YIELD RESPONSE OF COTTON TO NARROW-ROW PLANTING AND THREE PLANT POPULATIONS IN THE COASTAL BEND OF TEXAS

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Abstract

The effects of two row configurations (single rows and double rows) and three in-row planting rates on growth and yield of upland cotton were evaluated in Corpus Christi, Texas during 2000. The combination of these two factors resulted in target plant populations of 40,000, 55,000, 70,000, 80,000, 110,000, and 140,000 plants per acre. Higher in-row planting rates and double-row planting decreased individual plant size. Doubling plant population through double-row planting decreased about 35% the number of fruiting positions per plant. Boll size was decreased by increased in-row planting density (11% decrease between 3 and 5 plants per row-foot), but was not affected by row planting configuration. Doubling plant population through double-row planting increased the number of harvested bolls per unit area and the boll weight per unit area by about 27% across in-row planting rates. Lint yield was increased 11% by double-row planting, but was not affected by the in-row planting rates.

Introduction

Cotton is an economically important crop in the Coastal Bend of Texas, as it contributes from 62% to 77% of the combined gross income of the region's popular cotton-grain sorghum rotation (L. Falconer, personal communication). An increased and more stable profitability of cotton production is essential for improving and securing the sustainability of the farming industry in the region.

Narrow-row planting in cotton production was introduced about 35 years ago as a means of improving the use efficiency of light, water, and nutrients. The optimum configuration for narrow-row planting of cotton is still under investigation and likely depends on the particular environmental conditions of each cotton growing region.

The objective of this study was to evaluate the combined effects of three in-row planting rates and two row configurations, namely, single rows and double rows.

Materials and Methods

The experiment was conducted at the Texas A&M University Agricultural Research and Extension Center in Corpus Christi, TX, during the 2000 season. The soil at the experimental site is a Victoria clay-Orelia fine sandy clay loam complex. Before planting, fertilization of 45 lbs./acre of P_2O_5, 110 lbs./acre of N, 20 lbs./acre of S, and 4 lbs./acre of Zn, as well as yellow herbicide, were applied broadcast and incorporated by disking. Pre-emergence herbicide was also applied. Upland cotton cv. Paymaster 2280BG/RR was planted with a vacuum precision Monosem NG Plus planter on 31 March 2000. Insect pests were controlled by ground applications of insecticides as needed.

Treatments included two row configuration patterns on beds 38 inches apart (single rows and 12-inch apart double rows that left 26 inches of furrow between beds) and three in-row planting rates within each row configuration (3, 4, and 5 seeds per row-foot). The combination of these two row configurations and three in-row planting rates resulted in target plant populations of 40,000, 55,000, 70,000, 80,000, 110,000, and 140,000 plants per acre. Plots were four beds wide and 150 ft long. Treatments were arranged in a randomized complete block design with four replications

Rainfall and potential evapotranspiration (PET) totals during 90 d before planting were 3.4 inches and 12.1 inches, respectively. From planting to first square stage, rainfall and PET totals were 0.7 and 5.5 inches, respectively. Rainfall, irrigation, and PET totals from first square to first bloom were 4.1, 1.0, and 6.0 inches, respectively, and from first bloom to early open boll stage were 0.8, 4.9, 13.5 inches, respectively. Irrigation was applied using a drip system.

Prior to harvesting and after plants were completely defoliated, plants from 1-m row were cut at the base from the second or third row of each plot for plant mapping and determination of yield components including final plant population.

Yield measurements were made by hand-picking 1/1000 of an acre from one of the two central rows in each plot and ginning for lint turnout determination.

Results and Discussion

Plant Population
Plant populations ranged widely from 33,339/acre for single rows planted at 3 plants per row-foot to 117,326/acre for double rows planted at 5 plants per row-foot (Figure1). Plant populations of all treatments were lower than the target populations; from 17% to 28% lower in single rows and from 16% to 20% lower in double rows. The objective of producing different in-row plant populations and doubling the plant population by using double row configuration, nevertheless, were fairly achieved.

Fruiting Positions
The number of fruiting positions (sympodial nodes) per plant was similar (28 nodes per plant) at the two lowest plant populations (single rows with 3 and 4 plants/row-foot). With further increases in plant population, the number of sympodial nodes declined almost proportionally from 28.4 to 13.6, the latter corresponding to 4 or 5 plants/row-foot in double rows (Figure 2). When expressed on a per area basis, however, the number of sympodial nodes increased almost proportionally to the increase in plant population, from 224 nodes/m^2 to 392 nodes/m^2 (graphic data not shown). The number of sympodial nodes in double rows was about 1.5 times greater than that in the single rows; all differences were significant.

