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Effect of irrigation schedule and trash mulch on growth, yield and economics of sugarcane (*Saccharum officinarum*) ratoon

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ABSTRACT

An experiment was conducted during 1998–99 and 1999–2000 at Agricultural Research Station, Rajasthan Agriculture University, Sriganganagar, to study the effect of irrigation schedule and trash mulch on 'Co 66-17' sugarcane (*Saccharum officinarum* L.) ratoon. The cane yields of 498.6 and 499.8 q/ha recorded, respectively, at IW : CPE of 0.9 (18 irrigations) and 1.2 (23 irrigations) were at par and significantly superior to that of 0.6 ratio and irrigations applied at 21-day interval. Trash mulching at 6 tonnes/ha resulted in significantly higher cane yield (566.5 q/ha) over mulching at 3 tonnes/ha (493.8 q/ha) and no mulch control (410.8 q/ha). Irrigation scheduled at 0.9 IW:CPE along with trash mulching at 6 tonnes/ha recorded the highest cane yield (574.0 q/ha) as well as 23% saving in irrigation water. The water-use efficiency and net return per unit quantity of water applied decreased markedly with an increase of irrigation regime from IW: CPE of 0.6 to 1.2. Benefit : cost ratio, net returns, and water-use efficiency increased substantially with trash mulching.

Key words : Sugarcane ratoon, Trash mulch, Benefit : cost ratio, IW : CPE, Water saving, Water-use efficiency

The sugarcane crop with its high capacity of utilizing solar radiation is a valuable store house of food, feed, fibre, fuel and fertilizer. Sugarcane ratoon occupies about 40% of the area under sugarcane cultivation. In North-western part of Rajasthan, inadequate water availability coupled with summer drought reduces crop yield as the crop suffers from moisture stress during one or other growth stages. The primary waste produced at field level, constitutes enormous quantity of ligno-cellulosic residue, is available in the form of trash. Under limited water supply conditions management practices like irrigation schedule and application of trash mulch minimize the cane yield loss. Hence the present experiment was undertaken to study the effect of irrigation schedule and trash mulching on cane yield and saving of water

without affecting the cane yield.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station, Rajasthan Agriculture University, Sriganganagar, during 1998–99 and 1999–2000, to study the effect of irrigation schedule and trash mulch on growth, yield and economics of sugarcane ratoon. The treatments comprised 4 levels of irrigation, viz. irrigation at irrigation water to cumulative pan-evaporation (IW : CPE) of 0.6, 0.9 and 1.2 and at 21-day interval, and 3 levels of trash mulch, viz. no mulch, mulch @ 3 and 6 tonnes/ha. The experiment was laid out in split-plot design keeping irrigation schedule in main plot and trash mulch in subplots with 3 replications.

The plant crop 'CO 66-17' sugarcane planted in rows spaced at 75 cm apart was harvested during January–February. After the harvest of plant crop, stubbles were shaved for uniform sprouting. Initially a uniform irrigation of 100 mm depth was given 30 days after harvesting of plant crop for establishment of crop and drilling of full dose of phosphorus and potash and one-third dose of nitrogen. Thereafter, the trash mulch treatments were imposed and irrigations were scheduled as per treatments. Measured quantity of irrigation water (60 mm) was applied with the help of 15 cm Parshal flume fixed in the irrigation channel. The crop was fertilized with 150 kg N and 40 kg each of P_2O_5 and K_2O per ha. One-third dose of nitrogen and full amount of P_2O_5 and K_2O were applied through drilling after the first irrigation and before trash mulching. Remaining two-thirds dose of nitrogen was given in June and July every year.

The soil of experimental field was sandy loam, having pH 7.8, EC 0.2 mmhos/cm, organic carbon 0.18% and available phosphorus and potash of 33 and 330 kg/ha respectively. Average values of field capacity, permanent wilting point and bulk density were 16.2%, 6.3% and 1.53% g/cc respectively. The effective rainfall of 338 mm during 1998–99 and of 203 mm during 1999–2000 crop season was added to irrigation water to compute the total water applied. The pan evaporation of 1,627 and 1,576 mm were recorded during crop season of 1998–99 and 1999–2000 respectively.

