2002 BELTWIDE COTTON CONFERENCES, ATLANTA, GA – JANUARY 8-12

COTTON RESPONSE TO PLANTING DATE IN A SHORT SEASON ENVIRONMENT

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Abstract

Kansas cotton (*Gossypium hirsutum* L.) farmers were reliant on information from Oklahoma for common agronomic practices, including optimum planting time. This study was initiated in 2000 to measure yield and quality response of cotton to different planting dates at two rainfed sites in Kansas. Cotton on the Kansas-Oklahoma border counties returned the greatest yields when planted April 27 to May 2. At the northern sites, cotton responded positively to a wider range of planting dates, from early May to mid June. The responses were similar to traditional Oklahoma planting date recommendations. Cotton planted from mid to late June produced fiber with discount level micronaire. Fiber length and strength were reduced as planting date was delayed at the location that was under severe temperature and moisture stress. South central Kansas cotton growers would realize greater yields and quality if their cotton is planted by May 10, where cotton growers in more northern and western regions of the state should plant from May 5 through early June.

Introduction

Kansas was considered to have too few available Growing Degree Days (GDD's) to consistently produce profitable cotton yields. However, cotton (*Gossypium hirsutum* L.) acres stripped in Kansas have grown from 1,200 in 1994 to 44,000 in 2001. The 1996 Farm Bill allowed flexibility for southern Kansas farmers to diversify their cropping options and still participate in government programs. Cotton fits well into the wheat (*Triticum aestivum* L.) - grain sorghum [*Sorghum bicolor* (L.) Moench] rotations commonly found in south central Kansas and north central Oklahoma. Profits realized by early adapters of cotton increased interest, and consequently acreage. In 1998, the Southern Kansas Cotton Growers Coop began ginning cotton near Winfield, KS, and in 1999, the OK-Kan Gin near Anthony, KS and the Great Plains Cotton Gin near Blackwell, OK both opened.

The number of stripper varieties adapted to the High Plains that are also adapted to Kansas' growing season has increased dramatically since the early 1990's. May, June and July, are the peak rainfall months, when approximately half of the yearly precipitation is received. This coincides with the vegetative and early reproductive (through early bloom to mid bloom) periods of cotton development. Favored planting dates have traditionally been from mid May to early June, similar to those recommended for the High Plains cotton growing areas of Oklahoma and Texas. If soil temperatures and moisture allow cotton planting to take place earlier than the traditional dates, growers would be able to add time with less moisture and temperature stress to the fruit setting and fiber development and finishing stages of crop development. This could lead to lint yield and quality increases with a corresponding increase in net returns to producers. The objectives of this study were to: i) determine the optimum cotton-planting window in Kansas and ii) measure the effects of planting date on cotton lint yield and quality.

Materials and Methods

Dates of planting (DOP) effects were evaluated in cotton plots planted in the Wellington and Hutchinson, KS areas during the 2000 and 2001 growing seasons. At the Wellington sites, the 2000 plots were located on a Tabler silty clay loam (Fine, smectitic, thermic Udertic Argiustolls) and on a Bethany silt loam (Fine, mixed, superactive, thermic Pachic Paleustolls) in 2001. The plots at Hutchinson were planted at the Kansas State University South Central Experiment Field (SCEF) on a Clark-Ost (fine, loamy, mixed, superactive, mesic Udic Calciustolls-fine, loamy, mixed, superactive, mesic Udic Argiustolls) complex soil in both years. In 2000, plots were planted on May 2, 18, June 20 and July 11 and on May 5, 25, June 16 and July 6 at Wellington and Hutchinson, respectively. Plots were planted April 27 and June 12 and April 30, May 21, June 11 and July 6 at Wellington and Hutchinson, respectively, in 2001. Paymaster '2280BG/RR' was the variety planted both years. Starter fertilizer [15 lb nitrogen (N) and 40 lb phosphate (P) acre^{-1}] was applied in a 2x2 band both years. Thirty-five lb acre^{-1} N was topdressed both years (dry urea in 2000 and liquid urea ammonium nitrate in 2001) to bring total N applied to 50 lb acre^{-1}. Plots were 4 – 30 in. rows, which were 50 ft in length. A preemergent herbicide combination of 1.3 pt acre^{-1} Dual II Magnum® plus 3 pt acre^{-1} Cotoran® plus 0.6 oz acre^{-1} Staple® was applied after planting for weed control. If necessary, Roundup Ultra® at 1.5 pt acre^{-1} was applied according to label instructions, or hand weeding was used for late season weed control. The center two rows were machine harvested to determine yield. A sub-sample was taken from each plot for fiber quality analysis. Results were analyzed using the analysis of variance procedure of SAS.

