Effect of irrigation interval and picking time on lint quality and the degree of stickiness on two cotton varieties

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Abstract

This study was carried out at the Gezira Research Station (GRS) in Wad Medani during two successive seasons (2000-01 and 2001-02), to investigate the effect of two crop management practices (watering interval and picking time) on cotton lint quality and stickiness level. The treatments included: three irrigation intervals (7, 14 and 21 days), two picking times (successive pickings and farmer's practice) and two cultivars (Barac (67)B and Barakat-90). Results showed no clear differences in yield and quality between the two shorter watering intervals, 7 and 14 days for both cotton cultivars. On the other hand, the longer irrigation interval of 21 days lowered fibre maturity compared to the other shorter watering intervals (and also decreased the yield by 16% and 22% for Barac (67)B and Barakat, respectively. The farmer's practice (late picking) exposed the seed cotton to insect secretions, dust and small leaf trash resulting in higher levels of stickiness and lower lint grades compared to programmed successive picks. However the prolonged irrigation interval of 21 days resulted in a lower stickiness level. Economic analysis indicated that benefits from successive picks were higher by 15 and 5% for Barac (67)B and Barakat 90, respectively, compared to farmers' practice of late picking.

Introduction

Cotton in the Sudan is produced by both rain and irrigation. Total area under cotton reached a peak of 1,209,600 feddans in 1972 and produced a record yield of 1,284,800 bales (1 bale = 184 kg lint) in the same year. The domestic textile mills consume only 10% of the national cotton production. The bulk of the production is exported as raw fibre (90%) in a highly competitive world market. During the last two decades, Sudan cotton experienced a strong competition in the world market, mainly due to low yields and contamination with honey dew (stickiness).

The most important contamination factor, however, is stickiness. Stickiness was observed in Sudan since the early 1960's, but was sporadic at that time and of little importance. During the 1980's the stickiness contamination started to constitute a real problem to the marketability of Sudan cotton. It caused substantial economic losses to the cotton producers due to discounts in prices, which ranged from 5-30%. (Fadlalla, 1998).

Research programs addressing the causes and control measures were carried out by ARC. During 1998-2000, a stickiness research project financed by the Common Fund for Commodities (CFC) was executed with the objectives of developing an objective methodology (rather than the current subjective methods in use) to separate sticky from non-sticky cotton in order that the latter could be sold at the due price. The methodology was developed and, in addition, the study revealed considerable variability in stickiness levels among the cotton production areas, and considerably low levels of stickiness were observed in some schemes. This suggested that further studies were needed involving the crop management practices which

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might be affecting the incidence (occurrence and level) of stickiness.

The objective of the present study was to investigate the influence of irrigation interval and picking time on the quality of cotton lint.

Material and methods

This research work was carried out at the Gezira Research Station (GRS) in Wad Medani for two successive seasons (2000-01 and 2001-02). The soils of the Gezira and other irrigated cotton production areas are generally classified as vertisols. Three irrigation intervals were tested, namely 7 (W1), 14 (W2) and 21 (W3) days (W2 as control). Two cotton varieties were used in this study, namely Barakat 90 (*G. barbadense*) and Barac(67)B (*G. hirsutum*). Two picking times were evaluated: successive picks (optimum picking time) versus farmer practice (late picking). Seed cotton yield and quality data were recorded.

The experiment was laid out in a split-split-plot design with three replications. The main plots comprised irrigation intervals (W1, W2 and W3), sub-plots were composed of varieties (Barac(67)B and Barakat 90) and the sub-sub plots were composed of picking times (successive picking versus farmer's practice). The total numbers of treatments were:- 3 irrigation intervals × 2 varieties × 2 picking times = 12 treatment combinations. Plots were 10 m long, each composed of 8 rows with 0.8 m inter-row spacing (10 × 8× 0.8 = 64 m^2). Cultural operations were applied according to the GRS standard practices. No serious infestations by pests or diseases were observed. All fibre quality tests were carried out at the ARC Fibre Testing Laboratory and run at standard conditions of relative humidity (RH 65% ± 2) and temperature (20C° ± 2). The South Indian Technical Research Association (SITRA) Method was used as a reference for significance tests. If the difference was greater than the listed value then the difference will be critical. The stickiness level was measured by the Sticky Cotton Tester (SCT) of CIRAD-CA (see Appendix 1**).**

