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Effect of irrigation scheduling and other agronomic manipulations on yield and water economy in sugarcane

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ABSTRACT

An experiment was conducted during 1988–1989 and 1989–1990 at Main Sugarcane Research Station, Sehore, to evaluate the effect of different irrigation management practices and irrigation (IW : CPE) ratio on yield and water economy of sugarcane (*Saccharum officinarum* L.). Yield, yield attributes and quality of the cane varied significantly. *Jalshakti* 20 kg with irrigation in all the rows and full trash mulch with alternate row irrigation proved better than other practices. An IW : CPE ratio of 0.8 was better than that of 0.5. The net realization (Rs/ha-mm of water applied) was considerably high under full trash mulch with alternate row irrigation at 0.5 IW : CPE ratio.

The water requirement of sugarcane (*Saccharum officinarum* L.) is quite high. Excess irrigation impeds aeration and certain beneficial reactions within the plant and the soil, where deficit, on the other hand results pith formation in cane, wilting of tender tillers and reduction in yield (Prihar *et al.*, 1975). Efficient management of irrigation for the sugarcane crop not only solves the problem of water scarcity and irregular distribution of rainfall, but also enhances the cane yield. Mulching economizes 30% in irrigation water and increases the cane yield by 10% and sugar yield by 9% as compared to no mulching (Prasad *et al.*, 1988). Similarly, the skip-furrow method of irrigation and the use of *jalshakti* increase the water-use efficiency. Climatological approach is one of the best approaches for scheduling irrigation. Hence an attempt was made to study the effect of various water-management practices on water economy in sugarcane and its yield.

MATERIALS AND METHODS

The experiment was conducted at Main Sugarcane Research Station, Sehore, during 1988–89 and 1989–90. The experiment was laid out in randomized block design with 3 replications. Treatments comprised combinations of 7 irrigation management practices and 2 irrigation ratios (Table 1). Sugarcane variety 'Co 7318' was planted in rows spaced 1 m apart during the second week of January and harvested during third week of February in both the years. The crop was fertilized with the recommended dose 300, 85 and 60 kg of N, P and K/ha. The soil was clayey loam (27.5% sand, 28% silt and 43.5% clay) having good surface drainage and neutral reaction (pH 7.4) with electrical conductivity of 0.32 mmhos/cm at 25°C. It was poor in organic carbon (0.20%) and available nitrogen (78 kg N/ha), me-

dium in available phosphorus (30 kg P_2O_5/ha) and high in available potash (550 kg K_2O/ha). The value of field capacity and permanent wilting point were 38 and 16% respectively in 0–60 cm soil depth. The trash mulch was applied 6 cm thick as per the treatment, whereas *jalshakti* was applied after germination. The required quantity was mixed with soil to build up volume and applied at depth of 5 inches in the root-zone area of the crop along the furrows or rows by ring method.

RESULTS AND DISCUSSION

Effect of irrigation-management practices

The effect of different irrigation-management practices on cane yield, growth and quality parameters was significant except number of millable canes (Tables 1, 2). Application of *jalshakti* and irrigation in all the rows gave consistently better performance for growth parameters, quality and ultimately the yield, followed by treatment normal irrigation in all rows (flood method) and treatment full trash mulch with alternate row irrigation. These findings are in accordance with those reported by Prasad *et al.* (1987) and Prasad *et al.* (1988).

Effect of irrigation ratio

The ratio of 0.8 IW : CPE showed better performance for all the growth parameters and resulted in significantly higher cane yield over 0.5 IW : CPE ratio. However, for quality the later was superior. The results are in close conformity with those of Phogat *et al.* (1987).

Water-use efficiency

The saving of irrigation water (%) was maximum under treatment of full trash mulch with alternate row irrigation at both the ratios (0.5 and 0.8 IW : CPE), i.e. 43.40

Table 1. Cane yield (tonnes/ha) as influenced by different irrigation management practices and irrigation ratio

Treatment	1988–89	1989–90	Pooled
Irrigation management practice			
Alternate row irrigation	70.55	55.80	63.17
Full trash mulch with alternate row irrigation	80.71	80.24	80.48
Trash mulch only in those row where irrigation applied	79.21	73.58	76.40
Trash mulch in only those rows where irrigation not applied	77.77	63.82	70.79
20 kg *jalshakti* and irrigation in all the rows	85.88	83.20	84.55
20 kg *jalshakti* and alternate row irrigation	76.66	64.44	70.54
Flood method	81.65	80.61	81.13
CD (P = 0.05)	NS	5.70	10.02
Irrigation ratio (IW : CPE)			
0.5	74.44	68.32	71.42
0.8	83.30	75.02	79.16
CD (P = 0.05)	4.73	4.68	5.36