Results and Discussion

The 2000 project review led to the decision to increase planting dates in 2001 to six, at approximately 14-day intervals. However, at planting time in 2001, we were still dependent on another project for the availability of planting equipment. This, in combination with untimely rainfall resulted in only two dates being planted at Wellington and larger than desired intervals between plantings at Hutchinson.

Wellington

In 2000, lint yield decreased significantly for each delay in planting date (Table 1), similar to results reported by Peng et al., in 1989. The 2000 study did not go under heat and moisture stress until mid-August (Figure 1), at which point the May 2 and May 18 cotton was well into bloom and fruiting, but the June 20 plantings were just beginning to bloom, which is the onset of the most critical period of water supply (Morrow and Krieg, 1990). Peng et al., (1989) reported bolls acre^{-1} and boll weight decreased with delayed DOP. The 2000 plots followed those trends, but the differences were significant ($P<0.05$) only when comparing the number of bolls acre^{-1} from the first two DOP to those from DOP 3 (Table 1). The corresponding reductions in lint yield would be expected according to Morrow and Kreig (1990). Lint quality was generally affected adversely by the delay in seeding (Table 2). When cotton was planted later in the season, fiber development was occurring during a period of high GDD accumulation with high nighttime temperatures (Figure 1). Quisenberry and Kohel (1975) reported micronaire was highest in the warmest of three tested environments. Micronaire in these plots increased significantly ($P<0.05$) when cotton was planted later in the season and increased to discount levels at the June 20 planting date. Fiber length decreased slightly in later plantings, too, probably as the result of moisture stress as described by Ramey (1986).

Even with only two DOP with a 45-day interval, lint yields showed no significant response to planting date in 2001 (Table 1). Plant populations in the April 27 planting were significantly (data not shown) reduced as the result of a heavy rain before emergence. However, since April 27 plants had nearly twice as many bolls plant^{-1} as June 12 plants, (the increase was not significant) and the number of bolls acre^{-1} was similar between planting dates (Table 1). The soil moisture level was good for both dates, but no significant precipitation fell for 75 days (Figure 1) after the June 12 planting, a period which spanned the major fruiting and fiber filling period for both planting dates. Fiber quality results were not yet available.

In the southern tier of Kansas counties, late April or early May plantings of cotton will apparently produce greater lint yields and better fiber quality than cotton planted from mid-May to mid-June.

