%*	*%*		*Grams*	*2.5%*	*50%*	*g/tex*		
Stoneville 213	40	1112	889	80	---	38.7	11.4	5.78	1.12	.54	18.62	8.2	5.33
Stoneville 213	30	1222	987	81	110	38.9	11.3	5.74	1.14	.55	19.20	8.2	5.31
Stoneville 213	15	1086	752	69	98	38.4	11.2	5.37	1.12	.55	19.49	8.1	5.17
Deltapine 16	40	1088	942	87	---	38.5	10.9	5.90	1.15	.55	19.14	9.4	4.76
Deltapine 16	30	1168	1024	88	107	38.3	10.9	5.85	1.15	.55	19.85	9.5	4.66
Deltapine 16	15	1057	867	82	97	38.5	10.7	5.67	1.15	.55	19.70	10.0	4.66
Coker 310	40	1078	934	87	---	38.9	11.0	5.37	1.21	.56	19.67	7.5	4.64
Coker 310	30	1122	981	87	104	39.0	10.8	5.41	1.21	.57	20.11	7.3	4.69
Coker 310	15	1222	1051	86	113	38.9	10.8	5.29	1.20	.56	19.79	7.7	4.59
Stoneville 817	40	1031	840	81	---	36.3	11.2	5.31	1.09	.52	19.62	7.1	4.70
Stoneville 817	30	1090	887	81	106	36.7	11.5	5.23	1.11	.53	20.34	7.3	4.64
Stoneville 817	15	1010	786	78	98	35.8	11.1	5.21	1.11	.53	19.64	7.0	4.52
Lockett 4789A	40	837	687	82	---	33.6	13.6	6.64	1.15	.55	19.15	6.9	4.56
Lockett 4789A	30	954	768	80	114	33.6	13.4	6.48	1.14	.55	19.56	7.3	4.63
Lockett 4789A	15	871	714	82	104	33.7	13.6	6.14	1.14	.55	19.00	6.9	4.41

Planted: May 17, 1971. Harvested: October 13, and November 2, 1971. *See footnote, Table 1. **See footnote, Table 1.

Table 3: Influence of row-spacing on four cotton varieties, Stoneville, Mississippi, 1972

Variety	Row width	Lint Per Acre				Lint	Seed index	Boll size	Fiber Properties				
		Total	First pick	First pick	40-in. rows				Length		Strength*	Elongation**	Micronaire
	in	*lb*	*lb*	*%*	*%*	*%*		*Grams*	*2.5%*	*50%*	*g/tex*		
Stoneville 213	40	1239	827	67	---	40.0	10.5	5.54	1.12	.53	19.54	7.5	5.25
Stoneville 213	30	1288	818	64	104	40.5	10.3	5.48	1.11	.51	19.54	7.5	5.28
Stoneville 213	15	1290	868	67	104	40.9	10.3	5.30	1.12	.53	19.54	7.5	5.36
Deltapine 16	40	1106	690	62	---	40.0	10.8	6.22	1.15	.55	20.54	9.6	5.26
Deltapine 16	30	1306	621	48	118	39.9	10.9	6.20	1.13	.54	20.48	9.5	5.21
Deltapine 16	15	1119	627	56	101	40.0	10.7	5.79	1.13	.54	20.96	9.4	5.09
Coker 310	40	1178	710	60	---	39.8	11.4	5.91	1.21	.57	21.40	7.3	4.93
Coker 310	30	1286	777	60	109	39.8	11.2	5.62	1.20	.56	21.05	7.5	4.82
Coker 310	15	1199	775	65	102	40.5	11.0	5.33	1.19	.55	21.40	7.5	4.75
STV. 7A-S. Okra	40	926	635	69	---	40.1	9.7	5.09	1.10	.51	17.61	6.5	5.26
STV. 7A-S. Okra	30	1103	840	76	119	40.4	9.5	4.95	1.09	.50	17.67	6.4	5.17
STV. 7A-S. Okra	15	1163	832	72	126	40.5	9.8	5.03	1.09	.50	18.08	6.3	5.33

Planted: May 11, 1972 Harvested: September 21, and October 13, 1972. *See footnote, Table 1. **See footnote, Table 2.

