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Optimum Irrigation Scheduling for CRIS-134, A New Heat Resistant Cotton Variety of Sindh in Sakrand Conditions

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Abstract: A field experiment was conducted to evaluate the different dates of initial irrigation and later irrigation frequencies on seedcotton yield of CRIS-134, an advance heat resistant variety. On an average, data revealed that CRIS-134 significantly responded to first irrigation at 45 days after planting (DAP) and yielded highest (2429 kg ha^{-1}). As regards interval between subsequent irrigations, results revealed that averagely CRIS-134 produced significantly highest yield of 2230 kg ha^{-1} at every two weeks interval.

Key words: Cotton, irrigation scheduling, water management, critical period, non-critical period

Introduction

Cotton is a high demanding field crop in management; water management is probably being a major knowledge-based component. Water application has to be optimized. Deficient irrigation generates water and carbohydrate stress leading to yield shortfall, whereas excess irrigation ends in rank growth, low harvest index leading to yield loss and waste of valuable resource. Water scheduling optimization is to understand the plant necessities and to respond precisely.

Despite the reality that there is sufficient fresh water to support a much greater population, water is scarce in a number of growing locations. Varietal selection plays important role in water use efficiency for cotton production. Improved technology and scheduling has promoted the productivity and water use efficiency. Nevertheless, accuracy and control of water application in space, time and quantity remain constraints for enhancement of productivity and water use efficiency, regardless of the method applied.

The genetic yield potential of today's cotton plant is at least 5 and probably close to 10 times the average yields we attain each year. The primary cause of potential yield reductions is an unfavorable physical environment, including radiation, temperature and water supply. Water stress from lack of water is rarely a problem in seedling emergence and stand establishment. Water stress from excess water is a more serious problem to stand establishment and seedling survival than in limited water supplies. Today however, the emphasis is on short season cotton production, the release of new high yielding and early maturing varieties. Therefore, more information about initial irrigation and frequency of irrigation is necessary.

Sensitivity of cotton plants to water stress during various reproductive development phases is well documented (Krieg *et al.*, 1993). Three basic stages are identified: square formation and early flowering; flowering peak and boll development; and boll ripening. It is well established that water stress during boll development has the most pronounced inhibiting effect on yield and quality. Both the early and later development periods are less affected by water stress (de Kock *et al.*, 1990).

Mustafa and Siddiqui (1978) reported that optimum interval of 1st irrigation after sowing was 42 days with two soaking doses and 28 days with one soaking dose. The optimum interval of subsequent irrigations was 15 days and the yield of seedcotton decreased with increase in interval of subsequent irrigations.

Johnson *et al.* (1990) indicated that the most common practice in the field has been to "stress" cotton particularly prior to the first irrigation. With the release of more determinate verticillium wilt tolerant varieties, early observation indicated that this common practice did not appear to meet water requirement of new plant types.

Grimes (1991) opined that if full genetic potential of fiber quality is to be realized, irrigation has to be scheduled to avoid severe stress during boll maturation. This is especially true during the early part of the boll set period. A water deficit sufficient to lower fiber growth at this time will almost certainly affect the productivity.

Godoy *et al.* (1994) indicated that the highest values in lint yield were found when initial irrigation was applied 60 or 70 DAP and then irrigated each 28 days. Fiber quality characteristics were not affected by any one of the treatments evaluated.

Khan and Malik (1996) were of the view that first post planting irrigation may be applied at 50 to 60 percent depletion of available moisture. Further depletion of available water may restrict vegetative growth but when followed by ample supply of water, vegetative growth will be somewhat excessive, which may cause late flowering and reduced yield. These studies therefore, were conducted to determine the effect of initial and subsequent irrigations on yield of CRIS-134, an advance heat resistant strain developed by CCRI in Sakrand conditions for the information of its growers to take maximum benefit from its genetic potential.

Materials and Methods

The experiment was conducted during 1997 and 1998 on the experimental field of Central Cotton Research Institute Sakrand. The experimental design was split plot with four replications. The main plot was initial irrigation dates with three levels (30, 40 and 45 DAP). The subsequent irrigation frequencies were the sub-plots with three levels; at every two weeks interval, at three weeks interval during non-critical period and at four weeks interval during non-critical period. During critical period irrigation interval was kept uniform (two weeks) CRIS-134, was sown. One bag $acre^{-1}$ of DAP fertilizer was applied at the time of seed bed preparation and 2 bags/acre of urea were applied in split doses (one bag at the time of first irrigation and the second at the time of peak flowering) during both the seasons.

