Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
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Asian Journal of Plant Sciences 2 (4): 365-367, 2003
ISSN 1682-3974

Optimum Time of Last Irrigation for Cotton Cultivars FH-634 and CIM-443

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Abstract: Two cotton cultivars viz. FH-634 and CIM-443 were tested for various intervals of termination of last irrigation. Progressive seed cotton yield increase (3333 to 3951 kg ha^{-1}) in FH-634 was obtained with cut-off irrigation during 2nd week of October 2000. While cv. CIM-443 gave maximum yield of 3992 kg ha^{-1} with discontinuation of irrigation during Ist week of October, closely followed by termination during last week of September (3951 kg ha^{-1}). The respective benefit cost ratio (6.17 and 1.02) showed that second week of October for cv. FH-634 and last week of September for cv. CIM-443 are economical irrigation intervals.

Key words: Cotton, last irrigation, seed cotton yield , benefit cost ratio

Introduction

Cotton (*Gossypium hirsutum*) is a major fibre crop of Pakistan. During 2000, the area under cotton was 2927.5 thousand hectares with total production of 10731.9 thousand bales of lint (Anonymous, 2001). It would produce maximum yield if enough water and nutrients are applied. The irrigation water is an important factor for higher yield. At present Pakistan is facing a severe shortage of good quality irrgational water. Thus, there is urgent need to cut short the frequency of irrigation to cotton without affecting the economic yield. Mukhdum *et al.* (2001) stated that cotton crop water requirement decline rapidly at maturity stage as a result of leaf shedding, boll aging and weather cooling. Depending upon the soil type, root systems and weather conditions, water supply during boll ripening may be discontinued to achieve early maturity. This generally happens during late September to early October. Napoles *et al.* (1999) studied suppression effect of last irrigation at 20, 30, 40, 50 and 60 days after appearance of first white flower of cotton and reported the seed cotton yield of 2.0, 3.1, 3.2, 2.7 and 2.9 t ha^{-1} with a total irrigation supply of 492, 602, 679, 759 and 832 mm, respectively. Shah *et al.* (1999) studied response of cotton varieties of NIAB-78 and NIAB-86 to different irrigations. They found that seed cotton yield of NIAB-78 was the highest with three irrigations (6 weeks after sowing+flowering+boll formation). The yield of NIAB-86 was optimum at two irrigations (6 weeks after sowing and flowering). Gill *et al.* (1990) reported that the end September, water suppression of cv. B-557 sown on mid May and mid June gave better results compared to early September and beyond end September. Similarly, Mustafa and Siddiqi (1978) recommended the continuation of irrigation till last week of September to cotton sown on 15th May. Conversely, Muhammad and Hanif (1979) obtained maximum seed cotton yield of cv. AC-134 by stoppage of irrigation in Ist week of October. Thakar and Brar (2000) reported the decreased yield in cotton with delay in last irrigation. Anac *et al.* (1999) reported that vegetative stage was most sensitive to water stress than boll formation and flowering stage. Omitting irrigation at boll formation stage saved water from 4 to 9%. Similarly, Wahed *et al.* (1998) reported that when irrigation was applied at generative stage, the NIAB-86 yielded 23 and 12% more than omitting irrigation at vegetative and maturity stage, respectively. But FH-682 gave similar seed cotton yield receiving irrigation at vegetative+generative stage. It was also observed that seed cotton yield decreased with irrigation at maturity owing to the initiation of re-vegetative growth which provably limited the translocation of photosynthates to cotton bolls.

Therefore, the study was conducted to assess the termination period effects of last irrigation in two cotton varieties (CIM-443 and FH-634).