Hutchinson

Yields and yield determining factors from the Hutchinson sites are reported in Table 3. As planting date was delayed from early May to July 2000, at the SCEF, lint yields decreased significantly. Precipitation received was near the long-term average until after the June 16 plots were planted (Figure 2), then ceased until late July. Just as the first planting date fruiting heavily (data not shown), several timely rains fell on the plots. The volume of rainfall received was evidently sufficient to produce excellent rainfed cotton lint yields in the first planting date. After the late July rains, however, no other significant rainfall events occurred until after the season was finished. During the same period of no rainfall, GDD accumulation was well above the long-term average. The May 25 planted cotton plants developed similar bolls plant^{-1} and acre^{-1} as the earliest planted cotton, but the boll weights were less than half of the May 5 planted bolls. Consequently, lint yields were reduced 46% as might be expected considering that Morrow and Krieg (1990) reported that boll weight was the second most important component of lint yield after boll number area^{-1}. Plant populations from the June 16 planted cotton were good (55,590 acre^{-1}), but the entire fruiting and fiber development process was completed during the period of high temperatures and minimal rainfall, resulting in reduced ($P<0.05$) bolls plant^{-1}, bolls acre^{-1} and boll weight compared to DOP 1. Planting date 3 bolls plant^{-1} and bolls acre^{-1} were also lower than DOP 2, but boll weight was similar. Fiber quality measurements from the Hutchinson sites are summarized in Table 4. Similarly to Wellington in 2000, micronaire increased as planting date was delayed. At Hutchinson, however, the second DOP produced premium micronaire cotton rather than DOP 1 at Wellington. Fiber from the DOP 3 cotton fiber had discount level micronaire readings, similar to the Wellington site. Fibers of DOP 1 cotton were longer ($P<0.05$) from DOP 2 and 3 fibers, which were similar in length. No differences were noted in any of the other fiber quality measurements.

Both DOP 1 and DOP 2 cotton seedlings were stressed by cool, wet weather during emergence in 2001 (Figure 2), which did not result in plant death, but the seedlings recovered slowly from the shock. The cool wet period in late May and early June, which slowed emergence of the second planting date, stymied growth of DOP 1 plants for a second time and evidently damaged early squares, since first bolls were not set until the fourth reproductive branch (data not shown). Rainfall and heat units were such that DOP 2 and 3 produced similar yields, boll numbers and boll weights (Table 3). Though no differences ($P<0.05$) existed between DOP for any measured yield factor, early plantings appeared to be at a disadvantage compared to mid-May to mid-June plantings in 2001.

After two years, our results would indicated that in the northern cotton producing areas of Kansas, optimum planting dates range from early May to mid-June. Late May to early June plantings of rainfed cotton produced consistent lint yields, but not enough for positive net returns to producers at current prices.

References

Morrow, M.R., and D.R. Krieg, 1990. Cotton management strategies for a short growing season environment: Water-Nitrogen considerations. Agron. J. 82:52-56.

Peng, S., D.R. Krieg, and S.K. Hicks. 1989. Cotton lint yield response to accumulated heat units and soil water supply. Field Crops Res. 19:253-262.

Quisenberry, J.R. and R.J. Kohel. 1975. Growth and development of fiber and seed in upland cotton. Crop Sci. 15:463-467.

Ramey, H.R. jr. 1986. Stress influences on fiber development. In "Cotton Physiology" (J.R. Mauney and J..McD. Stewart, eds.), pp. 351-360. The Cotton Foundation Reference Book Series, Number 1, The Cotton Foundation, Memphis, Tennessee.

Table 1. Lint yield, bolls plant^{-1}, bolls acre^{-1} and boll weight for different planting dates from cotton grown near Wellington, KS in 2000-01.

2000					2001				
Planting Date	**Yield**	**Boll Number**		**Boll Weight**	**Planting Date**	**Yield**	**Boll Number**		**Boll Weight**
	lb acre^{-1}	plant^{-1}	acre^{-1}	g		lb acre^{-1}	plant^{-1}	acre^{-1}	g
May 2	506.4	5.2	159,865	1.48	April 27	313.7	4.0	104,287	1.36
May 18	382.5	4.0	135,472	1.29	June 12	243.1	1.9	95,997	1.13
June 20	211.5	2.9	90,605	1.13					
July 13	---	---	---	---					
$LSD_{(0.05)}$	52.6	0.9	39,394	0.35		276.7	2.7	66,823	0.55
Mean	366.8	4.0	128,647	1.30		278.4	3.0	100,142	1.25
C.V.	6.4	10.0	13.6	12.0		44.2	40.1	29.7	19.7

Table 2. Fiber quality for different planting dates from cotton grown near Wellington, KS in 2000.

