YIELD RESPONSE OF IRRIGATED AND RAINFED COTTON TO ROW SPACING, N RATE AND PLANT POPULATION DENSITY

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Abstract

Cotton (*Gossypium hirsutum L.*) in the mid-South USA is grown at row spacing of 30 to 40 inches. Most agronomic research has been conducted at row spacings of 38 to 40 inches. The objective of this research was to compare the performance of cotton in 30- and 40-inch row spacings using different N rates and plant population densities. Field studies were conducted for four years (1992-1995) on Sharkey clay at the Northeast Research Station near St. Joseph, LA. Each year a factorial experiment was planted with two row spacings (30 and 40 inches), two irrigation regimes (irrigated and nonirrigated), four plant densities (26000, 39000, 52000 and 65000 per acre) and four N rates (60, 90, 120 and 150 lb per acre). Irrigation increased yield in only one of four years. Lint yields were higher in the 40-inch row spacing in two of the four years and were not affected by row spacing in the other two years. Averaged across years, irrigation, N rate and plant density, the 40-inch rows had a lint yield advantage of 54 pounds per acre. The row spacing x N rate and row spacing x plant density yield interactions were significant. The optimal N rate for cotton in 30-inch rows was 120 pounds per acre and for 40-inch rows was 90 pounds per acre. Optimal plant density for 30-inch rows was 26000 per acre and for 40-inch rows was 39000 per acre. Results demonstrate that little yield difference should be expected between 30- and 40-inch row spacings and that closer row spacing requires higher N rates for maximum yield.

Introduction

The traditional row spacing for cotton in the mid-South USA is 38 to 40 inches (Burch, 1989; Waddle, 1984). The development of spindle harvesters in the early 1990's that can pick cotton in row spacings closer than 38 inches has allowed use of closer row spacings. Farmers view this development as an opportunity to benefit from several perceived advantages of narrow-row cotton. These include: i) increased efficiency of farm enterprises that grow multiple crops, ii) possible earlier maturity of cotton and iii) higher yields. In some regions, a row spacing of 30 inches has increased yield 10 to 20% compared with a 40-inch row spacing (Andries et al., 1971; Briggs et al., 1974; George et al., 1980; Hielman and Namken, 1987; Kerby et al., 1990; Peacock et al., 1971). Williford et al. (1986) initially reported that, in the mid-South, closer row spacing did not increase yield, but later found that response to row spacing was dependent upon soil texture (Williford, 1990). Hutchinson et al. (1986) found no differences in yield between 20-, 30- and 40-inch rows for cotton grown on silt loam soil in the Macon Ridge area of Louisiana. Additional research is needed to clarify the possible benefits of 30-inch row spacings for cotton in the mid-South. Further, since most previous research has been conducted with cotton in 38 to 40-inch row spacings only, research is needed to compare yield responses to varying levels of management practices and inputs such as irrigation, N rate and plant population density. Specific cultural practices identified as optimal for cotton in wide row spacings may not produce optimal results with cotton planted in 30-inch rows. This study was conducted to: i) compare yields between 30- and 40-inch row spacings and ii) to determine the optimal N rate and plant density for irrigated and nonirrigated cotton in 30-inch rows.

Materials and Methods

Field experiments were conducted on Sharkey clay from 1992 through 1995 at the Northeast Research Station near St. Joseph, LA. Each year the experiment included two row spacings (30- and 40-inches), two irrigation regimes (irrigated and nonirrigated), four N rates (60, 90, 120, and 150 lb per acre) and four plant densities (26000, 39000, 52000 and 65000 plants per acre). The planting dates were 14 April 1992, 25 April 1993, 13 April 1994 and 4 May 1995. Hyperformer HS46 was the cultivar used from 1992 through 1994. In 1995, Stoneville LA887 was planted. Irrigation water was applied whenever the soil water suction at a depth of 20 inches reached 700 mb. Fertilizer N was broadcast applied at planting as ammonium nitrate. Desired plant densities were obtained by excess seeding and hand thinning to precise densities during the two weeks following emergence. Plant densities were verified after harvest. The experiments were planted in a randomized complete block design with four blocks. A split plot arrangement of treatments was used with irrigation on main plots, row spacings on sub plots and N rate-plant density combinations on sub sub plots. The experimental units consisted of plots four rows wide and 50 feet long.

Data were collected on seedcotton yield per acre, lint percent, boll size, number of bolls per acre and number of rotten bolls per acre. Lint yield per acre was calculated as seedcotton yield x lint percent. Data were analyzed by analysis of variance and the protected LSD(P=0.05) was used for mean separation.