Three insecticidal sprays were done; first for sucking pests (60 DAP), second to control sucking as well as bollworms (at peak flowering and boll formation) and third to control the bollworm (at the time when 50% boll opening was observed).

Each plot had five rows, which were 10 m long. Three inside rows of each five-row plot were picked for seedcotton yield per hectare calculations. Duncan's Multiple Range Test (Duncan, 1937) was applied to differentiate the mean performance statistically.

Results and Discussions

The data of seedcotton yield of CRIS-134 under different irrigation treatments during 1997 and 1998 are presented in Table 1, revealing statistically significant difference among initial irrigations and subsequent irrigation frequencies. The highest seedcotton yield (2429 kg ha^{-1}) from CRIS-134 was obtained when first irrigation was applied at 45 DAP and lowest yield of 2165 kg ha^{-1} from the treatment where first irrigation was applied at 30 DAP during 1997. Similar results were obtained during the second year of study (1998). The average data of two years regarding application of initial irrigation also advocated that CRIS-134 requires first irrigation after 45 DAP. In Sindh the common practice of farmers is to apply the first irrigation at 30-35 DAP; this may be due to high temperature during this period. But present results suggested that CRIS-134 needs first irrigation at 45 DAP and also suggested that CRIS-134 being heat resistant variety, tolerate the drought to some extent. The results regarding the application of first irrigation after sowing are in accordance with those of Mustafa and Siddiqui (1978) and Godoy *et al.* (1994) who reported maximum yield, when first irrigation was applied at 42 DAP or even later. Johnson *et al.* (1990) also indicated that the most common practice in the field has been to "stress" cotton particularly prior to the first irrigation.

Table 1: Effect of different irrigation treatments on seedcotton yield of CRIS-134 during 1997 and 1998 at Central Cotton Research Institute, Sakrand

Irrigation Treatments	Seedcotton yield (kg ha^{-1})		
	1997	1998	Average
Initial			
30 days after planting	2005 c	2325 bc	2165 c
40 days after planting	2115 b	2411 b	2263 b
45 days after planting	2245 a	2613 a	2429 a
Frequency			
Subsequent irrigations at every two weeks interval.	2175 a	2285 a	2230 a
Subsequent irrigations at three weeks interval during non-critical period and two weeks during critical period.	1925 b	2050 b	1988 b
Subsequent irrigations at four weeks interval during non-critical period and two weeks during critical period.	2015b	2125 b	2070 b

Means followed by similar letters do not differ significantly from each other according to DMR Test

As regards the subsequent irrigation frequencies the results obtained were also statistically significant. Maximum yield (2175 and 2285 kg ha^{-1}) was obtained during 1997 and 1998 respectively when subsequent irrigations were applied after two weeks interval followed by the remaining irrigation frequency treatments that were statistically at par according to DMR test. These results are in conformity with those of Mustafa and Siddiqui (1978) who reported that late applied first irrigation and subsequent irrigations after 15 DAP gave maximum yield of seedcotton. However, the results achieved regarding subsequent irrigations were different from those of Godoy *et al.* (1994) who advocated the subsequent irrigations after 28 days. This may be due to climatic conditions of that particular area where the experiment was conducted. It was concluded that being heat resistant variety, CRIS-134 needs fist irrigation 15 days late as compared to common practice of farmers, who apply first irrigation at 30-35 DAP. CRIS-134 requires subsequent irrigations at two weeks interval. The data regarding irrigation frequencies (Table 1) demonstrated significant difference between subsequent irrigation intervals at every two weeks, three weeks interval during non-critical period and two weeks during critical period, and interval of four weeks during non-critical and two weeks during critical period. The later two irrigation frequencies were at par with each other according to DMR Test. On an average highest yield of 2230 kg ha^{-1} was achieved when CRIS-134 was irrigated at every two weeks interval followed by the irrigation frequency where subsequent irrigations were applied at four weeks interval during non-critical period. This suggests that CRIS-134 during its critical stage (boll development) may not be stressed.

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