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Effects of Row Width and Leaf Shape on Cotton

CONTENTS

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THE EFFECTS OF ROW WIDTH AND LEAF SHAPE ON COTTON GROWTH AND YIELD

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INTRODUCTION

The yield potential of cotton (*Gossypium hirsutum* L.) grown in the Gulf Coast area of the southeastern U.S. is generally high as a result of the fertile soils, long growing season, and abundant rainfall. However, late season rainfall increases the likelihood for boll rot, which can reduce cotton yield. Producers and researchers have evaluated various options for combating this problem, including the use of skip row planting patterns, variable planting rates and dates, and cultivar selection to maximize cotton yield. One option that has shown promise is the use of cultivars with a narrow lobed or cleft leaf, classified as "okra leaf" cotton *(11)*.

Okra leaf cotton cultivars have recently been introduced to the U.S. market. These cultivars have a more open canopy, which might increase CO_2 exchange, increase light penetration, and reduce the potential for boll rot *(2, 6)*. While okra leaf cotton might mature earlier than normal leaf cultivars *(4)*, yield is sometimes less *(1, 7, 14)*.

Producers in areas with historically high rainfall and rank growth have also developed management practices to limit vegetative growth; however, cotton cultivars may react differently to different production practices *(7)*. The number of fruiting forms (blooms, squares, and bolls) and their location on the plant can change with plant density *(9, 10)* while row width may have positive *(4)* or no effect *(5)*. Mainstem nodes may also decrease as population increases *(9, 10)*.

Although previous studies have been conducted to investigate cotton growth and yield response to leaf shape and row spacing, results are often conflicting *(9, 12, 13)*. No previous studies have been conducted and published from the Gulf Coast area of the southeastern U.S. comparing the growth habit and yield of normal leaf cotton to an okra leaf cotton isoline planted in two different row widths.

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MATERIALS AND METHODS

Experiments were conducted at the Gulf Coast Research and Extension Center in Fairhope, Alabama, to compare the growth and yield response of okra and normal leaf cotton planted in two different row spacings. Normal and okra leaf isolines of 'MD51-ne' were planted on May 12, 1994; May 5, 1995; and May 6, 1996, on a Malbis sandy loam (fine-loamy, siliceous, thermic Plinthic Paleudult). The 1995 experiment was irreparably damaged by a late-July hurricane; therefore, these data were not reported. The Malbis soil had a pH of 6.0 and contained 51% sand, 37% silt, 12% clay, and 1.2% organic matter. Monthly rainfall amounts for 1994 and 1996 are listed in Table 1.

All plots were conventional-tilled (moldboard plowed to 8- to 10-inch depths the spring prior to initiation of the experiment and disked prior to planting). Cotton was fertilized prior to planting in 1994 with 400 pounds per acre 5-22-22 analysis fertilizer in April and with a side-dress application of 175 pounds per acre ammonium nitrate on June 21, 1994. Cotton was fertilized prior to planting in 1995 and 1996 with 300 pounds per acre 7-21-21 analysis fertilizer in April and with a side-dress application of 448 pounds per acre 15-0-15 analysis fertilizer on June 14, 1995, and June 17, 1996. Seedling diseases were controlled using soil-applied in-furrow fungicides applied at planting. Plots were maintained weed-free throughout the growing season using herbicides, cultivation, and hand weeding. Insecticides were applied according to recommendations provided by the Alabama Cooperative Extension System. Mepiquat chloride [N,N-dimethylpeperidinium chloride] was applied at 0.005 pounds active ingredient (a.i.) per acre beginning prior to early bloom (three applications per season in 1994 and two in 1996) to control vegetative growth. Plots were chemically defoliated prior to harvest. The center two rows from each plot were machine-picked once on October 17, 1994, and October 11, 1996.

Data collected included the following: plant height in June, July, and September; height to node ratio in July and September; number of reproductive nodes (late season); percent fruit loss; earliness (number of open and closed bolls per 16 row-feet); and seed cotton yield. Season-end plant maps as described by Bourland and Watson *(3),* plant height, and node counts were recorded from six plants (first two fruiting positions per branch) in each plot.

Treatments were arranged in a randomized complete block design with a stripped plot arrangement. Row width (30- and 36-inch) represented whole plots,

TABLE 1. MONTHLY RAINFALL AT THE GULF COAST RESEARCH AND EXTENSION CENTER DURING 1994 AND 1996[1]

Year	April	May	June	July	August	September
1994	2.4	2.90	7.3	10.9	6.5	1.4
1996	11.7	0.48	7.4	6.6	6.0	1.9

[1]Amounts are in inches.

and leaf shape (normal and okra leaf) represented subplots with eight replications. Subplots were four rows wide by 20 feet long each year. Data were subjected to analysis and means were separated using Fisher's Protected LSD Test at the 5% level. Data were not pooled across experiment years where there was a year-by-treatment interaction (P>F= 0.05).