Planting Date	Mic	Length	Unif.	Strength	Elong.	Rd	+b	Color Grade[1]
		in.	%	g/tex				
May 2	4.0	1.05	80.0	28.8	5.9	64.8	7.5	61-4, 51-3
May 18	4.6	1.02	80.9	26.9	5.6	67.1	8.0	51-3, 61-3
June 20	5.1	1.02	82.1	28.3	5.9	66.9	8.2	51-3, 52-1
July 13	---	---	---	---	---	---	---	
$LSD_{(0.05)}$	0.6	0.04	1.1	2.1	0.2	11.6	1.2	
Mean	4.6	1.03	81.0	28.0	5.8	66.2	7.9	
C.V.	5.7	1.55	0.6	3.3	1.8	7.8	6.6	

1. Fiber quality data were taken from replications 2 and 3.

Table 3. Lint yield, bolls plant^{-1}, bolls acre^{-1} and boll weight for different planting dates from cotton grown near Hutchinson, KS in 2000-01.

2000					2001				
Planting Date	**Yield**	**Boll Number**		**Boll Weight**	**Planting Date**	**Yield**	**Boll Number**		**Boll Weight**
	lb acre^{-1}	plant^{-1}	acre^{-1}	g		lb acre^{-1}	plant^{-1}	acre^{-1}	g
May 5	619.1	5.3	284,108	1.07	April 30	219.1	1.3	94,671	1.27
May 25	337.2	5.0	299,015	0.52	May 21	334.8	1.7	129,518	1.22
June 16	73.2	1.4	77,827	0.47	June 11	335.7	1.9	129,591	1.19
July 10	---	---	---	---	July 6	---	---	---	---
$LSD_{(0.05)}$	149.8	2.1	137,203	0.27		150.8	0.7	61,477	0.59
Mean	343.2	3.9	220,317	0.69		296.5	1.6	117,927	1.22
C.V.	19.4	23.4	27.5	17.5		29.4	24.9	30.1	28.0

Table 4. Fiber quality for different planting dates from cotton grown near Hutchinson, KS in 2000.

Planting Date	Mic	Length	Unif.	Strength	Elong.	Rd	+b	Color Grade[1]
		in.	%	g/tex				
May 5	3.9	1.04	80.7	27.2		62.4	7.9	61-4, 51-3
May 25	4.3	0.98	79.7	24.5		61.8	7.9	51-3, 61-3
June 16	5.1	0.97	79.6	24.5		59.8	7.3	51-3, 52-1
July 10	---	---	---	---	---	---	---	---
$LSD_{(0.05)}$	0.7	0.03	1.8	2.9		6.9	0.8	
Mean	4.4	1.0	80.0	25.4		61.3	7.7	
C.V.	7.2	1.2	1.0	6.4		5.0	4.5	

