NITROGEN MANAGEMENT IN ULTRA-NARROW ROW COTTON

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Abstract

Effective nitrogen management is more important for cotton than for most other major field crops; however, little information is available regarding the effects of narrow row spacing on cotton N requirements. A study was conducted to evaluate the effects of four nitrogen rates (0, 50, 100, 150 lbs N per acre) and two row spacings (19 and 39 inches) on cotton growth and production. Both row spacing and N rate significantly affected plant height. From peak bloom through maturity, plants in 19-inch rows were significantly shorter compared to those in 38-inch rows. Petiole nitrate concentrations increased consistently with increasing N rate regardless of row spacing. However, plants in conventional rows had significantly greater nitrate concentrations compared to UNR plants across N treatments. Averaged across N rates, the 19-inch UNR row spacing significantly increased lint yields producing 1,089 lbs lint/acre compared to 865 lbs lint/acre for conventional 38-inch row spacings. Consistent with previous results, plant mapping data showed that UNR plants set a higher percentage of bolls on fruiting branches 1 through 5 compared to plants in conventional row spacings. In addition, increasing N rate tended to shift boll retention to higher positions, regardless of row spacing.

Introduction

Producer interest in ultra-narrow row (UNR) cotton production systems (i.e., row spacing less than 20-inches) continues to increase in Texas. UNR systems have the potential to significantly increase production efficiency compared to conventional (40-inch) and narrow (30-inch) row spacing systems. Research in central Texas has shown that UNR may shorten the crop development period, which can reduce costs associated with late season insect control, and can lessen yield and quality losses that often result from September rainfall. In addition, early crop development has the potential to reduce over-wintering boll weevil populations for the coming year. Most importantly, studies have shown that UNR production systems can increase cotton yields by 40 to 100% compared to conventional and narrow row spacing systems.

Nitrogen deficiency during the critical fruiting period from first square to peak flowering (typically 40 to 85 days after planting) can significantly reduce crop yields (Gerik et al., 1997). Likewise, excess N can promote vegetative growth at the expense of boll production, promote shedding of floral buds and small bolls, and delay maturity.

The basic N requirements of cotton are reasonably well defined; however, no information is available regarding the effects of narrow row spacing on cotton N requirements. UNR production systems may alter N uptake and use efficiencies relative to conventional and narrow row spacings. Shorter growth periods and more effective use of soil N may reduce the amount of fertilizer necessary to supply adequate N during the season. On the other hand, increased water use efficiency and the associated greater yield potential may increase crop N requirements. The primary objective of this study was to determine nitrogen fertilizer requirements for optimum growth and yield in ultra narrow row versus conventional row spacing cotton production systems.

Materials and Methods

The study site was located on the Stiles Research and Demonstration Farm near Taylor, Texas. Average annual rainfall for the area is about 34 inches and the average frost free period is approximately 224 days. The study was designed as a randomized complete block, arranged as a split plot with four replications. Main plots were row spacing (19 and 38 inches) and subplots were nitrogen rate (0, 50, 100 and 150 lbs N per acre). Nitrogen fertilizer was applied as 32% solution on March 10 and 11, 1999. Fertilizer N was knifed on 15-inch centers 6 inches deep in all plots. Plots were 30 by 250 feet and were planted on April 12. The variety used was DPL436 RR. Conventional rows were planted with a White 6700 vacuum planter to achieve a final plant population of 44,800 plants per acre. UNR plots were planted by making two passes through the plot with the conventional planter, the second pass being 19 inches from the center of the first. The UNR spacing had a final population of 91,000 plants per acre.

Soil samples were collected from each of the 0 nitrogen plots in increments of 0 to 6, 6 to 12, 12 to 24, 24 to 36 and 36 to 48-inches prior to fertilization and subjected to a routine soil test by the TAEX Soil Testing Laboratory. Plant height was determined height was determined at pinhead square, peak bloom and maturity by measuring 20 plants in each plot. Petiole nitrate concentrations were measured at peak bloom by collecting 20 petioles from each plot. Plots were harvested on August 31, 1999. A John Deere stripper was

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used to harvest the conventional plots while an Allis Chalmers stripper equipped with a broadcast header was used to harvest the UNR plots. Plant and boll counts were taken from three locations in each plot to provide estimates of bolls per acre and bolls per plant. Prior to harvest, 5 plants in each plot were collected to determine plant height, node number, fruiting position and retention.

Results and Discussion

Rainfall was a limiting factor in 1999, with total rainfall during the April-August growing season (10.41 inches) amounting to only 52% of the long-term average (20.08 inches) for that period. Dry surface soil conditions at planting delayed and staggered emergence somewhat. Incremental soil samples to a depth of 48 inches indicated moderate residual nitrogen (as nitrate) levels within the soil profile.

Both row spacing and N rate significantly affected plant height. Plant growth was initially uniform between row spacings as indicated by plant height data at pinhead square (Figure 1). This was due primarily to early season cool temperatures which tended to slow plant development. However, by peak bloom and through maturity plants were significantly shorter in 19-inch rows compared to those in 38-inch rows. Overall, differences in plant height were much less evident in 1999 than in previous years. This was attributed largely to the high degree of vegetative branching which was observed across all treatments. Early season thrips and flea hopper damage was severe and likely contributed to this growth pattern.