Materials and Method

This experiment was conducted at Agronomy Research Area, Ayub Agricultural Research Institute, Faisalabad during 2000. Six stoppage intervals for last irrigation were; 3rd (D_1) and 4th (D_2) week of September and Ist (D_3), 2nd (D_4), 3rd (D_5) and 4th (D_6) week of October. Cotton varieties as main plots and irrigation stoppage intervals as sub-plots were tested in a split plot arrangement having three replication. The net plot size was 4.50 x 9.00 m^2. Cotton was sown on 27th May, 2000. It was sown by a single row hand drill with row to row distance 75 cm. Fertilizer was applied @ 100-60 NP kg ha^{-1} (1/3 N + all P at sowing and 2/3 N at Ist irrigation and at squaring stage in two equal splits). Last irrigation was applied according to the treatments. Recommended agronomic practices and plant protection measures were followed. Two pickings of seed cotton were taken. First picking was done on 17 October

and second on 23 November, 2000. Total seed cotton yield was obtained by summation of yield of both pickings. Seed cotton yield data were analyzed statistically using Duncan's multiple range test at 5% probability level (Steel and Torrie, 1980). Benefit cost ration (BCR) was also calculated for each cultivar according to the irrigation treatments. The climatic data on weekly basis for mean temperature (°C), relative humidity (R.H%) and rainfall (R.F) were also recorded for better understanding of results.

Results and Discussion

Both cotton cultivars responded differently when subjected to frequency and termination intervals of irrigation. But statistically they showed non significant response to termination intervals. Cotton cv. FH-634 (long stature), produced lower seed cotton yield than cv. CIM-443 (short stature and early maturing). CIM-443 gave 2060 kg ha^{-1} seed cotton yield during Ist picking (Table 1) that was 18 % more than FH-634. First picking was done on 17 October up-to which last irrigation to D_1 to D_4 i.e. second week of October was applied. Both cotton cultivars statistically gave equal seed cotton yields at all irrigation cut-off intervals. But yield data of 2nd picking (Table 1) done on 23 November showed a different trend. Final picking was done after the completion of all irrigation termination treatments. During 2nd picking FH-634 produced 6% more yield than CIM-443. The yield reduction was observed in D_1 (1736 kg ha^{-1}) during 2nd picking than from same treatment at Ist picking. This showed the adverse effect of earlier termination of irrigation. FH-643 gave maximum yield of 2180 kg ha^{-1} by termination of irrigation during 3rd week of October (D_5). About 17% less yield was obtained from FH-634 by delaying last irrigation for one week in D_6 as compared with D_5. This was mainly due to dense vegetation and less translocation of photosynthates to boll formation. A progressive decreasing yield trend was observed in CIM-443 by delaying last irrigation after 2nd week of October. Napoles *et al.* (1999) and Shah *et al.* (1999) also reported decreased seed cotton yield with suppression of irrigation after 40 days of appearance of first white flower or two to three irrigations (6 weeks after sowing + flowering + boll formation depending upon the variety).

A progressive yield increase (Table 1) in FH-634 was observed up-to D_4 (termination of irrigation during 2nd week of October). The yield reduction of about 3-8% was obtained by terminating irrigation during 3rd and 4th week of October as compared to terminating during 2nd week of October. While cv. CIM-443 gave maximum yield of 3992 kg ha^{-1} when final irrigation was applied during Ist week of October (D_3) closely followed by D_2 (terminating during 4th week of September. Wahed *et al.* (1998), Anac *et al.* (1999) and Thakar and Brar (2000) also reported the decreased seed cotton yield by applying irrigation at boll maturity stage or suppressing at vegetative or flowering or at boll formation stages subjected to variety.