Table 2. Growth and quality characters of sugarcane as influenced by irrigation management practices and irrigation ratio (pooled data of 2 years)

Treatment	Number of millable canes ('000/ha)	Number of internodes/ cane	Girth of the cane (cm)	Height of the cane (cm)	Tillers/ m (at 90 days)	CCS (tonnes/ ha)	Sucrose in juice (%)
Irrigation-management practice							
Alternate row irrigation	86.72	18.75	3.23	230.1	56.50	6.17	13.02
Full trash mulch with alternate row irrigation	90.18	20.71	3.65	241.5	70.16	7.90	13.08
Trash mulch only in those rows where irrigation applied	84.87	20.55	3.58	237.5	68.08	7.03	12.81
Trash mulch only in those rows where irrigation not applied	84.87	19.50	3.53	233.5	63.91	6.29	12.97
20 kg/ha *jalshakti* and irrigation in all the rows	96.41	21.08	3.70	247.8	78.16	8.51	13.22
20 kg/ha *jalshakti* and alternate row irrigation	81.17	20.25	3.55	238.5	66.16	6.29	12.82
Flood method	94.25	22.38	3.86	243.3	72.25	7.54	12.78
CD (P = 0.05)	NS	1.74	0.26	9.65	3.65	0.86	0.23
Irrigation ratio (IW : CPE)							
0.5	85.64	19.69	3.47	233.3	64.16	6.70	13.06
0.8	91.07	21.22	3.70	244.4	71.61	7.51	12.86
CD (P = 0.05)	NS	0.93	0.14	5.16	1.95	0.46	0.12

Table 3. Quantity of irrigation water applied, water-use efficiency and net realization (Rs/ha-mm water) in various treatments (mean data of 2 years)

Treatment	Yield (tonnes/ ha)	Number of irri-gations	Irrigation water app-lied (mm)	Saving (%) in irriga-tion applied	WUE (Rs/ha -mm of water)	Gross realization (Rs/ha)	Net realiza-tion (Rs/ha) (mm of water applied)	Net realization (Rs/ha)
Alternate row irrigation at 0.5 IW : CPE ratio	59.53	12	634.0	36.6	93.89	23,812	9498	14.98
Full trash mulch with alternate row irrigation at 0.5 IW : CPE	78.24	12	570.0	43.1	137.26	31,296	16,603	29.13
Trash mulch in alternate rows, where irrigation given at 0.5 IW : CPE	75.36	12	571.0	42.9	131.98	30,144	15,698	27.49
Trash mulch in alternate rows, where irrigation not given at 0.5 IW : CPE	63.70	12	632.0	36.8	100.79	25,480	10,920	17.28
20 kg/ha *jalshakti* and irrigation in all rows at 0.5 IW : CPE	82.03	12	1,000.0		82.03	32,512	15,788	15.79
20 kg/ha *jalshakti* and alternate rows irrigation at 0.5 IW : CPE	65.73	12	628.0	37.2	104.66	26,292	10,977	17.48
Normal irrigation in all the rows at 0.5 IW : CPE	75.09	12	1,000.0		75.09	30,036	15,036	15.04
Alternate row irrigation at 0.8 IW : CPE	66.94	15	778.7	37.2	85.96	26,776	12,640	16.23
Full trash mulch with alternate row irrigation at 0.8 IW : CPE	82.68	15	701.8	43.4	117.81	33,072	18,581	26.48
Trash mulch in alternate rows where irrigation given at 0.8 IW : CPE	77.13	15	705.5	43.1	109.32	30,852	16,604	23.53
Trash mulch in alternate rows where irrigation not given at 0.8 IW : CPE	77.77	15	782.4	36.9	99.36	31,108	16,717	21.37
20 kg *jalshakti* and irrigation in all the rows at 0.8 IW : CPE	87.12	15	1,240.0		70.26	34,848	17,824	14.37
20 kg *jalshakti* in alternate row irrigation at 0.8 IW : CPE	65.09	15	777.5	37.3	83.72	26,036	10,891	14.01
Normal irrigation in all rows at 0.8 IW : CPE	86.66	15	1,240.0		69.89	34,664	19,664	15.86

and 43.1% respectively. This has reflected on water-use efficiency which was considerably high in the above-mentioned treatments compared with the others. Similar results were reported by Prasad *et al.* (1988).

Economics

The highest net return was obtained from normal irrigation (flood method) in all the rows with 0.8 IW : CPE ratio, followed by full trash mulch with alternate row irrigation with 0.8 IW : CPE ratio. However, the net realization (Rs/ha-mm of water applied) was considerably low in this treatment than full trash mulch with alternate row irrigation with 0.5 IW : CPE ratio due to 43.1% more supplemental irrigation water required in normal irrigation in all rows with 0.8 IW : CPE ratio.

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