NITROGEN FERTILIZER RATES AND PLANT DENSITY FOR COTTON PLANTED IN A 10-INCH ROW SPACING

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Abstract

Stripper production of cotton planted in a 10-inch row spacing may be a viable alternative to wide-row spindle-picked cotton on the droughty loess soils of the mid-South USA. We performance of cotton in 10-inch row spacings with the conventional 40-inch row spacing. A single irrigated experiment was planted in 1996 conducted experiments to: 1) determine the optimal plant density and N rate for irrigated and dryland cotton planted in a 10-inch row spacing and 2) compare the and two experiments were planted in 1997 - irrigated and dryland. The soil type was a Gigger silt loam. Stoneville 495 was planted in 1996 and Paymaster 1220BG/RR was planted in 1997. The 1996 experiment evaluated plant densities of 45000 to 75000 in increments of 5000 plants. The 1997 experiments were a factorial arrangement of three plant densities (52000, 104000 or 156000 plants per acre), and four N rates (80, 100, 120, or 140 pounds per acre). To control plant height, Pix was applied as- needed to the irrigated tests. For comparison, each density-N rate treatment was paired with a conventional 40-inch row spacing treatment (cotton planted in a 40-inch row spacing at a density of 47000 plants per acre and fertilized with 80 pounds N per acre. Plant density had no effect on cotton yield in 1996 (avg. 1071 lb lint/a), or in the 1997 irrigated (avg. 957 lb lint/a) and dryland (avg. 457 lb lint/a) experiments. In comparison, yield of the 40-inch row spacing treatment in the 1997 irrigated test was 1092 lb lint/a and in the dryland experiment was 766 lb lint/a. Increase in plant density decreased boll number per plant and individual boll weight. Increasing the N rate had no effect on boll number per plant. Increase in N rate had little or no effect on boll weight. Cotton planted in a 40-inch row spacing yielded more than that planted in a 10-inch row spacing under both irrigated and dryland conditions.

Introduction

The loess soils of the mid-South USA are difficult to manage for cotton production because they contain little organic matter, are droughty and erode easily. Cost of production is high and irrigation is a necessity for optimal yield. Growing cotton in narrow-row spacing for stripper harvesting has been proposed as a means of increasing yield and/or lowering production costs (Atwell, 1996). Previous row spacing research has produced variable results depending upon location and cultivar. Hutchinson (1982) found that 20-, 30- and 40-inch row spacing for cotton resulted in similar yields. Gwathmey and Hayes (1996) reported increased yields for Deltapine 20 in 10-inch rows compared with 40-inch rows but found no difference in yields for Chembred 830 planted in 7.5 and 40-inch row spacings. Stripper cultivars have not yielded as well as picker cultivars in the mid-South, so the use of stripper cultivars in not an option for mid-South production (Gwathmey and Hayes, 1996; Boquet, 1982)

Because stripper harvesting requires smaller-stature plants than spindle harvesting, management practices for picker cultivars must be modified to ensure reduced plant size (<30- inch plant height). In the mid-South, this may be difficult to do and may require adjustments in irrigation scheduling, plant population density, N rates, and the use of a growth regulator. The objective of this study was to determine the effects of plant density and N rates on the yield and growth of cotton planted in a 10-inch row spacing under irrigated and dryland conditions. Yields of all treatments were directly compared with yields of cotton in the 40-inch- row conventional system. Plant density had no effect on cotton yield in 1996 (avg. 1071 lb lint/a), or in the 1997 irrigated (avg. 957 lb lint/a) experiments. In comparison, yield of the 40-inch row spacing treatment in the 1997 irrigated test was 1092 lb lint/a and in the dryland experiment was 766 lb lint/a. Increase in plant density decreased the boll number per plant and individual boll weight. Increase in the N rate had little or no effect on boll weight. Cotton planted in a 40-inch row spacing yield more than that planted in a 10-inch row spacing yielded more than that planted in a 10-inch row spacing under both irrigated and dryland conditions.