Results and Discussion

Irrigation affected cotton lint yield in only one of the four years. There was no interaction of irrigation with row

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spacing, N rate or plant density. For presentation of results in this paper, row spacing, N rate and plant density effects were averaged across the two irrigation regimes.

In two of four years, there was a significant lint yield advantage for the 40-inch row spacing over the 30-inch rows (Table 1). Averaged across years, per acre lint yield in the 40-inch rows was 54 pounds higher than the lint yield in 30-inch rows. As described below, however, there were significant row spacing x N rate and row spacing x plant density interactions.

There was a significant yield response to increasing N rate. The row spacing x N rate yield interaction was also significant. Lint yields in 40-inch rows were maximized with the application of 90 pounds of N per acre (Table 2). In contrast, cotton planted in the 30-inch rows required 120 pounds of N to attain maximum yields. At N rates of 60 and 90 pounds per acre, lint yields were higher in 40-inch rows compared with 30-inch rows. At N rates of 120 and 150 pounds per acre, there was no difference in yield between row spacings. This interaction was due to an increase in yields in the 30-inch spacing with increase in N rate above 90 pounds per acre concurrent with a decrease in yields in the 40-inch spacing with increase in N rate above 90 pounds per acre.

The effects of plant density on yield were small but significant and there was a significant row spacing x plant density interaction. Yields were increased in the 40-inch row spacing by increase in plant density up to 39000 per acre (Table 3). In the 30-inch row spacing, there was no yield response to increasing plant density above 26000 per acre. It was surprising that there was less response to increasing plant density with the 30-inch row spacing. There was no obvious reason for the lack of response. Yields were maximized with a plant density of 3 plants per foot of row in the 40-inch rows and 1.5 plants per foot of row in the 30-inch rows.

In three of the four years, cotton in the 30-inch row spacing produced a larger number of fruiting sites as determined by daily bloom production during the effective bloom period (the five weeks following bloom initiation). During this time, the 30-inch row spacing averaged 1000 more blooms per day than cotton in the 40-inch row spacing (Table 4). Despite the larger bloom production and ostensible higher yield potential, lint yield was not increased by the closer row spacing.

Summary

In this four-year study on Sharkey clay, lint yields of cotton planted in a 40-inch row spacing were higher than lint yields of cotton planted in a 30-inch row spacing. There were significant row spacing x N rate and row spacing x plant density yield interactions. The 30-inch row spacing required a higher N rate than 40-inch rows to maximize lint yield but highest yields in 30-inch rows were obtained with fewer plants per acre than 40-inch rows.

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Table 1. Lint yield of cotton planted in 30- and 40-inch row spacings at St. Joseph, LA.†

Year	Row spacing	
	30-inch	40-inch
	Lint yield, lb/a	
1992	1360	1420*
1993	1190	1340*
1994	1290	1280
1995	1230	1250
4-yr.avg.	1268	1322*

†Yields were averaged across irrigation, N rate and plant density treatments.
*Indicates a significantly higher lint yield for the 40-inch row spacing over the 30-inch row spacing within a year or 4-yr. avg. at the 0.05 probability level.

Table 2. Lint yield response to N rate in 30- and 40-inch row spacings at St. Joseph, LA - averaged across four years.†

	Row spacing	
N rate	30-inch	40-inch
lb/a	Lint yield, lb/a	
60	1160	1260*
90	1285	1365*
120	1320	1345
150	1345	1325
LSD(0.05) = 40		

†Yields were averaged across irrigation and plant density treatments.
*Indicates a significantly higher lint yield for the 40-inch row spacing over the 30-inch row spacing at the 0.05 probability level.

Table 3. Lint yield response to plant density in 30- and 40-inch row spacings at St. Joseph, LA - averaged across four years.†

Plant	Row spacing	
density	30-inch	40-inch
Plts/a	Lint yield, lb/a	
26000	1285	1295
39000	1265	1350
52000	1280	1325
65000	1280	1335
LSD(0.05) = 40		

†Yields were averaged across irrigation and N rates treatments.

Table 4. Average 24-hour bloom production for cotton planted in 30- and 40-inch row spacings at St. Joseph, LA.†

Year	Row spacing	
	30-inch	40-inch
	Bloom no./a	
1992	9344*	8337
1993	7417	8020
1994	9432*	7884
1995	12487*	10671
4-yr. avg.	9670*	8728

†Bloom number was averaged across irrigation, N rate and plant density treatments.
*Indicates a significantly higher bloom number for the 30-inch row spacing over the 40-inch row spacing within a year or 4-yr avg. at the 0.05 probability level.