Optimum level and critical period of irrigation for sugarcane grown in areas of water deficit

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INTRODUCTION

In Uttar Pradesh, resources for irrigation are very scanty. About two thirds of the cultivated area still remains unirrigated. The crops generally depend on natural precipitation and underground soil water. Lack of adequate irrigation is, therefore, one of the main reasons for poor yields of all crops, particularly in sugarcane which is planted in the relatively dry season and has a large demand for water in the early stage of its life cycle due to the stresses caused by low temperature, low humidity, intense solar radiation and high wind velocity of the summer months.

Anon., (1940) claims that in Punjab, an irrigation requirement of about 50 acre inches is needed for optimum yields of sugarcane in addition to the usual rainfall. Rege and Basu (1944) report that optimum irrigation requirement for January planted sugarcane in Padegaon, Bombay is about 95 acre inches. Rege and Rao (1954) observe that 115 acre inches of water are required for sugarcane in the Deccan canal tract. Verma (1962) claims that in Uttar Pradesh, 61.77 acre inches of water are needed to raise a normal crop of spring planted sugarcane. Singh and Negi (1969) observe that 5 irrigations of about 80 thousand gallons/acre each must be given at frequent intervals till the onset of rains in addition to usual rainfall.

As regards the frequency of irrigation in various areas, Rege and Basu (1944) observe that 10 days interval is the best for sugarcane at Padegaon. Irrigation at 12 days interval during the growth phase and 15 days interval during maturity also proved as good as 10 days interval. Anon., (1951) reports that irrigation at 12 days interval increased the yield of sugarcane but it proved uneconomical when compared to the interval of 18 days at Anakapalle. Anon. (1951) claims that intervals of 6, 12 and 18 days between two irrigations gave similar results at Gudiyattam. Khan and Pattanayake (1956) report that irrigation at 20 days interval proved optimum for a good

sugarcane crop at Delhi. Khan and Mohapatra (1957) claim that intervals of 10, 15 and 20 days between two irrigations did not exhibit marked variation in their effect on yield. An interval of 20 days was, therefore, considered as optimum. Bhoj and Singh (1960) claim that irrigation at 15 days interval is sufficient for spring planted sugarcane at Shahjahanpur. Verma (1962), however, claims that irrigation at 20 days interval from April onwards till the onset of monsoon is necessary for an average crop of sugarcane.

Considerable work has thus been done to determine the irrigation requirement of sugarcane and interval of its application where ample irrigation facilities are available. But there is no information about water deficit areas, which pose a rather different problem. To meet this need the present investigations were undertaken to determine the optimum level and critical period of irrigation for sugarcane grown in areas of water scarcity so that an economic schedule of irrigation may be evolved for practical purposes and profitable ends.

EXPERIMENTAL PROCEDURE

An experiment was conducted during the crop season 1964-65, 1966-67 and 1967-68 on sugarcane variety, Co. 1158, in sandy loam soils of the Experimental Farm of Sugarcane Research Station, Shahjahanpur. Uttar Pradesh, which has an average pH of 6.6 and water holding capacity of 42.66 percent. The mechanical and chemical composition of a representative soil sample taken from surface to a depth of 22.5 cm is furnished below.

Mechanical		*Chemical*	
Coarse sand	1.34%	Organic carbon	0.34%
Fine sand	55.52%	Nitrogen	0.03%
Silt	23.47%	P_2O_5	0.09%
Clay	17.40%	K_2O	0.10%

The experimental layouts were in the randomized block design with 4 replications and 7 irrigation treatments, the schedule of which is given below.

SCHEDULE OF IRRIGATION TREATMENTS

S. N.	*Treatments*	*Dates of irrigations*			*Total No. of irrigations*
1	I_1	April, 20	—	—	One
2	I_2	—	May, 15	—	One
3	I_3	—	—	June, 10	One
4	I_4	April, 20	May, 15	—	Two
5	I_5	April, 20	—	June, 10	Two
6	I_6	—	May, 15	June, 10	Two
7	I_7	April, 20	May, 15	June, 10	Three

The net plot size was 1/112 ha during 1964-65 and 1/150 ha during 1966-67 and 1967-68. The rainfall data for these years from January to December are presented in table I.