Materials and Methods

Experiments were conducted on Gigger silt loam at the Northeast Research Station - Macon Ridge near Winnsboro, LA. The 1996 irrigated experiment was planted to Stoneville 495 on 8 May. The 1997 irrigated and dryland experiments were planted to Paymaster 1220BG/RR on 20 May but because seedling emergence in the 10-inch row spacing was less than needed to establish the desired plant densities, the 10-inch rows in both experiments were replanted on 6 June 1997. The experimental design was a factorial arrangement of three plant densities (52000, 104000 and 156000 plants per acre) and four N rates (80, 100, 120, and 140 pounds per acre) in a randomized complete block with four blocks. Check treatments were cotton planted in 40-inch rows at a plant density of 47000 plants per acre and a fertilizer N rate of 80 pounds per acre. The experimental units were plots 14 feet wide and 45 feet in length. Uniform stands of the desired plant densities were obtained by excess seeding and thinning one week after emergence. Multiple applications of Pix were applied to the 10-inch rows in the irrigated experiments as-needed to control plant height. In 1996, 6 oz were applied and in 1997 12 oz were applied.

Data were collected on plant height, boll weight , number of harvestable bolls per plant, lint percent and lint yield per acre. Plant height was determined by measuring 10 random plants per plot. Seedcotton yields and boll number per plant were determined by hand picking and counting all open bolls in a 42 square foot area from the center of each plot. Lint percentage and boll weight were determined by ginning a representative 30-boll sample for each plot. All data were analyzed using the GLM procedures of SAS (SAS Institute, 1989) and the LSD was calculated for mean comparisons.

Discussion

In the 1996 irrigated experiment, yields were not affected by plant population density that ranged from 45000 up to 75000 plants per acre (Fig. 1). Plant height was not affected by plant density and was an average of 37 inches. Due to the high N rate of 120 pounds per acre and irrigation, plant height was taller than desirable for stripper harvesting.

Lint yields in the 1997 dryland experiment averaged 452 pounds per acre and were not affected by plant density or by N rate (Tables 1 and 2). Yields were low due to low rainfall and dry conditions in August. Plant density had a small effect on plant height and N rate had no effect on plant height that averaged 23 inches. Even though no Pix was applied in this experiment, plant heights were short due to the dry conditions during late summer. Individual boll weight and boll number per plant were affected by plant density but not by N rate. The lowest plant density had the largest bolls and the largest number of bolls per plant (Table 1). There was no effect of plant density or N rate on lint percentage, which averaged 42.0.

The dryland check treatment (40-inch rows) averaged 766 pounds of lint per acre and a plant height of 37 inches. With the lower plant density and no Pix application, plants in the 40-inch rows were larger and produced more bolls. Some of the advantage of the check treatment was also due to earlier stand establishment, as the cotton planted on wide bedded rows were able to withstand heavy early-season rains much better than the drilled 10-inch cotton. The 40-inch rows were thus clearly superior to the 10-inch rows in 1997.

In the 1997 irrigated experiment, lint yields in the 10-inch row spacing averaged 954 pounds per acre. There was no effect of plant density or N rate on yield. (Tables 3 and 4). Plant height was not affected by plant density or N rate and averaged 28 inches. Similar to the dryland experiment, increase in plant density resulted in fewer bolls per plant and smaller bolls. Increasing the N rate had no effect on either boll number or boll weight. Lint percentage averaged 42.4 and was not affected by the plant density or N rate treatments.

Lint yield in the irrigated check treatment (40-inch rows) averaged 1092 pounds per acre, compared with an average yield of 954 pounds per acre in the 10-inch rows. Without Pix application, plants in the 40-inch rows averaged 9 inches taller than the plants in 10-inch rows. Boll number per plant in the 40-inch rows was much higher than in the 10-inch rows (Table 4). Individual boll weight of 5.1 g was similar to that of the cotton in the 10-inch row spacings.

