.EFFECTS OF POPULATION, ROW SPACING, AND NITROGEN FERTILIZATION ON LINT YIELDS OF NO-TILL COTTON

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Abstract

Cotton producers, due to current economic conditions, need to produce cotton more economically than they have in the past. They need to make less trips over the field and make the utmost use of their fertilizer dollar. One way of accomplishing this goal may be by using some form of the no-till system combined with an ultra narrow row production system. A study was conducted at two different locations to evaluate cotton lint yield response to four row spacings, four populations, and two nitrogen rates under no-till conditions. Results showed that row spacings, plant populations, and nitrogen rates had a direct effect on plant heights and lint yields at both locations.

Introduction

Research evaluating cotton response to different row spacings, plant populations, and nitrogen rates is important to improve regional technology useful to cotton producers in assessing costs of production and in increasing the conservation of soil and moisture. Studies with ultra-narrow row cotton (UNR) with varying populations and N fertilizer rates have shown to have a direct effect on cotton lint yields(Delaney, Monk, Reeves, Bannon and Durbin, 1999; McFarland, Lemon, Hons, and Gerik, 1999).

The purpose of this study was to determine the row spacing and plant density effect on certain cotton growth parameters and lint yields under no-till production systems and investigate possible interactive effects of plant densities with row spacings and N rates on growth parameters and lint yields.

Materials and Methods

Studies were conducted in 1999 at two different sites: Site A was located at the Texas A&M Agricultural Experiment Station at Corpus Christi, Texas, and Site B at the USDA-ARS Research Center at Weslaco, Texas, which is approximately 135 miles south-southwest of Corpus Christi.

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The soil type at the Corpus Christi site is an Orelia sandy clay loam (Hyperthermic Typic Ochraqualf); while at Site B, the soil was classed as Hidalgo sandy clay loam. Some characteristics of the surface horizon for the Orelia soil include: Sand content-60.2%, silt content-14.1%, clay content-25.7%, moisture retention at .1 bar-24.7%, and at .33 bar-18.2% (Stearman, Matocha, and Crenshaw, 1995). Surface horizon of the Hidalgo soil contained 56% sand, 19% silt, and 25% clay, with a pH of 8.0 and organic C of 1.1%.

This was the first year that no-till practices had been applied to this particular experimental field. In December 1998, a disc was used to lightly incorporate some of the previous crop residue and control weeds. On April 8, one quart of Roundup Ultra herbicide per acre was applied to control the light weed population. On April 9, Paymaster 1218 BGRR was planted and 1 1/2 pints Dual and 1 1/2 pints Cotoran preemergence herbicide was applied per acre. On May 7, an application of 1 1/2 pints Roundup Ultra per acre was applied.

The fertilizer was sidedressed with a spoke wheel injection system on May 28 approximately 6 inches deep and 4 inches to the side of the plant. Fertilizer N rates of 0, 40, and 80 lb. N/acre were applied to each row configuration and plant population treatment.

Due to the dry conditions at Site A during planting time, the projected plant populations were not achieved. The final plant populations at Site A for the two row spacings were: 19" row spacing, low population-70,000 plants/acre; 19" row spacing, high population-90,000; 38" row spacing, low population-59,000; and 38" row spacing, high population-74,000 plants/acre (Table 1).

At Site B (Weslaco), Paymaster 1220 BGRR was planted on March 15. Due to the fact that no appreciable rainfall occurred during the growing season, the plot was flood irrigated at 30 days after planting and again at 82 days after planting with approximately 6 inches of water. Eighty lbs. N/acre was applied on 15" spacings with a spoke wheel applicator 30 days after planting.

A randomized complete block design with four replications was used at both sites. Plot dimensions were 12.75 feet by 80 feet with 4 rows spaced 38 inches apart for the conventional system and 6 rows spaced 19 inches apart for the UNR system. The inside two rows in the conventional system and the inside four rows in the UNR system were used for measurement and yield determinations utilizing hand picking. At Site B, four different row spacings were used and their respective plant populations were as follows: 7.5"-60,000; 15"-64,000; 30"-33,600; and 40"-43,700 plants/acre (Table 1).

The rainfall pattern at Site A (Corpus Christi) was very erratic as is shown in Fig. 1. The potential evapotranspiration rate for the growing season was approximately 4.5 times more than the rainfall that was recorded (Fig. 2).

Results and Discussion

Plant heights at Site A (Corpus Christi),varied significantly with regards to row spacing and population. At 81 days after planting, the 38" row spacing low population, with 80lb N/acre produced plants 32.1 in. tall (Fig. 3). The shortest plants were produced in the 19" row spacing and high population with 40 lbs. of N (27.5 in.) The higher rate of N always produced a taller plant than the lower rate, except with the 38" row spacing at high population. With 40 lb. N/acre, the lower population produced a taller plant and the same was the case for the 80 lb. rate of N.