The fields were prepared after *palewa* by ploughing and planking and 3 budded sets of sugarcane were planted in rows made 90 cm. apart, at the rate of one set per 30 cm. of the row length during the month of February in the first two seasons and March in the last. Manuring was done with nitrogenous fertilizers at the rate of 134 Kg N per hectare. All the nitrogen was applied in one dose in the case of one irrigation treatment and two doses in case of two and three irrigation treatments. The fertiliser applications were made at the time of the first irrigation and at the first and second irrigations respectively. After each irrigation, hoeing and weeding were done as usual when the soil came into proper working condition. The sugarcane crop was harvested during the month of February in the first two seasons and March in the last. The yield data of stripped cane thus obtained plotwise were analysed statistically for each year and finally the pooled data for all the years was worked out to derive valid conclusions. The treatment differences were judged at 5 per cent. probability level, and results for each year are discussed separately and on the basis of pooled data for all the years. Final conclusions were drawn on the basis of pooled results.

TABLE 1.—RAINFALL OF DIFFERENT CROPPING SEASONS

Months	*1964–65*		*1966–67*		*1967–68*		*Mean of 10 year*	
	Rainfall (mm)	*Rainy days*	*Rainfall (mm)*	*Rainy days*	*Rainfall (mm)*	*Rainy days*	*Rainfall (mm)*	*Rainy days*
January	0.0	0	13.5	2	1.3	1	25.4	2
February	1.0	1	22.4	3	0.0	0	9.6	2
March	0.5	1	0.0	0	48.2	5	21.8	2
April	0.0	0	0.0	0	5.1	1	3.0	1
May	23.6	3	13.5	3	42.6	2	7.8	1
June	27.7	3	181.4	12	84.1	6	80.6	5
July	341.1	15	139.1	9	197.8	15	251.9	14
August	132.0	11	290.7	18	380.7	22	308.0	17
September	273.2	16	32.8	4	173.6	13	189.6	10
October	3.8	1	27.7	5	0.0	0	134.3	3
November	0.0	0	15.2	1	8.1	1	5.0	1
December	15.8	3	1.8	2	35.3	5	4.8	1

THE FINDINGS

The yield data of sugarcane for the different years, as well as the pooled data are presented in table II.

TABLE 2.—YIELD OF SUGARCAN IN M. T/HA

S.N.	Treatments	Seasons			Pooled
		1964–65	1966–67	1967–68	
1	I_1	53.82	35.27	58.82	49.30
2	I_2	41.63	35.54	59.01	45.39
3	I_3	54.47	32.14	60.38	48.99
4	I_4	59.06	50.35	65.39	58.27
5	I_5	63.35	55.17	75.84	64.78
6	I_6	61.42	52.57	69.30	61.10
7	I_7	66.05	63.30	81.74	70.35
S. E.		3.46	4.40	5.28	2.14
C. D. at 5%		10.28	13.08	15.69	6.11

It is evident from the above table that 3 irrigations as given in treatment 1_7 during the months of April, May and June invariably gave the highest yield and proved significantly superior to all treatments except 2 irrigations of April and June and May and June, as given in treatments 1_5 and 1_6 respectively, in all the seasons of trial. In the pooled results, however, the 2 irrigations of April and June alone proved statistically similar to 3 irrigation treatment and gave significantly higher yields than all the other treatments comprising one and two irrigations. Among the single and double irrigation treatments, somewhat variable results were obtained in different seasons. While in the initial year of trial, all treatments comprising one and two irrigations except that of the single irrigation in May (1_2) were on par statistically, in the second year, all the treatments comprising one irrigation were significantly inferior to the two irrigation treatments. In the third year, on the other hand, all the treatments comprising a single irrigation were statiscally similar to two irrigations of April and May and May and June. In the pooled result of all the three years, however, all the treatments comprising a single irrigation were significantly inferior to two irrigations. There

was no significant variation between different times of one irrigation *viz.*, April 20th, May 15th and June 10th but the two irrigations of April 20th and June 10th were significantly superior to those of April 20th and May 15th.