Fruit Retention
Percent fruit retention decreased slightly (about 3% across in-row planting rates) with double rows, but the significance of this difference was only marginal (Figure 3). Percent fruit retention ranged from 29.6% to 33.2% in single rows and from 27.4% to 29.9% in double rows.

Open Bolls
Because there were small differences in fruit retention, the number of open bolls per plant followed a similar trend than the number of sympodial nodes per plant, i.e. there were no differences between 3 and 4 plants/row-foot in single rows, but decreased with further increases in plant population from 9.5 bolls per plant to 3.9 bolls per plant (Figure 4). The number of open bolls ranged from 5 per plant with 3 plants/row-foot in single rows to about 2.2 per plant with 4 or 5 plants/row-foot in double rows.

When expressed on a per area basis and similarly to the number of sympodial nodes, the number of open bolls per unit area increased almost proportionally to the increase in plant population, from 74 bolls/m^2 to 113 bolls/m^2 (Figure 5). The number of open bolls per unit area ranged from 1.2 to 1.4 times greater in double rows than in single rows across in-row

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:464-467 (2001)
National Cotton Council, Memphis TN

planting rates, but the difference was only significant at 5 plants/row-foot (P=0.0059).

Weight of Individual Bolls

Individual boll weight decreased with increased in-row planting density within both single and double rows (Figure 6). In single rows it decreased from 4.5 g to 4.0 g, while in double rows it decreased from 4.6 g to 4.1 g, only these extreme differences were statistically significant.

Boll Weight

Boll weight per plant followed the same trend as the number of open bolls per plant, although its decrease with plant population was slightly more accentuated than observed in open bolls per plant (graphic data not shown). This resulted from the concomitant decrease in open bolls per plant and weight of individual bolls. Boll weight per plant ranged from 41 g with 3 plants/row-foot in single rows to 16 g with 5 plants/row-foot in double rows. Differences were statistically significant between extreme in-row planting rates in both row configurations. Differences between single and double rows in each in-row planting densities were all significant, in favor of single rows.

When expressed on a per area basis, differences in boll weight became smaller than the differences in number of open bolls, as the weight of individual bolls decreased with increased in-row planting density. Differences among in-row planting densities were not significant within both single and double rows (Figure 7). Boll weight per meter square was higher in double rows than in single rows only at the lowest and highest in-row planting density; 406 g/m^2 vs. 332 g/m^2 (P=0.1009) with 3 plants/row-foot and 454 g/m^2 vs. 312 g/m^2 (P=0.0040) with 5 plants/row-foot.

Lint Turnout

Percent turnout ranged from 33.9% to 34.7%, but there were no statistical differences among treatments (graphic data not shown).

Lint Yield

Lint yield showed significant differences among in-row planting densities only within the single row configuration (Figure 8). In single rows, the higher lint yields were obtained with 4 and 3 plants/row-foot (1245 and 1142 lbs./acre, respectively) Five plants/row-foot decreased yield 18% when compared to that of 4 plants/row-foot (P=0.0105). Lint yield in double rows ranged from 1232 lbs./acre to 1290 lbs. per acre. Lint yield differences between double and single rows was only significant with 5 plants/row-foot (1232 lbs./acre vs.1022 lbs./acre; P=0.0150); the difference in yield with 3 plants/row-foot was only marginal (1257 lbs./acre vs.1142 lbs./acre; P=0.1566).

Conclusions

- Higher in-row planting rates and double-row planting decreased individual plant size. Doubling plant population through double-row planting decreased about 35% the number of fruiting positions per plant.
- Fruit retention was only slightly decreased by double rows (3%), thus the number of bolls per plant followed similar trend as fruiting positions.
- Boll size was decreased by increased in-row planting density (11% decrease between 3 and 5 plants per row-foot), but was not affected by row planting configuration.
- Doubling plant population through double-row planting increased the number of harvested bolls per unit area and the boll weight per unit area by about 27% across in-row planting rates.
- Either in-row planting density or double-row planting did not affect lint turnout.
- Lint yield was increased 11% by doubling the plant population by double-row planting, but was not affected by the in-row planting rates.

