

## Effect of formative stage moisture stress, mulch and planting method on yield attributes, yield and quality of sugarcane (*Saccharum officinarum*)

K. KANNAN, R. SINGH AND D.K. KUNDU

*Water Technology Centre for Eastern Region, Bhubaneswar 751 023, Orissa.*

**Abstract :** A field experiment was conducted for two years during 2002-03 to find out the effect of formative moisture stress and planting method on yield attributes, yield, quality and water use efficiency of sugarcane at Dhenkanal, Orissa. The highest average cane yield (146.83 t ha<sup>-1</sup>) over all the irrigation levels was observed in pair row spacing. Even though second best cane yield was observed in the wider row spacing in full irrigation, the average cane yield under different irrigation levels was the least (124.66 t ha<sup>-1</sup> /ha) as there was higher (47%) yield reduction in that planting method under moisture stress condition. The highest brix reading was observed under deficit irrigation condition. The highest water expense efficiency was achieved with paired row planting (90 kg/ha-mm water use) followed by normal row spacing and the least was observed in wider row spacing.

**Key words:** *Deficit irrigation, water expense efficiency, planting methods, cane yield.*

### Introduction

In Orissa, Sugarcane crop is being grown in 22000 hectare with a average yield of 65 t ha<sup>-1</sup>. It is planted as main crop during December to March and as monsoon crop during June-July. Spring planted sugarcane faces moisture stress during the months between March -May as the crop water requirement is more in this period. Unfortunately this period coincides with the formative stage (60-120 days) of the crop, which is most sensitive and restricts crop growth severely if the crop water requirement is not met. Active growth of the crop begins only after initiation of monsoon. The recovery of the plants is remarkable but it is seldom able to surpass cane growth grown under moisture stress free condition. The stress during this period affects the final cane and sugar yields (Naidu, 1976). Altering the crop geometry and population helps in better utilization of available

soil moisture and maintains the yield under moisture stress condition. Several workers reported irrigation schedule and mulch on IW/CPE basis (Ganesh, 2002); irrigation schedules for different application methods (Ved Singh, 2000); planting times (Mishra *et al.*, 2004) and different sugarcane varieties (Ramesh and Mahadevaswamy, 1999).

The present study was carried out to find out the optimum irrigation schedules during formative phase under different planting methods.

### Materials and Methods

The experiment was conducted during the main season (January-December) of 2002 and 2003 at the experimental farm of Sakthi Sugars Ltd., Dhenkanal, Orissa. The soil was loamy with pH 7.3 having 182, 23.3 and 220 kg/ha of available N, P and K. The field capacity,

**Table 1. Effect of planting and water management practices on yield attributing characters at harvest (pooled data over 2 years)**

Treatments	Plant height at harvest (m)	Number of inter nodes	Plant girth (cm)	Millable canes ( <sup>0</sup> 000 ha <sup>-1</sup> )	Single cane weight (kg)
Spacing					
P <sub>1</sub>	3.35	34.33	8.75	127.85	1.4
P <sub>2</sub>	3.47	33.62	8.56	140.09	1.36
P <sub>3</sub>	3.66	33.90	9.18	91.49	1.52
CD (P=0.05)	0.27	NS	0.22	7.65	0.06
Water management					
I <sub>1</sub>	3.76	35.86	9.72	140.32	1.58
I <sub>2</sub>	3.61	34.63	9.18	124.90	1.45
I <sub>3</sub>	3.47	33.57	8.51	110.24	1.36
I <sub>4</sub>	3.14	31.73	7.77	103.63	1.30
CD (P=0.05)	0.12	1.03	0.42	11.05	0.05

**Table 2. Interaction effect of planting method and water management practices on millable cane and yield (pooled data over 2 years)**

