PERFORMANCE OF ULTRA-NARROW ROW COTTON IN CENTRAL TEXAS

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Abstract

Cotton production was evaluated for three row spacing (7.5, 15, and 30-inch) systems with plant populations ranging from 30 to 90 thousand plants per acre under dryland conditions in Hill County near Whitney, TX in 1996 and 1997. Overall, lint yield was substantially higher (37 and 21%, 1996 and 1997, respectively) for cotton grown in ultra-narrow rows, i.e., 7.5 and 15-inch compared to 30-inch rows. Regression analyses revealed that as plant density increased, cotton yield in 30-inch rows declined, while yield in 7.5 and 15-inch rows increased. Boll number per acre was responsible for the higher yield of the ultra narrow row systems. Individual boll weight and seed number were not influenced by row spacing or plant density. Plants grown on 7.5 and 15-inch rows set more bolls on lower fruiting branches than plants grown in the 30-inch rows, which suggests ultra-narrow row systems improve earliness in crop harvest and reduce late season yield losses and costs associated with insects.

Introduction

Narrow row production systems (i.e., rows spaced 30-inches apart) consistently increase cotton yield over conventional 40-inch row spacing and are rapidly becoming the typical row spacing across much of the Cotton Belt. Ultra narrow systems (i.e., row spacing less than 20-inches) can possibly increase the efficiency of cotton production systems beyond that of narrow rows. Experiments at the Blackland Research Center in Temple have shown that ultra narrow row systems can increase cotton yield from 40 to 100%, compared to narrow row systems (Smith et al. 1989; T.J. Gerik, unpublished data). However, this yield advantage of ultra narrow row systems is dependent on the presence and availability of water and the length of the growing season. Ultra narrow row systems may shorten the time from planting to harvest. This is important in the central Texas Blacklands, because it can substantially lower costs associated with late season insect control and reduce over-wintering boll weevil populations for the coming year. Physically, ultra narrow row systems enable the crop to intercept more sunlight for growth, better utilize rainfall, and escape damaging pests by reducing the time from planting to harvest than conventional or narrow row spacing. However, inadequate broad leaf weed control methods and problems with harvesting efficiency restrained development of ultra narrow row production systems for many years.

Recent development of over-the-top methods which control grasses (Post®, Fusilade®, and Roundup® resistant cotton) and broad-leaf weeds (Staple® and Buctril® resistant cotton) has changed our view of future cotton production systems. Weed control will not be the major obstacle to the development and adoption of ultra narrow row production systems. Managing these systems for maximum productivity and fiber quality and efficient stripper harvesting within constraints of the prevailing environment, however, is of paramount concern. The present study was conducted to: 1) Determine if narrow row cotton production can more effectively and efficiently, utilize environmental resources, resulting in increased yield compared to traditional row spacing systems; and 2) To evaluate cotton growth habit and plant density interaction on earliness, yield, and fiber quality grown in ultra narrow row systems.

Materials and Methods

Field studies were conducted during 1996 and 1997 in Hill County near Whitney, TX. Soil type was a Wilson-Stephens Complex with 0.5% slope. Field areas received pre-plant applications of 200 lbs. N and 40 lbs. P_2O_5 per acre and Cotoran, Dual, and Treflan, at 1 pint per acre followed by Prowl at 1 quart per acre. Tamcot Sphinx (1996), and G&P 74+ (1997), were planted into 7.5, 15, and 30-inch spaced rows at rates sufficient to achieve 50, 75, and 100 thousand plants per acre on April 9, 1996 and May 7, 1997. Experimental design was a split-plot randomized complete block with three replicates of main (row spacing) and sub-plots (plant population). Plots were 30 by 200 feet (7.5 and 15 inch rows) and 27.5 by 200 feet (30 inch rows). The experiment was initiated with a full soil-water profile each year, and received no supplemental irrigation. Plant water stress was monitored throughout the seasons with pressure chamber leaf water potential measurements. Prior to harvest, 10 plants per plot were collected to determine plant height, node number, fruiting position and retention. Plots were then hand-harvested for plant density, boll number, lint, and seed yield. Fiber was processed by the International Textile Center, Texas Tech University, Lubbock, TX.