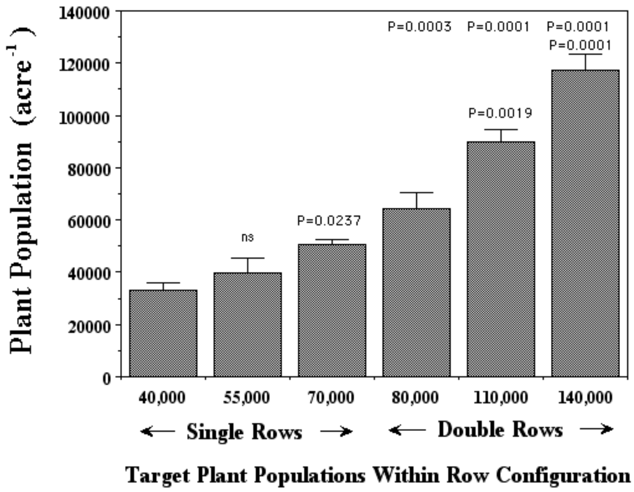

Figure 1. Final plant populations at each of the six treatments combining two row configurations and three in-row planting rates. Corpus Christi, 2000. Statistical note: Intermediate and high in-row planting rates were statistically compared to the low rate within row configurations. Single vs. double row treatments were compared within each in-row planting rate. Probability of null hypothesis are shown on top of corresponding bars. T-line on top of bars indicate magnitude of standard error.

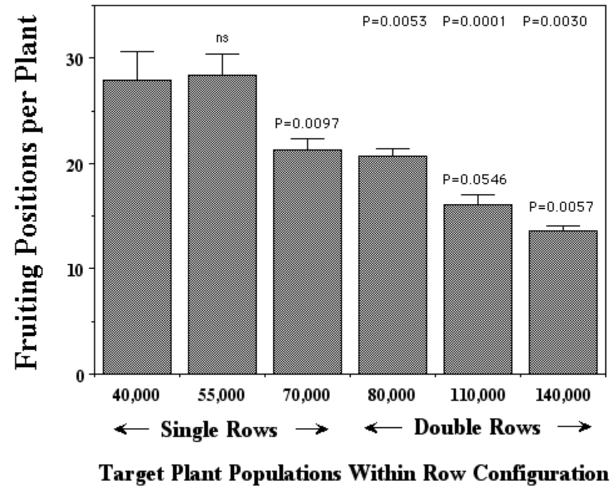

Figure 2. Effects row configuration and in-row planting rate on the number of fruiting positions per plant. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

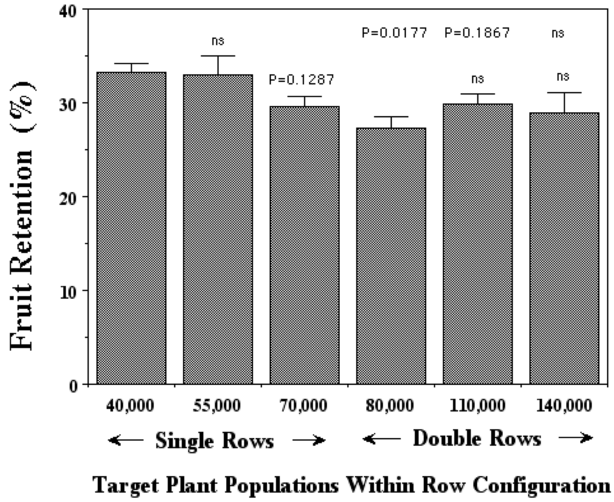

Figure 3. Effects row configuration and in-row planting rate on fruit retention. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

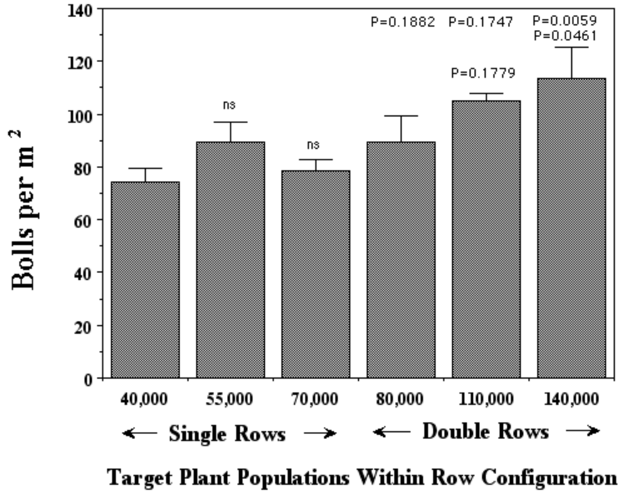

Figure 5. Effects row configuration and in-row planting rate on the number of open bolls harvested per unit ground area. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