Table 4. : Influence of row spacing on four cotton varieties, Stoneville, Mississippi. 1973

Variety	Row width	Lint Per Acre				Lint	Seed index	Boll size	Fiber Properties				
		Total	First pick	First pick	40-in. rows				Length		Strength*	Elongation**	Micronaire
	in	*lb*	*lb*	*%*	*%*	*%*		*Grams*	*2.5%*	*50%*	*g/tex*		
Stoneville 213	40	1130	795	70	---	40.6	10.9	5.68	1.14	.54	19.22	8.2	5.49
Stoneville 213	30	1210	840	69	107	41.2	10.8	5.57	1.13	.54	18.05	8.8	5.53
Stoneville 213	15	1200	1078	90	106	40.5	10.3	5.28	1.13	.54	18.25	8.5	5.39
Deltapine 16	40	966	626	55	---	40.6	11.1	6.07	1.17	.56	19.65	10.0	5.26
Deltapine 16	30	980	542	55	102	40.6	11.2	6.21	1.18	.57	19.80	10.0	5.41
Deltapine 16	15	1157	983	85	119	40.4	10.8	5.73	1.15	.54	19.25	9.9	5.26
Coker 310	40	938	534	57	---	42.0	11.3	5.90	1.21	.57	20.27	7.8	5.29
Coker 310	30	1099	680	62	117	42.9	11.1	5.65	1.20	.57	19.90	8.1	5.23
Coker 310	15	1102	959	87	117	41.6	10.6	5.34	1.20	.54	19.68	7.5	5.01
DES 2134-3	40	1018	712	70	---	39.1	11.0	5.56	1.19	.56	20.24	7.5	4.90
DES 2134-3	30	979	718	73	96	39.4	10.9	5.51	1.17	.55	20.36	7.6	5.07
DES 2134-3	15	1192	1015	85	117	39.0	11.0	5.22	1.17	.54	19.74	7.4	4.73

Planted: May 11, 1973. Harvested: October 4, and October 26, 1973. *See footnote, Table 1. **See footnote, Table 1.

Table 5: Influence of row spacing on three cotton varieties, Stoneville, Mississippi, 1971-73 average.

Variety	Row width	Lint Per Acre				Lint	Seed index	Boll size	Fiber Properties				
		Total	First pick	First pick	40-in. rows				Length		Strength*	Elongation**	Micronaire
	in	*lb*	*lb*	*%*	*%*	*%*		*Grams*	*2.5%*	*50%*	*g/tex*		
Stoneville 213	40	1160	837	72	---	39.8	10.9	5.67	1.13	.54	19.13	8.0	5.36
Stoneville 213	30	1240	882	71	107	40.2	10.8	5.60	1.12	.53	18.93	8.2	5.37
Stoneville 213	15	1192	899	75	103	39.9	10.6	5.32	1.12	.54	19.09	8.0	5.31
Deltapine 16	40	1053	752	71	---	39.7	10.9	6.06	1.16	.56	19.78	9.7	5.09
Deltapine 16	30	1151	729	63	109	39.6	11.0	6.08	1.15	.55	20.04	9.7	5.09
Deltapine 16	15	1111	825	74	106	39.6	10.7	5.73	1.14	.54	19.97	9.8	5.00
Coker 310	40	1065	726	68	---	40.3	11.2	5.73	1.21	.57	20.45	7.5	4.95
Coker 310	30	1169	813	70	110	40.6	11.0	5.56	1.20	.57	20.35	7.6	4.91
Coker 310	15	1174	928	79	110	40.3	10.8	5.32	1.20	.55	20.29	7.6	4.78
Average	40	1092b[1]	772	71	---	39.91a	11.05a	5.82a	1.17a	.56	19.78a	8.4a	5.13a
Average	30	1187a	808	68	109	40.12a	10.92a	5.75b	1.16ab	.55	19.77a	8.5a	5.12a
Average	15	1159a	884	76	106	39.97a	10.72b	5.45c	1.15b	.54	19.78a	8.5a	5.03b

[1] Means followed by the same letter are not significantly different at the 5% level of probability.
*See footnote, Table 1.
**See footnote, Table 1

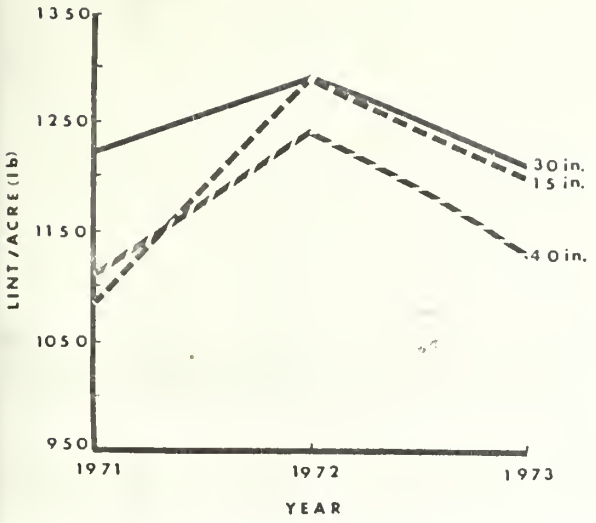

Figure 1. Average yield of Stoneville 213 planted in three row spacings, Stoneville, Mississippi, 1971-72-73.