Treatments	Number of tillers ( <sup>0</sup> 000 ha <sup>-1</sup> )				Cane yield (t ha <sup>-1</sup> )			
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	Average	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	Average
I <sub>1</sub>	146.66	160.66	113.66	140.32	171.33	186.67	175.67	177.89
I <sub>2</sub>	130.68	148.50	95.99	124.90	139.67	177.33	152.33	156.44
I <sub>3</sub>	118.51	131.55	80.66	110.23	142.67	165.0	93.33	133.66
I <sub>4</sub>	115.55	119.66	75.68	103.63	133.67	152.67	77.33	121.22
Average	127.85	140.09	91.49		146.83	170.41	124.66	
CD (P=0.05)								
I	11.05				11.17			
P	7.65				8.84			
I x P	23.3				17.69			

permanent wilting point and bulk density of soil are 18.5%, 11% and 1.23 respectively for the depth up to 60 cm. The treatments comprised of three plant spacings (Normal row spacing of 75 cm between two rows ( $P_1$ ), pair row (60 cm within and 90 cm between the paired row) ( $P_2$ ) and wider row spacing of 150cm between two rows ( $P_3$ )) as main plot treatments and four water management practices during the formative phase *viz.*,  $I_1$  - irrigation at 25% depletion of available soil moisture, (designated as full irrigation) with mulch;  $I_2$  -full irrigation without mulch;  $I_3$ - irrigation at 50 % depletion of available soil moisture,( designated as deficit irrigation) with mulch;  $I_4$ - deficit irrigation without mulch as sub plot treatments. The experiment was laid out in split-plot design and replicated thrice.

Sugarcane seedling (variety CO 86032) was planted in the month of December with the spacing of 30 cm between the plants. Common irrigation was given up to February. There after irrigation was given according to the treatments upto June I week. The plot size was 9.0 m x 6.0 m. Sugarcane trash mulch was applied @ 7.5 t ha<sup>-1</sup> in the mulch treatments. Recommended dose of fertilizer was applied as pocket application near the root zone.

## Results and Discussion

### *Yield attributes*

Among the planting methods, the highest average plant girth and single cane weight were recorded under wider row spacing (Table 1). This might be due the availability of more space per tiller in wide row spacing. Wider row spacing significantly increased average single cane weight over other planting methods. There was no significant difference in average single cane weight between normal row spacing and paired row planting. Number of inter nodes was not influenced by the treatments significantly.

But the highest average number of millable canes ha<sup>-1</sup> was observed under pair row planting followed by normal row spacing. This might be due to the failure to produce more millable canes with limited irrigation in the wider row spacing.

Among the water management practices, full irrigation with mulch significantly increased the cane girth, millable canes, number of internodes and single cane weight followed by normal irrigation without mulch. The highest average tiller number (Table 1) per hectare was recorded under the treatment full irrigation with mulch followed by normal irrigation without mulch and deficit irrigation with mulch. The least was recorded under deficit irrigation without mulch. Interaction effect of planting and water management shows that though average tiller number was the least under wide row spacing (Table 2), the tiller number under this planting method was comparable with other two planting methods under full irrigation condition. The rate of decrease in tiller number from the highest moisture availability to lower moisture availability (from  $I_1$  to  $I_4$ ) was the highest under wider row spacing compared to other planting methods. This might be due to the fact that under moisture stress condition, crop could not use the available space and nutrients to produce more tillers in wider row spacing. The highest average single cane weight (1.58 kg) was recorded under full irrigation with mulch ( $I_1$ ) followed by  $I_2$  and  $I_3$ . The least average cane weight was recorded under  $I_4$ . This might be due to higher evaporation under no mulch combined with less water availability under deficit irrigation. Interaction effect of planting methods and water management showed that the highest average single cane yield (1.82 kg) was recorded in wider row spacing under full irrigation with mulch. This might be due to the lesser competition between