The plant height measurements at Site B (Weslaco) were taken at 79 days after planting which is approximately the same physiological stage as at Site A (Corpus Christi). One difference was that Site B measurements were made immediately prior to the last irrigation and the Site A measurements were taken approximately 7 days following a 2.5 in. rain. Perhaps the largest difference in growth occurred due to the difference in planting dates, with Site A having considerably greater DD60's at this stage of growth . The 40 in. row spacing produced plants 18.1 in. tall, 30 in. row spacing-16.9 in., 15 in. row spacing-14.6in. and the 7.5 in. row spacing-14.2 in. (Fig. 4).

Lint yields at Site A varied significantly among treatments. The 19 in. row spacing at high population with 40 lb. N/acre produced the most lint (1115 lb/acre). The 38 in. row spacing high population with 40 lb. N/acre yielded 1052 lbs. of lint. The 19 in. row spacing low population produced 1017 lbs. with 40 lb. N/acre and 993 lbs. with 80 lb. N/acre. The 80 lb. N/acre rate in the 19 in. row spacing and high population decreased yields by 120 lbs. over the 40 lb. N/acre rate. There was no difference statistically between the 40 lb.N/acre rate and the 80 lb. rate in the 38 in. row spacing at low population(948 lbs. vs. 978 lbs.). The 40 lb. N/acre rate coupled with the 38 in. row spacing and high population yielded an additional 88 lbs. of lint compared to the 80 lb. rate (Fig. 5).

At Site B (Weslaco) treatment effects on yields were statistically nonsignificant with alpha at 0.05. The 40 in. row spacing produced 718 lbs. of lint/acre, followed by the 15 in. row spacing with 696 lbs. of lint/acre. The 7.5 in. row spacing and the 30 in. row spacing produced 614 and 612 lbs. of lint/acre respectively. Economically, there was a 100 lb. difference between the high and low yields at Site B (Fig. 6). Although not statistically significant, the approximate 100 lb/acre yield advantage from 40 in. rows over 30 and 7.5 in. spacings could have economic impact.

Summary

In conclusion, at Site B (Weslaco), the 40 in. row spacing produced the most pounds of lint/acre and also produced the tallest plants. The 7.5 and 30 in. row spacings yielded the same amount of lint/acre even though the 30 in. treatment had a 44% smaller population. Plants were the most efficient in the 30 in. row spacing producing 0.018 lbs. of lint per plant versus 0.010 lbs. of lint per plant in the 7.5 in. treatment.

At Site A (Corpus Christi), with 80 lbs. N/acre there was statistically no difference between row spacings or the population treatments. With 40 lbs. N/acre, we achieved the highest yield in the 19 in. rows with the high population. With 40 lbs. N/acre, cotton grown in 38 in. rows high population and 19 in. rows at low population yielded statistically the same. As the populations increased, heights decreased under both row spacings. Also, as the nitrogen rate changed from 40 lbs. to 80 lbs. N/acre, heights increased but yields decreased. This could possibly be due to insufficient soil moisture at boll maturation.

The substantially lower yields at the irrigated Weslaco site compared to the dryland Corpus Christi site were somewhat surprising. More research is needed on this subject under no-till or reduced tillage conditions to find the optimum row spacing and nitrogen rate in order to maximize profitability, though not necessarily maximizing yield. The narrower row spacings are showing potential for increasing yields, but we need to do more research on N rates and correct placement of nutrients with UNR cotton under no-till conditions.

References

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Acknowledgments

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Table 1. The actual plant emergence populations (plants/ac) at Site A and Site B.

Plant Populations (plants/ac)	
Site A - Corpus Christi, Texas	
19" row spacing-low population	- 70,142
19" row spacing-high population	- 90,502
38" row spacing-low population	- 59,336
38" row spacing-high population	- 74,395
Site B - Weslaco, Texas	
7.5" row spacing	-59,896
15" row spacing	-63,943
30" row spacing	-33,590
40" row spacing	-43,708

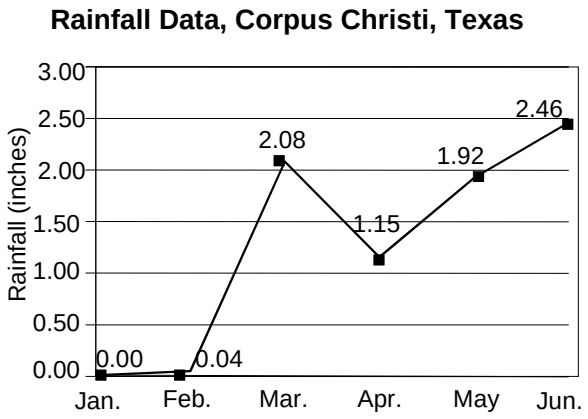

Figure 1. Erratic rainfall pattern at Site A.