RESULTS AND DISCUSSION

Plant Height

Plant heights recorded in June indicated that there was no difference between treatments on early-season growth (Table 2). The average plant height at the first date was 11 inches. There were also no differences in July (average= 2.1 inches) or September (average= 2.0 inches) height to node ratio.

There was a year-by-row width treatment interaction for September height (Table 2); therefore, these data are presented by year. In 1994, there were treatment effects but no interactions. In 1994 plants were five inches taller when planted in 30-inch rows, and normal leaf cotton was taller than okra leaf cotton (Table 3). There was a row width-by-leaf shape interaction in 1996 (Table 2); therefore, these data were not combined. Plants were either unaffected (okra leaf) or shorter (nor-

TABLE 2. ANALYSIS OF VARIANCE SUMMARY

	Variable				
	Row spacing (R)	Leaf shape (L)	RL	YR[1]	YL
	P>F				
July HNR	0.2391	0.5337	0.9247	0.1175	0.2547
Sept. HNR	0.1158	0.2247	0.1198	0.1407	0.3390
June height	0.7527	0.7449	0.9364	0.0746	0.8231
Sept. height				0.0001	0.6144
1994	0.0001	0.0152	0.1821		
1996	0.1001	0.0650	0.0001		
July FFN	0.9057	0.6785	0.9882	0.5999	0.1742
Reproductive nodes				0.0007	0.0114
1994	0.0111	0.2934	0.1288		
1996	0.0263	0.0135	0.5796		
Total fruit loss	0.0620	0.0017	0.3915	0.2515	0.9342
Fruit loss on lower five nodes	0.0196	0.2528	0.0635	0.1503	0.4538
Fruit loss on upper five nodes	0.2126	0.0017	0.9559	0.2044	0.9397
Total open bolls	0.5585	0.0057	0.9327	0.1450	0.7778
Seed cotton yield	0.0668	0.0040	0.6131	0.1980	0.2593

[1]Abbreviations: YR, year x row spacing interaction; YL, year x leaf shape interaction; HNR, height to node ratio; FFN, first node with a fruiting branch.

mal leaf) in the 30-inch rows in 1996 (Table 4). Normal leaf cotton was taller than the okra leaf isoline only when planted in 36-inch rows.

Table 3. Influence of Row Spacing and Leaf Shape on Sept. Cotton Height, 1994

Row spacing	Height	Leaf shape	Height
in	*in*		*in*
30	43	Normal	41
36	38	Okra	39
LSD (0.05)	2	LSD (0.05)	2

Table 4. Influence of Row Spacing and Leaf Shape on Sept. Cotton Height, 1996

Row spacing	Leaf shape	Height
in		*in*
30	normal	40
36	normal	45
30	okra	42
36	okra	40
LSD (0.05)		3

Reproductive Node Development

There was no treatment effect on the location (node) of the first fruiting branch (FFN), regardless of row width or leaf shape (Table 2). On average, the first fruiting branch developed at reproductive nodes 5 and 6 (average= 5.7).

There was a year-by-treatment interaction for total reproductive nodes (Table 2); therefore, these data are presented separately. In 1994, cotton planted in 36-inch rows developed 1.3 more reproductive nodes than when planted in 30-inch rows (Table 5). Likewise, in 1996, cotton planted in wider rows developed 1.1 more reproductive nodes than cotton planted in narrower rows. Leaf shape did not affect reproductive node development in 1994. In 1996, normal leaf cotton developed 1.2 reproductive nodes more than the okra leaf isoline (Table 6).

Table 5. Influence of Row Spacing on Number of Reproductive Nodes, 1994, 1996

Row spacing	Reproductive nodes	
	no/plant	
	1994	1996
30	12.1	14.6
36	13.4	15.7
LSD (0.05)	0.9	0.9

Table 6. Influence of Leaf Shape on Number of Reproductive Nodes, 1996

Leaf shape	Reproductive nodes
	no/plant
Normal	15.8
Okra	14.6
LSD (0.05)	0.5

Fruit Loss, Earliness, and Seed Cotton Yield

Total fruit loss was not affected by row spacing either year (Table 2); therefore, these data were combined. Normal leaf cotton had lower fruit loss at 43% compared to 59% for the okra leaf isoline (Table 7). Heitholt and Schmidt *(8)* also indicated that normal leaf cotton of standard cultivars had lower fruit loss when compared to the okra leaf isoline used in their study. Fruit loss on the lower five