RESULTS AND DISCUSSION

Growth and cane yield

Irrigation : Irrigation markedly influenced the crop growth and yield during both the years (Table 1). The cane yields of 498.6 and 499.8 q/ha recorded respectively under the irrigation treatment of IW : CPE of 0.9 (18 irrigations) and 1.2 (23 irrigations) were at par and significantly superior to that obtained under irrigations applied at IW : CPE of 0.6 and at 21-day interval where 12 irrigations were applied in both treatments. Similar effects were recorded on green fodder yield. Irrigations applied at IW : CPE of 0.9 and 1.2 also resulted in significantly higher number of millable canes, giving significantly higher cane yield over other 2 irrigation levels. Influence of irrigation levels on commercial cane sugar content was not significant. But higher cane yield under IW : CPE of 0.9 and 1.2 gave substantially higher sugar yield over IW :

CPE of 0.6 and irrigations at 21-day interval. The results are in accordance with Ramesh (1998).

Trash mulch : An effect of trash mulching on number of millable canes and cane yield was significant. The cane yield increased significantly with the increased levels of trash mulching (Table 1). Trash mulching @ 6 tonnes/ha resulted significantly higher cane yield compared to mulching @ 3 tonnes/ha and no mulching. The corresponding increases were 14.7 and 37.9%. Cane yield with trash mulching 3 @ tonnes/ha was 20% higher than no mulching. Similarly, number of millable canes/ha increased significantly with the increasing level of trash mulching. Trash mulching had no marked effect on commercial cane sugar content, but sugar yield substantially increased with increasing levels of trash mulching. Beneficial effect of mulching might be due to conservation of more soil moisture, efficient utilization of irrigation water, moderation of soil temperature and suppression of weeds. The results are in conformity with those of Prasad *et al.* (1998).

Intraction effect

Interaction effect of irrigation levels and trash mulching was found significant. With each increase in trash mulching level from the control to 6 tonnes/ha, cane yield continued to increase under all levels of irrigation (Table 2). The cane yields obtained under the treatment combination of IW:CPE of 1.2 × trash mulching @ 6 tonnes/ha and IW:CPE of 0.9 × trash mulching @ 6 tonnes/ha were at par and significantly higher than rest of the treatment combinations. It appears that 5 irrigations can be saved through trash mulching @ 6 tonnes/ha without compromising the cane yield. The corresponding

Table 1. Growth, cane yield and other characters of sugarcane ratoon under different irrigation schedules and trash mulching (pooled over 2 years)

Treatment	Cane yield			Green fodder yield (q/ha)	No. of millable canes ('000/ha)	Commercial cane sugar (%)	Sugar yield (q/ha)
	1998–99	1999–2000	Mean				
Irrigation schedule							
IW : CPE 0.6 (12)	480.5	470.7	475.6	210.9	52.3	12.06	57.3
IW : CPE 0.9 (18)	506.8	490.3	498.6	224.6	63.2	12.16	60.6
IW : CPE 1.2 (23)	506.2	493.3	499.8	220.0	64.1	12.13	60.6
21-day interval (12)	499.4	475.6	487.6	219.6	54.0	12.33	60.1
CD (P=0.05)	6.11	11.15	6.91		3.51	NS	
Trash mulch							
No mulch	418.6	403.1	410.8	195.6	50.1	12.30	50.5
3 tonnes/ha	498.5	489.1	493.8	223.5	60.3	12.26	60.5
6 tonnes/ha	577.6	555.4	566.5	237.3	64.8	12.28	69.5
CD (P=0.05)	8.01	11.24	8.90		4.32	NS	

Figures in parentheses represents number of irrigations applied

saving in irrigation water was 23%. Positive interaction may be attributed to marked improvement in the soil–plant environment including the chemical and bio-chemical changes associated with mulching.