Results and Discussion

In both years, approximately 10-inches of plant available water was present at planting. An additional 5.85 and 5.55 inches of rainfall was received in 1996 and 1997, respectively between planting and 75% open boll (Fig. 1). Plant growth and development therefore occurred under relatively unstressed conditions until 80 days after planting in 1996 (Fig. 2). Planting was delayed in 1997 by approximately 30 days, which limited unstressed development to about 60 days (Fig. 2). Row spacing did not

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affect the rate of plant water stress as inferred from leaf water potential measurements collected during both years (Fig. 2).

There were no row spacing or plant density effects on plant height or node number (Table 1). In 1996 lint yield was positively correlated with increasing plant density in 7.5 and 15-inch rows, and negatively correlated in 30-inch rows (Fig. 3). In 1997 similar relationships between density and yield were observed in ultra-narrow row plots, but results from the 30-inch row plots were inconclusive (Fig. 4). Yields in the ultra-narrow row plots did not differ. Increasing plant density led to higher boll number per acre in 7.5 and 15-inch rows, but reduced boll number in 30-inch rows both years (Tables 2 and 3). Plants in 7.5-inch rows set a higher percentage of bolls on the first 5 fruiting branches in 1996, but there were no differences in 1997 (Tables 2 and 3). Boll number on fruiting branches 6 to 15 was not affected by row spacing or plant density (Tables 2 and 3). Overall, yields were approximately 37 and 21% higher in ultra-narrow rows compared to 30-inch rows in 1996 and 1997, respectively (Fig. 5). There were no row spacing effects on crop maturity. Fiber quality and trash content were not affected by row spacing either year (Tables 4 and 5).

Summary

Overall, cotton planted in ultra-narrow rows (7.5 and 15-inches) yielded 37 and 21% higher compared to 30 inch rows in 1996 and 1997, respectively. Higher yields were due to increased boll number per acre both years. Plant height and node number were not affected by row spacing. Row spacing did not affect crop maturity or fiber quality.

Acknowledgements

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References

Smith, C.W., J.M. Chandler, and J.M. Morrison. 1989. Genotypic response to narrow rows at Temple, TX. Proceedings Beltwide Cotton Conferences. 120-122.

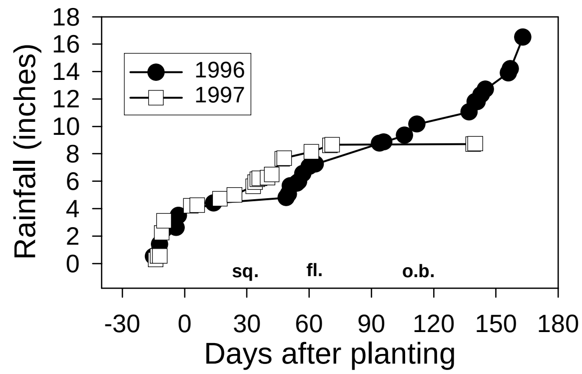

Figure 1. Total cumulative rainfall from 15 days before planting until harvest in 1996 and 1997 near Whitney, TX. The periods of squaring, flowering and 75% open boll are indicated.

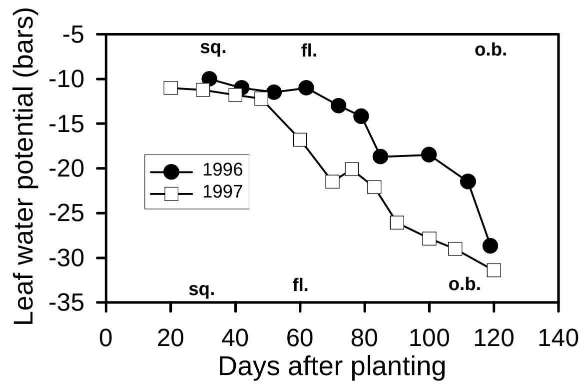

Figure 2. Relationship between leaf water potential and time after planting in 1996 and 1997. Periods of squaring, flowering, and 75% open boll are indicated.

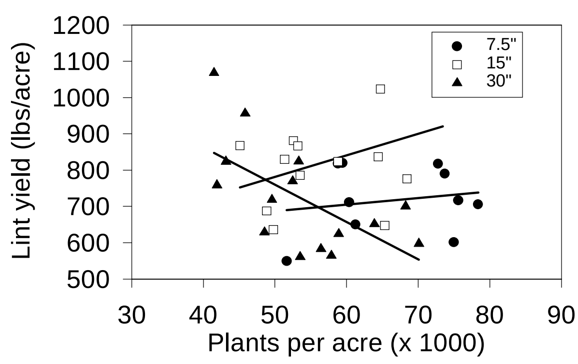

Figure 3. Correlations between lint yield and plant population for three row spacings in 1996.