**Table 3. Effect of treatments on cane quality and water use**

Treatments	Brix	CCS (%)	Irrigation water use (mm)	Water Expense Efficiency (WEE) (Kg/ha-mm)
<b>Planting</b>				
P <sub>1</sub>	19.48	12.05	1880	82.44
P <sub>2</sub>	19.46	11.01	1880	90.69
P <sub>3</sub>	19.50	12.00	1880	66.30
CD(P=0.05)	NS	NS		5.03
<b>Water Management</b>				
I <sub>1</sub>	19.28	12.27	2090	85.30
I <sub>2</sub>	19.37	11.56	2090	79.74
I <sub>3</sub>	19.24	11.67	1670	80.23
I <sub>4</sub>	20.03	11.19	1670	72.65
CD(P=0.05)	0.82	0.52	-	6.22

tillers under the availability of wider space. Though, the least single cane weight was recorded under paired row spacing in deficit irrigation, it did not affect the final cane yield as the cane numbers compensated the average cane weight. Benefit of sugarcane trash mulches in increasing yield attributes of sugarcane was reported by Dineskumar *et al.* (1995)

#### *Cane Yield*

The highest average cane yield (Table 2) was recorded in pair row planting followed by normal row spacing. The least average cane yield over all the water managements was recorded under wider row spacing. Among water management practices, the highest cane yield of 177.89 t ha<sup>-1</sup> was recorded under full irrigation followed by I<sub>2</sub> and I<sub>3</sub>. The least cane yield was observed under deficit irrigation without mulch. Ramesh and Mahadevaswamy (1999) also reported decrease in yield due to formative stage limited irrigation.

Interaction effect of planting methods and water management showed that the highest cane yield was observed in pair row planting under full irrigation with mulch followed by wider row spacing and normal row spacing. Even though the second highest cane yield was recorded under wide row spacing, the least cane yield was observed in this planting method under deficit irrigation. This might be due to lesser tiller production under deficit irrigation compared to other planting method. The rate of decrease in cane yield under deficit irrigation in wide row planting was more (47 %) compared to other planting methods.

#### *Quality and water use*

There was no significant difference on brix reading between planting methods (Table 3). Among water management practices, the highest brix reading was observed under deficit irrigation condition. This might be due more to total solids present in the juice under moisture stress condition. But the commercial cane sugar per cent was more under full irrigation. It was non significant among planting methods.

Among planting methods, the highest water expense efficiency (Table 3) was achieved with paired row planting (90 kg/ha-mm) followed by normal row spacing and the least was observed in wide row spacing. This might be due to drastic reduction in yield in wide row planting under deficit condition. The highest water expense efficiency was achieved under full irrigation with trash mulch. The difference between I<sub>2</sub> and I<sub>3</sub> was not significant.

The present study suggest that pair row planting with sugarcane trash mulch @ 7.5 t ha<sup>-1</sup> and wider space planting (150 cm) can be practised respectively for deficit and normal irrigation for maximum yield and under Orissa condition.

## References

- Dineshkumar, M., Chalapathi, K., Chanabasppa, K. S. and Patil, S.G. (1995). Management of sugarcane (*Saccharum officinarum*) under moisture stress condition at Tungabhadra project area. *Indian J. Agron.*, **40**: 673-677.
- Ganesh, H. V. (2002). Effect of irrigation schedules and trash mulching on cane yield and yield attributes in sugarcane. *Mysore J. Agri. Sci.*, **36**: 242-247.
- Mishra, P., Jmishra, P.K., Biswal, S., Panda, S.K. and Mishra, M.K. (2004). Effect of method and density of planting on growth and yield of sugarcane in Coastal Orissa. *Indian sugar*, August 2004, p 371-374.
- Naidu, K.M. (1976). *Annual report*. Pp 89. Sugarcane Breeding Institute, Coimbatore, Tamil Nadu, India.
- Ramesh, P. and Mahadevaswamy, M. (1999). Effect of formative phase drought on yield attributes, yield and water use efficiency of sugarcane varieties. *Indian J. Agron.*, **44**: 841-845.
- Ved, Singh. (2002). Effect of irrigation schedule and trash mulch on growth, yield and economics of sugarcane (*Saccharum officinarum*) ratoon. *Indian J. Agron.*, **47**: 561-565.