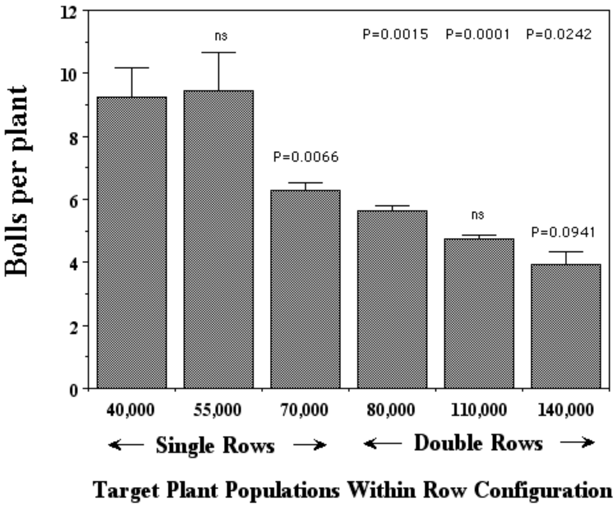

Figure 4. Effects row configuration and in-row planting rate on the number of harvested open bolls per plant. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

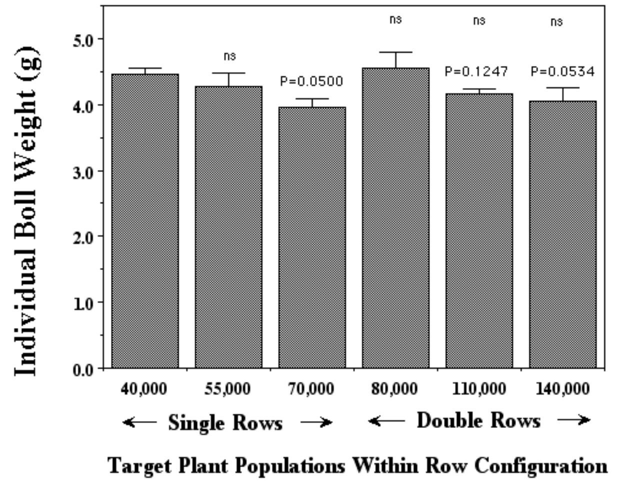

Figure 6. Effects row configuration and in-row planting rate on the weight (lint + seed) of individual harvested open bolls. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

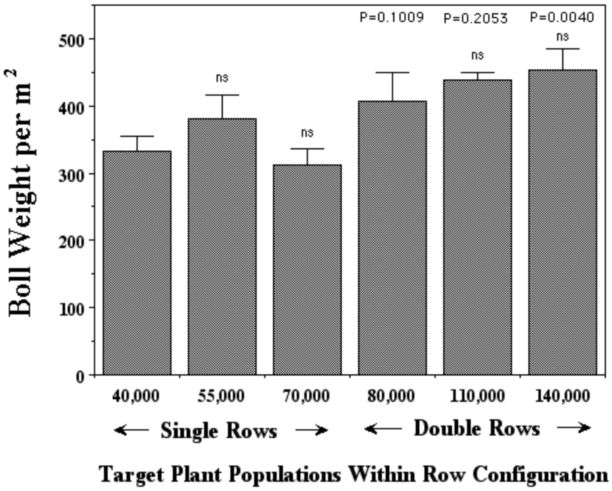

Figure 7. Effects row configuration and in-row planting rate on the total weight (lint + seed) of open bolls harvested per unit ground area. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

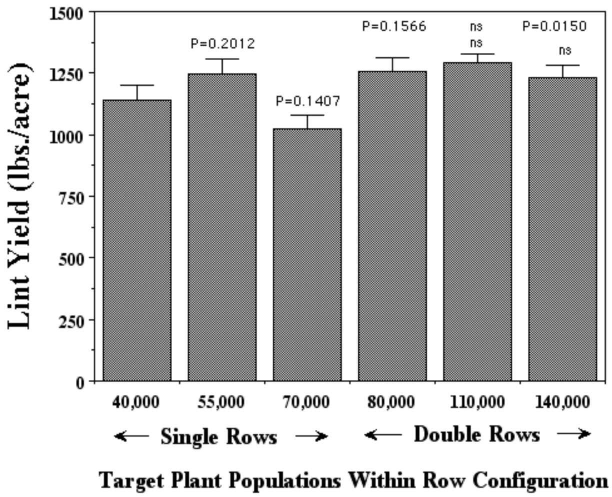

Figure 8. Effects row configuration and in-row planting rate on hand-picked lint yield. Corpus Christi, 2000. Statistical note: same as in Fig. 1.