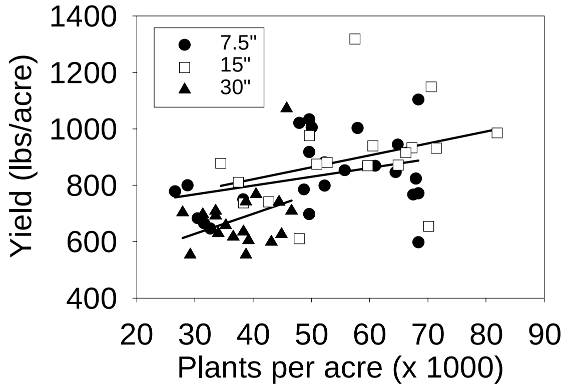

Figure 4. Correlations between lint yield and plant population for three row spacings in 1997.

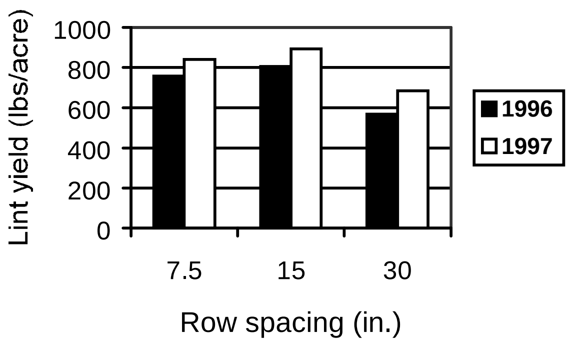

Figure 5. Average lint yield as affected by row spacing in 1996 and 1997.

Table 1. Plant height and main stem node number as affected by row spacing in 1996 and 1997.

	Row Spacing (in.)		
	7.5	15	30
Plant Height (in.)			
1996	24.4	24.8	26.0
1997	23.3	24.3	24.3
Main Stem Nodes			
1996	21.5	22.0	21.9
1997	22.0	21.8	22.3

Table 2. The effects of row spacing on the number of bolls per acre arranged by fruiting branches in 1996.

Row spacing (inches)	Boll number/acre (x 1000)				
	Fruiting Branches				
	1 to 5		6 to 10	11 to 15	total
7.5	422	†	108	1	531
	(79)	††	(20)	(1)	
15	271		116	6	393
	(69)		(29)	(2)	
30	211		91	3	305
	(69)		(30)	(1)	

† values are x 1000.
†† numbers in parentheses are the percentages of the total.

Table 3. The effects of row spacing on the number of bolls per acre arranged by fruiting branches in 1997.

Row spacing (inches)	Boll number/acre (x 1000)				
	Fruiting Branches				
	1 to 5		6 to 10	11 to 15	total
7.5	189	†	81	1	271
	(69.8)	††	(29.8)	(0.4)	
15	211		96	6	313
	(67.4)		(30.8)	(0.8)	
30	151		73	3	227
	(66.7)		(32.1)	(0.2)	

† values are x 1000.
†† numbers in parentheses are the percentages of the total.

Table 4. The effect of row spacing on fiber properties and trash content of Tamcot Sphinx grown near Whitney, TX (Hill County) in 1996.

	Row Spacing		
	7 .5"	**15"**	**30"**
Fiber Properties			
Micronaire	5.40	5.20	5.20
Length (in.)	0.97	1.00	1.00
Strength (g/tex)	22.80	23.60	23.50
Uniformity (%)	80.00	81.00	81.00
Elongation (%)	6.90	6.90	6.90
Trash Content (counts/g)			
Total	3166	3212	3232
Trash, <500 m	443	461	454
Dust, >500 m	2723	2751	2778
Particle size, mm	297	301	300
VFM*	8.3	8.4	8.4

* Visible foreign matter, percent by weight

Table 5. The effect of row spacing on fiber properties and trash content of G&P 74+ grown near Whitney, TX (Hill County) in 1997.

	Row Spacing		
	7 .5"	**15"**	**30"**
Fiber Properties			
Micronaire	4.15	4.19	4.25
Length (in.)	1.04	1.06	1.06
Strength (g/tex)	23.2	23.7 *	22.8
Uniformity (%)	81.4	81.5	81.6
Elongation (%)	7.6	7.4	7.7

* Significantly greater