1. Fiber quality data were taken from replications 2 and 3.

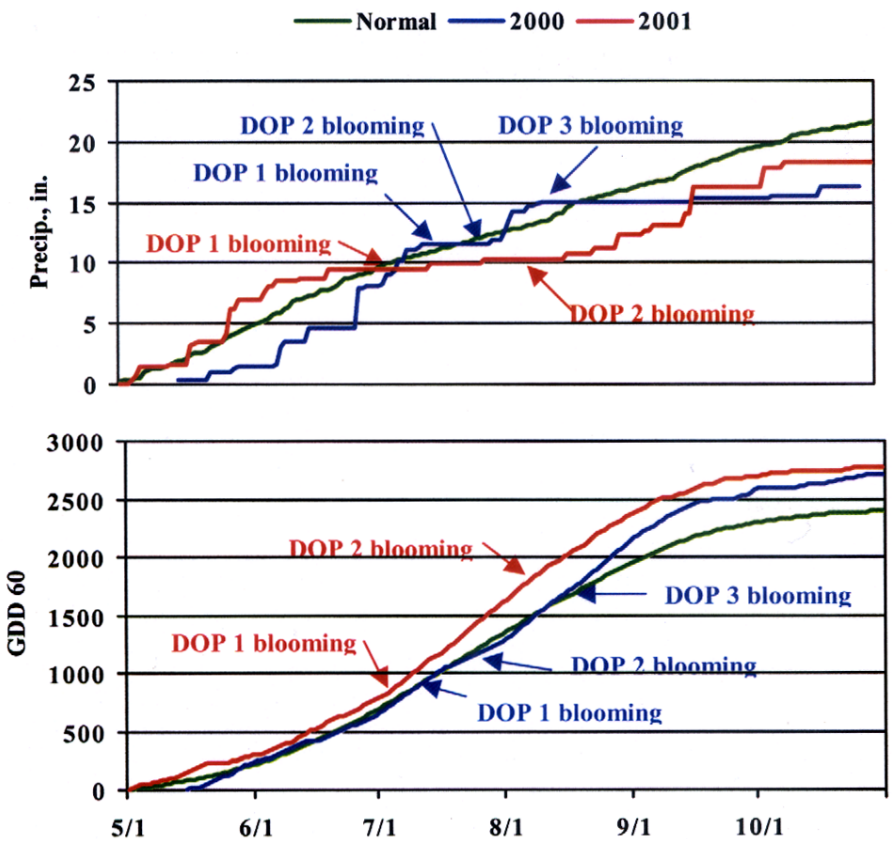

Figure 1. Long term May 1 to October 31 normal, 2000 and 2001 Growing Degree Days and precipitation for Wellington, KS.

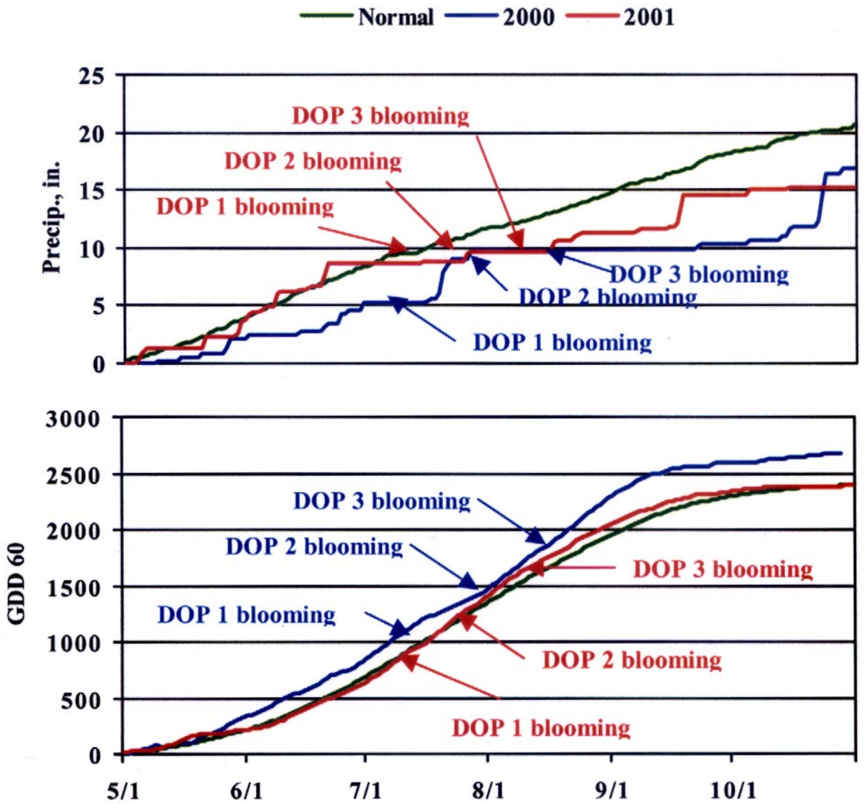

Figure 2. Long term May 1 to October 31 normal, 2000 and 2001 Growing Degree Days and precipitation for the South Central Experiment Field near Hutchinson, KS.