TABLE 7. INFLUENCE OF LEAF SHAPE ON FRUIT LOSS, EARLINESS, AND SEED COTTON YIELD

Leaf shape	Fruit loss	Open bolls	Seed cotton yield
	%	%	*lb/acre*
Normal	43	56	2280
Okra	59	62	1950
LSD (0.05)	6	4	170

reproductive nodes was not affected by leaf shape (Table 2) but was highest in 30-inch rows (Table 8). There was no effect of row spacing on fruit loss at the uppermost five nodes either year (Table 2). Normal leaf cotton had lower fruit loss (65%) at the uppermost five nodes compared to 80% for the okra leaf isoline (Table 9). Results from this study and others *(7)* indicated that earliness (percent open bolls) was not affected by row spacing (Table 2). The higher fruit loss on the uppermost five reproductive nodes on okra leaf cotton resulted in a higher percentage of open bolls (Table 7).

TABLE 8. INFLUENCE OF ROW SPACING ON FRUIT LOSS ON THE LOWER FIVE REPRODUCTIVE NODES

Row spacing	Fruit loss
inches	%
30	65
36	59
LSD (0.05)	5

TABLE 9. INFLUENCE OF LEAF SHAPE ON FRUIT LOSS ON THE UPPER FIVE REPRODUCTIVE NODES

Leaf shape	Fruit loss
	%
Normal	65
Okra	80
LSD (0.05)	9

There was no effect of row spacing on seed cotton yield either year (Table 2); therefore, these data were combined. Normal leaf cotton yielded higher than the okra leaf isoline (Table 7). The normal leaf yield was 17% higher compared to the okra leaf isoline.

CONCLUSIONS

Normal leaf and okra leaf cotton had similar early-season growth (as reflected by height or height to node ratio measurements). Normal leaf cotton was generally taller than the okra leaf isoline by the end of the growing season. Plant height response to row spacing was not consistent with taller plants in narrow rows in 1994 and taller plants in wider rows in 1996. The results from 1996 are in agreement with other research that indicates that cotton height generally decreases as row spacing decreases *(1)*. Although normal leaf cotton was taller (and yielded more in this study) than okra leaf cotton, other studies indicate that there is no consistent correlation between plant height and yield *(9)*. The effect of row spacing on reproductive node development tended to be similar both years with cotton planted in 36-inch rows averaging slightly higher than cotton in 30-inch rows. There was no consistent effect of leaf shape on reproductive node development with no effect in 1994 and slightly higher reproductive nodes produced on normal leaf cotton in 1996.

In this study, row spacing had no effect on earliness although reducing the row spacing further has been shown to increase open boll count as row width decreased *(1)*. Normal leaf cotton retained more fruit than the okra leaf isoline. This resulted in slightly later maturity for the normal leaf cotton. Earliness may result in reduced boll rot in some areas of the country *(1, 2)*. However, producers in the Gulf Coast area of the southeastern U.S. often delay planting in an attempt to delay boll opening and reduce the likelihood of boll rot after seasonal late summer rains. Normal leaf cotton yielded 17% higher than its okra leaf isoline in our study. Other researchers have also found lower yields with okra leaf cotton *(1, 14)*.

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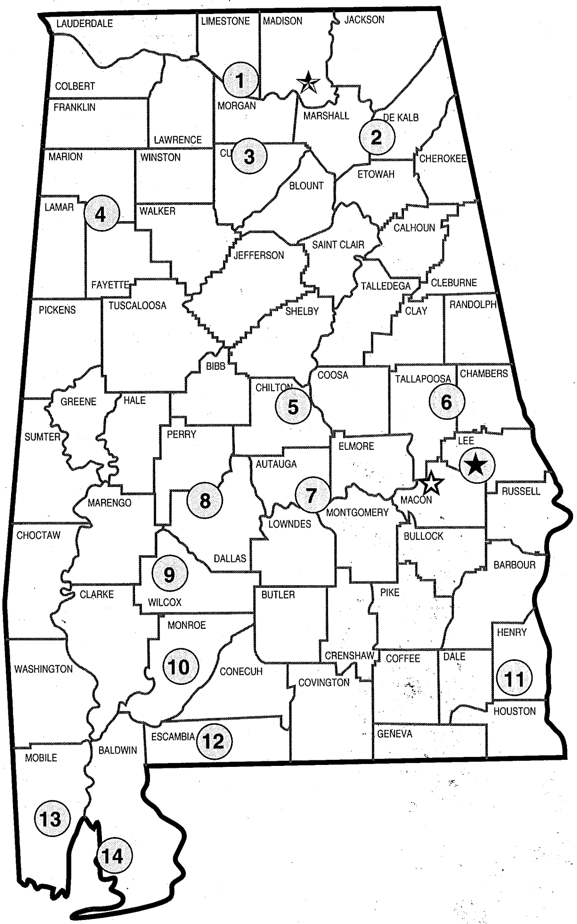

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