The weather remained almost dry during the study period (Table 2) except 4th week of September where 14.5 mm rainfall was recorded with minimum mean temperature of 21.8°C. The minimum temperature ranged between 16.9 to 24 °C and of maximum mean 32.9 to 36.7°C during 3rd week

Table 1: Seed cotton yield (kg ha^{-1}) as affected by different irrigation intervals

		First picking			Second picking			First+second picking		
Last Irrigation Termination Interval	Frequency Of Irrigation After Mid-September	FH-634	CIM-443	Mean	FH-634	CIM-443	Mean	FH-634	CIM-443	Mean
D_1	1	1686	1909	1798	1605	1867	1736	3333	3778	3556
D_2	2	1770	2222	1996	1894	1728	1811	3663	3951	3807
D_3	3	1753	2247	2000	1951	1753	1852	3704	3992	3848
D_4	4	1867	1934	1900	2086	1934	2010	3951	3811	3881
D_5	5	1647	2099	1873	2180	1852	2016	3827	3951	3889
D_6	6	1728	1951	1839	1809	1770	1789	3539	3720	3630
Mean	-	1742	2060	N.S	1921	1817	N.S	3670	3867	N.S

N.S stands for statistically non significant data

Table 2: Weekly average meteorological data from September to October, 2000

	Air Temperature (°C)			Relative Humidity (%)			Total rainfall
Weekly intervals	Maximum	Minimum	Average	8 a.m.	5 p.m.	Average	mm
1st week of September	38.1	28.1	33.1	69	44	57	-
2nd week of September	36.3	24.4	30.1	69	45	57	12.3
3rd week of September	36.0	24.0	30.0	69	45	57	0.8
4 rd week of September	34.0	21.8	27.9	72	50	61	14.5
1st week of October	36.7	22.7	29.7	71	36	54	-
2nd week of October	35.5	19.7	27.6	68	31	50	-
3rd week of October	35.5	18.0	26.7	66	37	52	-
4th week of October	32.9	16.9	24.9	78	43	61	-

Table 3: Benefit cost ratio as affected by subsequent irrigation

Seed cotton yield (+/-) by subsequent irrigations			Revenue obtained by subsequent irrigation (Rs./ha)		Benefit cost ratio (gross income/ input cost)	
$Y_{dn} - Y_{dn-1}$	FH-634	CIM-443	FH-634	CIM-443	FH-634	CIM-443
$D_2 - D_1$	330	173	6188	3243	8.25	4.32
$D_3 - D_2$	41	41	769	769	1.02	1.02
$D_4 - D_3$	247	-181	4631	-3394	6.17	-4.52
$D_5 - D_4$	-124	140	-2325	2625	-3.10	3.50
$D_6 - D_5$	-228	-231	-5400	-4331	-7.20	-5.77

One irrigation charges / ha = Rs. 750/- Seed Cotton Price = Rs. 750/40 kg

Y_{dn} = Total seed cotton yield at respective irrigation interval. Y_{dn-1} = Total seed cotton yield at previous interval.

Last Irrigation Termination Interval

D_1 = 3rd week of September D_2 = 4rd week of September D_3 = 1st week of October

D_4 = 2nd week of October D_5 = 3rd week of October D_6 = 4th week of October

of September to 4th week of October. It is evident that maximum and minimum temperature decreased gradually after 1st week of September with sudden fall during last week of September due to rainfall of 14.5 mm. The meteorological data indicated crop growth and genetic diversification for water requirement. It gradually decreases from end of September with out going significant yield loss.

Maximum seed cotton yield increase of 330 kg ha^{-1} for FH-634 and 173 kg ha^{-1} for CIM-443 with respective benefit cost ratio (BCR) of 8.25 and 4.32 was recorded in D_2-D_1 as compared to D_1. However, seed cotton yield increase /BCR was marginal by D_3-D_2 from both the cultivars but seed cotton yield of FH-634 gained momentum by applying an extra irrigation than D_3. The results showed that the optimum time of irrigation up-to 2nd week of October for FH-634 and end of September for CIM-443 was economical. The findings of Mustafa and Siddiqi (1978), Muhammad and Hanif (1979) and Gill *et al.* (1990) are partially in accordance because of different varieties and planting time.

In brief the results of the experiment showed that applying irrigation beyond last week of September to cotton CIM-443 is uneconomical due to its early maturing character. But final irrigation to FH-634 (late maturing) may be given during 2nd week of October.

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