Summary

Plant density and N rate had no effect on the yield of cotton planted in 10-inch rows. Increase in plant density decreased the number of bolls per plant but did not affect individual boll weight. Increasing the N rate had no effect on boll number or boll weight. Cotton planted in a 10-inch row spacing yielded less than that planted in a 40-inch row spacing under both irrigated and dryland conditions.

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Table 1. Plant population density effect on dryland cotton grown in a 10-inch row spacing, averaged across four N rates, 1997.

Plant density	Lint yield	Lint	Plant height	Boll Weight	Boll Number
-no./ac-	-lb/ac-	--%--	--in.--	---g---	-no./plot-
52,000	430	42.1	23.7	4.6	2.3
104,000	479	42.1	23.5	4.3	1.6
156,000	460	42.0	21.4	4.2	1.1
Control*	766	41.5	36.7	4.8	4.9
LSD (0.05) =	64	0.7(NS)	1.6	0.25	0.2

*The control treatment was planted in a 40-inch row spacing with 47,000 plants/acre fertilized with 80 lb N/ac.

Table 2. Nitrogen rate effect on dryland cotton grown in a 10-inch row spacing, averaged across three N rates, 1997.

N Rate	Lint yield	Lint	Plant height	Boll Weight	Boll Number
-lb/ac-	-lb/ac-	--%--	--in.--	---g---	-no./plot-
80	456	41.9	22.0	4.2	1.9
100	450	42.5	22.3	4.3	1.6
120	454	41.9	23.9	4.3	1.6
140	468	41.9	23.5	4.6	1.6
Control*	766	41.5	36.8	5.1	4.9
LSD (0.05) =	74	0.8(NS)	1.8	0.29	0.3

*The control treatment was planted in a 40-inch row spacing with 47,000 plants/acre fertilized with 80 lb N/ac.

Table 3. Plant population density effect on irrigated cotton grown in a 10-inch row spacing, averaged across four N rates, 1997.

Plant density	Lint yield	Lint	Plant height	Boll Weight	Boll Number
-no./ac-	-lb/ac-	--%--	--in.--	---g---	-no./plot-
52,000	983	42.4	28.5	5.1	4.8
104,000	960	42.1	28.9	5.0	3.0
156,000	929	42.6	26.8	4.8	2.2
Control*	1092	42.8	36.8	5.1	5.8
LSD (0.05) =	87	0.7(NS)	3.7	0.18	0.5

*The control treatment was planted in a 40-inch row spacing with 47,000 plants/acre fertilized with 80 lb N/ac.

Table 4. Nitrogen rate effect on irrigated cotton grown in a 10-inch row spacing, averaged across three N plant densities, 1997.

N Rate	Lint yield	Lint	Plant height	Boll Weight	Boll Number
-no./ac-	-lb/ac-	--%--	--in.--	---g---	-no./plot-
80	904	42.5	27.3	5.1	2.8
100	1002	42.2	28.5	4.9	3.3
120	920	42.3	28.8	4.9	3.4
140	988	42.5	27.2	4.9	3.2
Control*	1092	42.8	36.8	5.1	5.8
LSD (0.05) =	100	0.8(NS)	4.3	0.21	0.6

*The control treatment was planted in a 40-inch row spacing with 47,000 plants/acre fertilized with 80 lb N/ac.

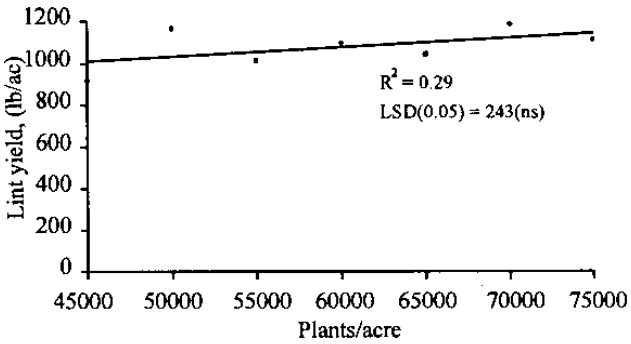

Figure 1. Plant population density effect of irrigated cotton grown in a 10-inch row spacing on lint yield, 1996.