Result and discussion

Weather data for the two successive seasons (2000-01 and 2001-02) are shown in Table 1. A rather lower amount of total rainfall (170 mm) was recorded for the first season (2000-01), compared to (226 mm) for second season (2001-02). Data of insect counts (whiteflies and aphids) are summarized in Table 2. Higher numbers of whiteflies were noted for barac(67)B compared to those of Barakat 90. This was probably due to the fact that, the former is more hairy and bushy (closed canopy), which in turn favored whitefly build up. Barakat 90, on the other hand, is an open canopy variety which makes it less appealing to whiteflies and, at the same time, allows for more efficient penetration of pesticides. This was in agreement with earlier findings. Khalifa (1982) found that the medium staple variety Barac(67)B showed higher stickiness levels compared to the long staple variety Barakat 90. He attributed this mainly to the fact that the *hirsutum* variety is more hairy and bushy and, hence, more susceptible to whitefly infestation. This was also supported by some recent findings of Babiker (2004).

The yield data were given as averages and percentages in Table 3. As expected, Barac(67)B out yielded Barakat 90. Barac(67)B is potentially higher yielding than Barakat; it has a larger boll size and higher ginning outturn compared to Barakat.

Data for different watering intervals for both Barac(67)B and Barakat 90 indicated that the interval of 7 days (W1) and 14 days (W2), showed no clear

differences in yield. On the other hand the results indicated clearly, that watering intervals for 3 weeks (W3) gave the lowest yield for both cultivars. The yield was decreased by 16% and 22 % for Barac (67)B and Barakat 90, respectively.

The summaries of different fibre quality parameters are given as averages in Tables 4 and 5. Regarding the cultivar Barakat 90, similar results were obtained for length for the different watering intervals.

On the other hand stickiness results indicated a very low contamination for different treatments (almost free). This was probably related to the variety Barakat 90 itself (open canopy) and the practice of early successive pickings. This was in support of the results obtained by Khalifa (2001) and Babiker (2004).

Regarding the effect of different treatments on cotton grade, results indicated that there was a general trend towards lower grades as the watering interval was extended. However differences between W1 and W2 were somewhat small. On the other hand, the decline in cotton grade was very sharp for W3. This was probably due to lower maturity level (micronaire value) obtained for W3, compared to those of W1 and W2. Concerning the cultivar Barac(67)B, the result followed the same trend as for Barakat 90 (within the same treatment).

Regarding the stickiness problem, higher number of sticky spots were obtained for Barac(67)B compared to Barakat 90. As was mentioned before, this is mostly attributable to the fact that Barac(67)B is more hairy and bushy, and hence, is more attractive to whiteflies.

The results indicated clearly that a lower contamination was observed in case of successive picks compared to farmer practice (same trend with Barakat 90). The late picking (farmer practice) exposed the seed cotton to more insect secretions, dust and small leaf trash resulting in higher levels of stickiness and lower lint grades compared to early successive picks. This was in support of other findings (Abdelmageed, 2005). On the other hand, it was very clear that stickiness level and cotton lint grade were negatively affected by farmer practice. The farmer normally leaves the cotton open in the field for a long time (several weeks). So cotton catches dust, leaves and other foreign matters, as a result cotton becomes gray and darker (low grade).

In the Sudan, It has been realized that, differences in prices between higher grade (usually picked early) and lower grade (late picking) are insignificant.