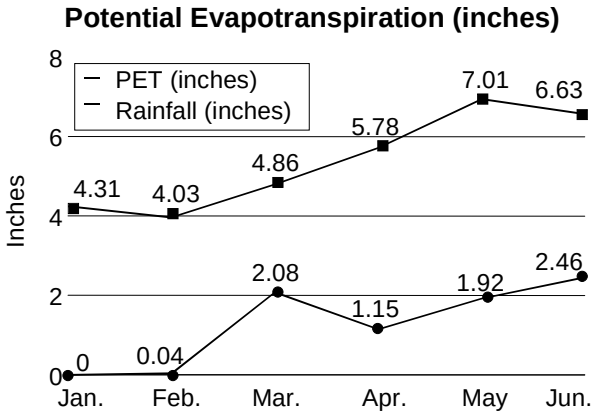

Figure 2. The potential evapotranspiration rate for the growing season was approx. 4.5 times more than the rainfall.

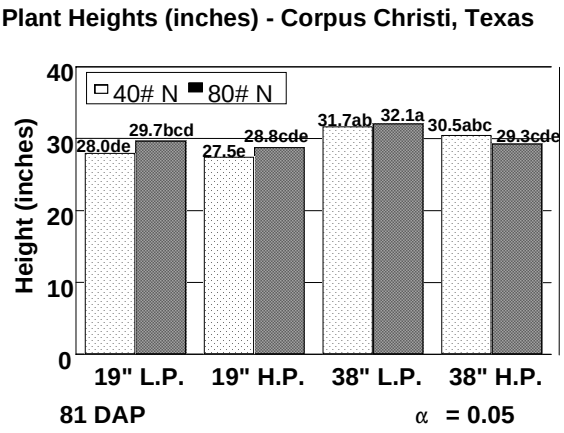

Figure 3. Plant hights at Site A, 81 days after planting affected by row spacings, plant populations, and N rates.

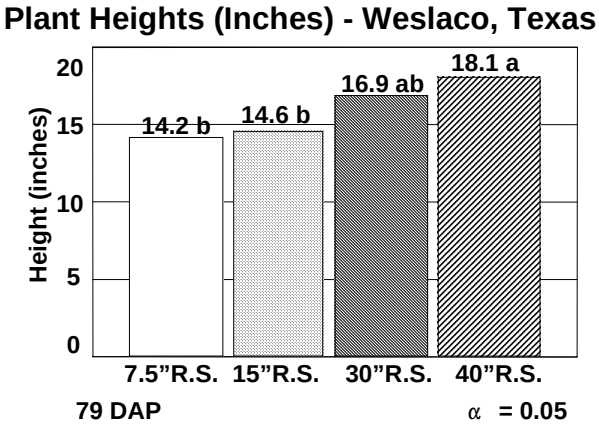

Figure 4. Plant hight measurements at Site B, 79 days after planting.

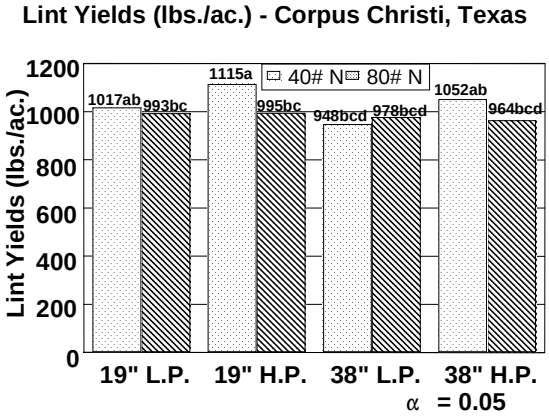

Figure 5. Lint yields at Site A as effected by row spacings, plant populations and N rates (L.P.=low population, HP=high population).

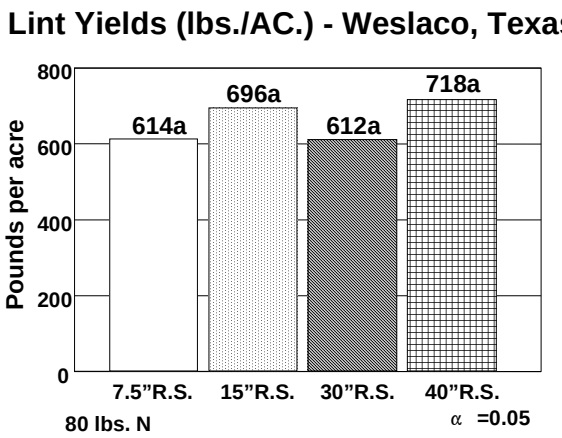

Figure 6. Lint yields at Site B as affected by row spacings.