The seasonal variations in yield appeared to be caused by variations in the weather conditions especially rainfall. When the maximum rainfall was received during the germination phase in 1967-68, highest yield was obtained during this season. On the other hand, minimum rainfall of 1966-67, during the germination phase resulted in the lowest yield. There was thus a close relationship between rainfall and the sugarcane yield.

DISCUSSION

The sugarcane crop showed favourable response to increasing levels of irrigation in general, and the maximum yield was obtained with three irrigations applied in the months of April, May and June. But there was no statistically significant difference over 2 irrigation treatment of April and June in all the years of trial as well as to the data pooled. It thus gave a definite indication that the additional irrigation in May di dnot result in any significant yield increase and may therefore, be easily dispensed with, in the event of water deficit The wide frequency of 50 days between two irrigations applied at critical periods proved equally good to narrow frequency of 25 days fixed arbitrarily and thus indicated the importance of critical periods of water application to the sugarcane crop. The adoption of irrigation practice based on critical periods of water requirement may enable considerable economy in water use and make possible the irrigation of larger areas than are actually irrigated presently with the limited irrigation resources. The recommendations made by Rege and Basu (1944), Anon. (1951), Khan and Pattanayak (1956), Khan and Mohapatra (1957), Bhoj and Singh (1960) and Verma (1962) to irrigate sugarcane crop in various areas at short periods of 10 to 20 days did not find support in these studies.

The highest yields of 1967-68 and lowest yields of 1966-67 were associated with the highest and lowest rainfall received during the germination phase. It evidently shows that irrigation of the sugarcane crop during this phase in the event of failure of rain or its deficiency is absolutely necessary for obtaining high yields. Likewise, the great importance of irrigation during the tillering period in June was brought out. In areas of water deficit, therefore, irrigation of the crop

during the germination and tillering periods in the month of April and June respectively is imperative, for these appear to constitute the critical periods of crop water requirement. The rainfall received during the growth phase has also shown profound influence on the yield of sugarcane. Higher rainfall of 1964-65 and 1967-68 of this period as compared to that of 1966-67 resulted in the higher yields of sugarcane and indicate that in the event of rain failure or scanty rains during the monsoon, an irrigation may be required to meet the crop's need. The positive relationship of sugarcane yield with the rainfall of the growth phase as observed earlier by Singh and Ahmad (1969) has been also corroborated by these results.

SUMMARY AND CONCLUSIONS

An experiment was conducted for three years to determine the optimum level and critical periods of irrigation for sugarcane grown in areas of water deficit. The treatments consisted of 3 dates of irrigation *viz.* one, two and three which were given in the months of April, May or June, singly and in different combinations. Thus, there were 7 treatments of irrigation, viz. April, May, June, April plus May April plus June, May plus June and April plus May plus June. These were tried in a randomised block design with 44 replications with the sugarcane, variety Co. 1158.

The crop responded favourably to increasing levels of irrigation and 3 irrigation gave the maximum yield but was not significantly superior to that obtained by two irrigations applied at critical periods in the months of April and June. It showed that in water deficit areas the water applied in the month of May can be omitted without adversely influencing the yield. The results also show that rainfall had a considerable influence on sugarcane yields and an increase in precipitation was associated with increases in yield. Irrigation needs, therefore, to be applied in the event of rain failure or scanty rainfall during germination and growth phases. The need for a minimum of two irrigations for sugarcane in the premonsoon period was established. These should be applied in the months of April and June for efficient and economic production of this crop.

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