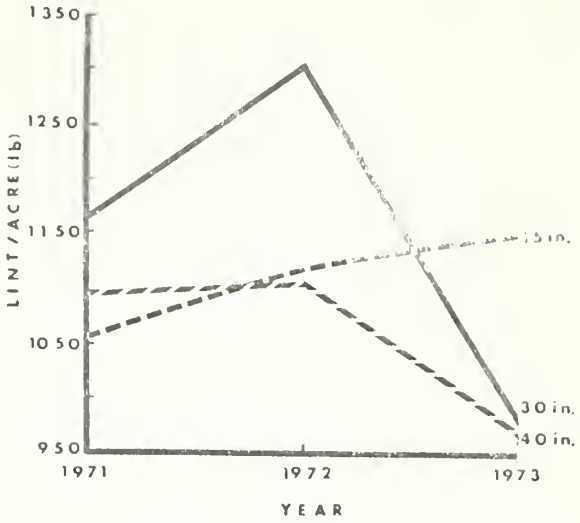

Figure 2. Average yield of Deltapine 16 planted in three row spacings, Stoneville, Mississippi, 1971-72-73.

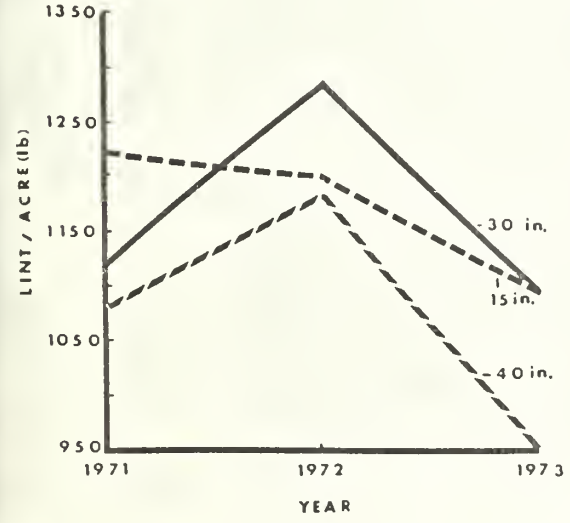

Figure 3. Average yield of Coker 310 planted in three row spacings, Stoneville, Mississippi, 1971-72-73.

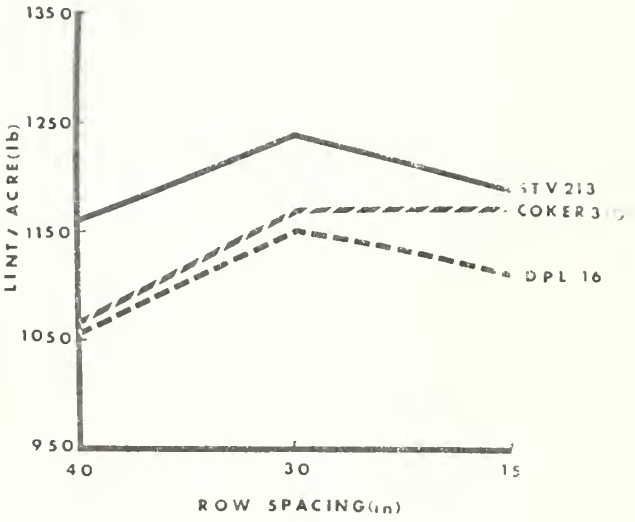

Figure 4. Average yields of three varieties of cotton planted in three row spacings, Stoneville, Mississippi, 1971-72-73.

gnificant variety by spacing and acing by year interactions were so measured. Briggs and Patter-n (3) reported that their studies ith narrow row spacings in cotton ave been inconsistent---a test in ie year was not very comparable a test of another year. Wilkes and obgood (15) reported lower yields ie year but equal yields the sec-id year from cotton grown in arrow rows. They also concluded that conventional varieties are not particularly adapted to narrow row production.

Our data also show that the response to different row spacings has been inconsistent (Figures 1-4). The performance of Stoneville 213 was more consistent than that of the other varieties tested. The highest lint yield of Stoneville 213 was obtained from the 30-inch row spacing in two of the three years. In 1972, the lint yield obtained from 30- and 15-inch rows was about equal. In two out of three years, the lint yield obtained from 15-inch rows was higher than that of 40-inch rows.