Water use and water-use efficiency

Highest quantity of irrigation water (1,751 mm) was given under irrigation treatment of IW:CPE ratio 1.2, followed by IW:CPE of 0.9 (1421 mm) (Table 3). The water-use efficiency, on the other hand, decreased with an increase in irrigation regimes, i.e. 43.60 kg/ha-cm under IW : CPE of 0.6 to 35.09 and 28.54 kg/ha-mm at 0.9 and 1.2 ratios respectively. Increasing trend of 31.74, 38.31 and 43.41 kg/ha-mm in water-use efficiency was recorded with increasing levels of trash mulch.

Table 2. Interaction effect of irrigation schedule and trash mulching on cane yield of sugarcane ratoon (q/ha) (pooled over 2 years)

Treatment	Trash mulch (tonnes/ha)			Mean
	0	3	6	
IW : CPE 0.6	392.2	484.0	550.7	475.6
IW : CPE 0.9	421.6	500.1	574.1	498.6
IW : CPE 1.2	425.3	496.9	577.1	499.8
21-day interval	404.2	494.4	564.3	487.6
Mean	410.8	493.8	566.5	
CD (P=0.05)				
Irrigation		8.63		
Mulch		9.63		
Irrigation × mulch			19.25	
Mulch × irrigation			17.96	

Economics

Highest net returns and benefit : cost were obtained when sugarcane ratoon was irrigated at an IW : CPE of 0.9 (Table 4). The net return per unit of water applied decreased with an increase in irrigation regimes, i.e. Rs 30.55/ha-mm under IW : CPE of 0.6 to Rs 24.85 and Rs 19.72/ha-mm under 0.9 and 1.2 IW:CPE ratios respectively. The net return in terms of both unit area and water applied as well as benefit : cost were markedly increased with increasing levels of trash mulch.

Table 3. Effect of irrigation schedule and trash mulching on total water use and water-use efficiency in sugarcane ratoon (pooled over 2 years)

Irrigation schedule	Total water applied (mm)*				Water-use efficiency (kg/ha-mm)			
	Trash mulch (tonnes/ha)				Trash mulch (tonnes/ha)			
	No mulch	3	6	Mean	No mulch	3	6	Mean
IW : CPE 0.6	1,091	1,091	1,091	1,091	35.95	44.36	50.48	43.60
IW : CPE 0.9	1,451	1,451	1,451	1,451	29.05	34.46	39.56	34.35
IW : CPE 1.2	1,751	1,751	1,751	1,751	24.29	28.38	32.96	28.54
21-day interval	1,091	1,091	1,091	1,091	37.05	45.31	51.72	44.70
Mean	1346	1,346	1,346		31.58	38.13	43.68	

*Including rainfall and 1 irrigation of 100 mm for drilling of fertilizer

Table 4. Effect of various irrigation schedules and trash mulching on monetary returns from sugarcane ratoon (pooled data of 2 years)

Treatment	Returns (Rs/ha)			Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Benefit : cost ratio	Net return Rs/ha-mm of water applied
	Cane	Green fodder	Total				
Irrigation schedule							
IW : CPE 0.6	48,515	84,39	56,954	23,624	33,330	2.41	30.55
IW : CPE 0.9	50,857	89,87	59,844	24,527	35,317	2.44	24.85
IW : CPE 1.2	50,976	88m00	59,776	25,239	34,537	2.37	19.72
21 days interval	49,739	87,86	58,525	23,723	34,802	2.46	31.90
Trash mulch							
No mulch	41,906	78,25	49,731	23,458	26,273	2.12	19.63
3 tonnes/ha	50,372	89,41	59,313	24,312	35,001	2.44	26.15
6 tonnes/ha	57,787	94,92	67,279	25,060	42,219	2.68	31.54

Sugarcane rate in factory, Rs 102/q; green fodder, Rs 40/q; harvesting of cane, Rs 9/q

Thus, sugarcane productivity can be improved with the use of trash mulch @ 6 tonnes/ha irrespective of water-availability conditions.

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