The reasons behind this are generally complex. Ahmed (2000) stated that tenants are discouraged to pick early because they can not cover the expensive costs of picking early. Other factors for late picking, cotton pickers demand more wages per unit of picked weight because, it takes more time per unit per weight than is the case when all the bolls are open. Another factor that added to stickiness is that, tenants are not paid the cost of picking immediately after they deliver their harvest. Late payments oblige them to get cotton picked once than several times. However, it was very clear that farmer practices, of late picking, showed higher stickiness levels and a lower lint grade compared with successive picks.

Average Stickiness (number of sticky spots) of W3 (throughout different picks and farmer practice) were generally lower than those obtained from W1 and W2, This was probably due to the effect of the treatment, which in case of W3 , characterized by lower humidity, hence less favorable to whiteflies. In fact, pick 2 for the Acala was normally done relatively late in the season. Better vegetative growth was observed for both 7 days and 14 days. This provides a better shelter for whiteflies (at the end of season). Farah and Ali (1983) reported that prolonged vegetative growth provided the insect with food during late season, so, the possibility of contamination with whitefly secretions will increase with the decrease of water interval.

Likewise, lint grade fallowed the same pattern of the cultivar Barakat90. The first water interval (W1) recorded the best lint quality grade, closely followed by

(W2). A critical difference was observed for lint grade obtained for (W3). This was mainly because of the low fibre maturity level of this treatment.

Economic analysis

Economic evaluation was carried out for the effect of irrigation interval and picking time on lint quality and the degree of stickiness. The analysis was conducted for the treatment of 14 day irrigation interval and for two varieties, Barac(67)B and Barakat 90. Based on an average price of 50 cents/lb and price differential of 10 cents/lb for higher grade of Barac(67)B, and an average price of 80 cents/lb and price differential of 20 cents/lb for higher grade of Barakat 90, the following benefits could be shown, assuming that picking costs are the same in both successive and late picking. For Barac(67)B, with successive picks (100% higher grade), one feddan (based on average yield of one bale of cotton) could earn about US$ 252 compared to farmers' practice of late picking (20% higher grade) of only about US$ 218. i.e. extra.

Benefit of about US$ 34 (15%) . In the case of Barakat 90, with successive picks (45% higher grade), one feddan could fetch about US$ 374 compared to farmers' practice (25% higher grade) of about US$ 357 i.e. a benefit of about US$ 17 more (5%). Such benefits would represent considerable value addition to cotton production in the Gezira, if the treatment of successive picks was adopted. However, farmers are discouraged to pick early due to certain economic and administrative problems and constraints.

Recommendation

According to the results obtained in this study programmed successive picks are highly recommended to reduce stickiness contamination and improve cotton grade.

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Table 1. Rainfall (mm) data as 10 days totals, mean and max temp (C°), and relative humidity (R.H%) at Gezira Research Station, seasons 2000-01 and 2000102. Latitude 14°. 23 N, Longitude 33°. 29 E, altitude (405 m)

Element	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
2000-01									
Rainfall									
1-10	Nil	TR	6	44	67				
11-20	TR	NIL	19	11.8	Nill				
21-31	2.8	7	1	0.7	Nill				
Total/month	2.8	7	26	57	67				
Total/ season	(170)								
Mean max. Temp.	42	41	36	37	37	37	34	32	35
Mean min. Temp.	25	26	23	23	21	19	16	16	18
R.H%(0900 SLT)	47	71	82	76	59	45	49	45	37
ETo(mmday)	8.0	6.8	6.4	7.0	5.9	4.5	4.0	3.9	4.5
2001-02									
1-10	Nill	29	24	33	2				
11-20	2	87	6	15	TR				
21-31	1	18	3	3	3				
Total/ month	3	134	33	51	5				
Total /season	(266)								
Mean max. Tem.	40	36	34	37	39	38	36	32	37
Mean min Tem.	25	24	23	23	22	23	18	23	18
R.H%	51	71	82	76	59	45	47	43	39
Eto (mm/day)	7.3	6.6	6.1	6.5	6.0	5.0	4.6	4.1	5.3