N fertilizer increased plant height at each growth stage compared to the control (Table 1). Differences among N rates were observed only at peak bloom where plant height was greater in the 150 lb N/acre rate than the 50 lb N/acre rate. These data suggest that residual soil nitrogen levels tended to compensate for the reduced N supplied in the fertilizer treatments. Due to the dry conditions, no mepiquat chloride was needed to manage crop height.

Both row spacing and N rate significantly affected petiole nitrate concentrations at peak bloom (Table 2). Petiole nitrate concentrations increased consistently with increasing N rate regardless of row spacing. However, plants in conventional rows had significantly greater nitrate concentrations compared to UNR plants across N treatments.

Similarly, both row spacing and N rate significantly affected cotton lint yield in 1999. Averaged across N rates, the 19-inch UNR row spacing significantly increased lint yields producing 1,089 lbs lint/acre compared to 865 lbs lint/acre for conventional 38-inch row spacings (Table 3). Fertilizer N increased cotton lint yields regardless of row spacing, but no differences were observed among rates from 50 to 150 lbs N/acre. As observed in previous years, boll numbers per acre were greater for UNR spacing treatments compared to conventional row spacing; however, boll size was not significantly different (Table 4).

Consistent with previous results, plant mapping data showed that UNR plants set a higher percentage of bolls on fruiting branches 1 through 5 compared to plants in conventional row spacings (Table 5). As described previously, early season insect damage was observed at this site and resulted in loss of a high percentage of first position bolls. In addition, increasing N rate tended to shift boll retention to higher positions, regardless of row spacing. Row spacing and N rate did not significantly affect the fiber properties of micronaire, strength or length (Table 6).

Table 1. Effects of N Rate on Plant Height (inches)

N Rate (lbs/A)	Pinhead Square	Peak Bloom	Maturity
0	13.1 b	22.9 c	23.0 b
50	14.9 a	25.4 b	24.9 a
100	15.4 b	25.7 ab	25.4 a
150	14.1 ab	26.6 a	25.2 a
LSD (0.05)	1.4	1.0	1.4

Table 2. Effects of Row Spacing and N Rate on Petiole Nitrate Levels (ppm)

N Rate (lbs/A)	Conventional	UNR	Average
0	911	328	620 d
50	2645	929	1787 c
100	4312	2748	3530 b
150	5081	3778	4430 a
Average	3237 a	1946 b	LSD (0.05)=868
	LSD (0.05)=65		

Table 3. Effects of Row Spacing and N Rate on Cotton Lint Yields (lbs/A)

N Rate (lbs/A)	Conventional	UNR	Average
0	804	1038	921 b
50	889	1123	1006 a
100	882	1081	982 a
150	886	1115	1001 a
Average	865 b	1089 a	LSD (0.05)=51
	LSD (0.05)=65		

Table 4. Effects of Row Spacing on Bolls per Acre and Lint per Boll

Row Spacing (inches)	Bolls/Acre (1000s)	Lint/Boll (g)
Conventional	275.2 b	1.43
UNR	350.9 a	1.41
LSD (0.05)	433.3	---

Table 5. Effects of Row Spacing and N Rate on Boll Distribution (%)

	Fruiting Branches			
	1 to 5		6 to 10	
N Rate (lbs/A)	Conventional	UNR	Conventional	UNR
0	41.6	43.6	35.1	39.3
50	45.9	46.1	40.7	43.8
100	35.8	40.3	46.7	43.7
150	36.2	40.7	43.5	41.0
LSD (0.05)=2.3	39.8 b	42.7 a		

Table 6. Effects of Row Spacing and N Rate on Fiber Quality Parameters

N Rate	Micronaire		Length (in.)		Strenght (g/tex)	
(lbs/A)	Conv.	UNR	Conv.	UNR	Conv.	UNR
0	3.7	3.7	1.10	1.09	27.3	27.0
50	3.7	3.5	1.09	1.08	27.3	27.6
100	3.5	3.5	1.08	1.08	28.1	27.5
150	3.6	3.5	1.07	1.07	27.9	27.3

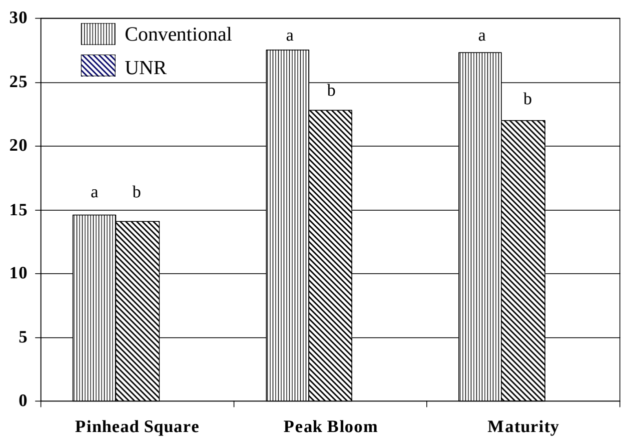

Figure 1. Effects of Row Spacing on Plant Heights