The response of Deltapine 16 to various row spacings was somewhat different, although in two of three years the 30-inch row spacing produced the highest yields. In 1971 and 1972, the

highest yield response of Deltapine 16 was obtained from 30-inch rows, but in 1973 the yield response obtained from 15-inch rows was the highest. In 1971 and 1972, the lint yield obtained from 30-inch rows was higher than for either 15- or 40-inch rows. These data indicate that differences in environment play a major role in the response obtained from different row spacings.

The response of Coker 310 to different row spacings was different from that of Stoneville 213 and Deltapine 16. In all three years the lowest lint yield of Coker 310 was obtained from 40-inch rows, but 15- and 30-inch rows gave variable results. In 1971, the 15-inch rows produced the highest yields, in 1972 the 30-inch rows were higher yielding, and in 1973 the 15- and 30-inch rows produced equal yields, which again points out the role of environment in measuring differential responses.

The three-year average (1971-73) of our study shows that the lowest lint yield was obtained from 40-inch rows for all varieties. The lint yield of Stoneville 213 and Deltapine 16 was the highest when planted in 30-inch rows (7 and 9% increases, respectively) and decreased slightly in 15-inch rows (3 and 6%, respectively). The lint yield of Coker 310 was equal in 15- and 30-inch rows, showing a 10% yield increase over 40-inch rows (Table 5).

The combined response (1971-73) of all varieties (Table 5) shows that 30- and 15-inch rows gave 9 and 6% increases in yield, respectively, when compared to 40-inch rows. These data imply that 15-inch rows matured earlier than 40-inch rows, but this was the case in only one of three years. The difference was so large during one year (1973) that the overall average indicated earlier maturity.

Niles (8) reported that Deltapine Smoothleaf was nearly identical in yield and maturity in single row and double row culture (31,000 and 62,000 plants per acre). He concluded that relatively high populations offer a means for increased yields when used in conjunction with proper genotypes. Wilkes (14) reported on the comparison of two varieties, planted on two dates in two drill spacings, and found that yield of the conventional variety, Deltapine Smoothleaf, was not significantly affected or was slightly decreased when planted in close drills during the normal planting season (April 20). When planted 30 days later (May 20) the yield increased in closer drill spacings, when compared with 40-inch rows. Our studies were planted 1 to 2 weeks later than normal each year, which may have reduced yields in 40-inch rows as compared to the closer spacings.

Niles (9) reported on variety performance at two row spacings, (one drill on a 40-inch bed and two drills 10 inches apart on a 40-inch bed). The response of Deltapine 16 to increased populations was negligible---he reported a 1% increase in lint yield over 2 years. His greatest yield increase in each season was from experimental strains that averaged 12-37% more lint over a two-year period. Brown, Beaty, Ethridge, and Hayes (4) reported that irrigation affected the optimum plant population considerably, irrespective of row spacing in corn. Since a moisture stress is evident at a much earlier date for 15-inch row spacings in cotton, timely irrigations might increase yield.

The combined data (1971-73) of our study indicated that row spacing had no significant influence on lint percent, fiber strength, and fiber elongation. Bolls produced on 15-inch row plots were significantly smaller than those of 30- and 40-inch row plots. There was no significant difference in boll size between 30- and 40-inch rows for Stoneville 213 and Deltapine 16, but the bolls produced by Coker 310 became significantly smaller as the distance between rows was reduced.

There was no significant difference in seed index between 30- and 40-inch rows, but 15-inch row plots produced slightly smaller seed. Fiber produced in 40-inch row plots was significantly longer than that produced in 15-inch rows, although in most years this difference was very small. Micronaire values of 40- and 30-inch row plots were significantly higher than those of 15-inch row plots. Kirk, Brashears, and Hudspeth (7) found that fiber length was not influenced by row width, but that fiber strength was reduced as row width and space between plots were reduced. Their data also showed a successive trend toward micronaire reduction as row width and spacings between plants decreased.

These data suggest that evaluation of Delta type varieties in narrow rows is less consistent than evaluations in 40-inch rows. These data also imply that it is necessary to have a relatively large number of environments to adequately evaluate the varietal response to several row spacings.

The potential for narrow row cotton production appears to vary between cotton growing areas. To the present time, yield results have been inconsistent.

One of the major obstacles in realizing the full potential of narrow row culture is the lack of special genotypes or varieties adapted to this type of production. In most studies it has been concluded that conventional varieties are not particularly adapted to narrow rows.

It has been suggested that narrow row culture may reduce production costs under certain circumstances. This potential will have to be evaluated on an area basis, since production systems and environments vary drastically across the Cotton Belt.

iese results do indicate a potenfor narrow rows, but suggest variety evaluation is more dift and requires more testing our usual variety evaluations.

The transfer to a narrow row production system would require the producer to replace or modify much of his field equipment. These conversions should be undertaken only when there are significant increases in yield or significant reductions in production cost.

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