SLT = Sudan Local Time
0.900 = 0600 GMT

Table 2. Mean number of whiteflies per 100 leaves and percent of aphid infestation in Barakat 90 (V1) and Barac (67)B (V2) at different watering intervals (seasons 2000-01 and 2001-02)

2000-01					2000-02				
Treatment	Whiteflies		Aphids		Treatment	Whiteflies		Aphids	
	V1	V2	V1	V2		V1	V2	V1	V2
W1	35	45	5	7	W1	49	54	14	13
W2	31	41	4	5	W2	44	48	6	9
W3	23	37	3	4	W3	40	45	5	7
	30	41	4	5		40	49	8	9

V1 = Barakat 90 and V2 = Barac(67)B

Table 3. Effect of watering interval on average seed cotton yield for Bakakat-90 and Barac(67)B in two seasons (2000-01 and 2001-02).

Barac(67)B				Barakat-90			
W/season	**Kantar/fed**	**kg/ha**	**%/W1**	**%/W2**	**kg/ha**	**Kantar/fed**	**W/season**
W1-1	4.4	545	98	95	444	4.0	W1-1
W1-2	5.3	656	110	96	533	4.8	W1-2
Average	4.9	600	104	96	489	4.4	Average
W2-1	4.5	557	100	100	455	4.1	W2-1
W2-2	4.8	594	100	100	555	5.0	W2-2
Average	4.7	575	100	100	505	4.6	Average
W3-1	3.9	483	87	83	387	3.4	W3-1
W3-2	3.9	483	81	72	400	3.6	W3-2
Average	3.9	483	84	78	389	3.5	Average

For barac(67)B, kg/ha = Kantar/fed* 117(GOT)/2.25*2.38
For Barakat 90, kg/ha = Kantar/fed* 105(GOT)/2.25*2.38

Table 4. Effect of watering interval and picking time (successive picks vs. farmer's practice) on fibre quality and stickiness level in Barac (67)B, averaged over two seasons (2000-01 and 2001-02).

Water	Pick	Length (mm)		Fin.	Mat.	Stickiness	Higher
		2.5%	UR%	Mic.		SCT*	Grade%
W1	Successive	28.4	50	4.1	0.92	4	100%
W1	Farmer	27.7	49	4.1	0.90	14	25%
W2	Successive	28.1	48	4.1	0.90	5	100%
W2	Farmer	27.8	48	4.0	0.89	14	20%
W3	Successive	27.9	48	3.9	0.86	3	90%
W3	Farmer	27.7	48	3.9	0.86	9	10%

* Number of sticky spots (0-5 = Free)

Table 4. Effect of watering interval and picking time (successive picks vs. farmer's practice) on fibre quality and stickiness level in Barakat 90 over two seasons (seasons 2000-01 and 2001-02)

Water	Pick	Length (mm)		Fin.	Mat.	Stickiness	Higher
		2.5%	UR%	Mic.		SCT	Grade %
W1	Successive	34.3	50	3.8	0.92	2	60%
W1	Farmer	34.1	49	3.8	0.88	9	30%
W2	Successive	34.3	50	3.7	0.89	2	45%
W2	Farmer	34.0	48	3.8	0.87	7	25%
W3	Successive.	33.4	49	3.5	0.85	2	30%
W3	Farmer	33.1	48	3.6	0.85	6	10%

* Number of sticky spots (0-5 = Free)

Appendix 1. The South Indian Technical Research Association (SITRA) were used as a reference for significant differences test

Type of test	critical diff.(%)	
2.5% S.L	4	nearly about 2 mm
U.R%	4	" " 2%
Mic. Value	6	" " 0.3

	2.5% S.L	U.R%	Mic. value
Range for Acala	27-28(mm)	48-50%	3.8-4.3
Range for Barakat	32-35(mm)	48-50%	3.5-4.1