Journal of Crop and Weed, ***8****(2):77-79(2012)*

Effect of different row spacing on ratoonability of high sugar genotypes of sugarcane hybrids

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Received:09-10-2012, Revised:09-10-2012, Accepted:15-10-2012

ABSTRACT

A field experiment was conducted during consecutive three years from spring season of 2009 to 2011 (plant - ratoon - ratoon cycle) to assess the ratoonability of three sugarcane genotypes viz. cvs.Madhuri (CoB 94164), BO 91, Rasbhari (CoSe 95422) each at three row spacing (60, 90 and 110 cm) in split plot design, keeping three sugarcane genotypes in main plot and three row spacing in sub-plot, replicated thrice. Planting of sugarcane was done during third week of February and their ratoon was initiated during first week of February. Ratoon sugarcane genotype cv. Madhuri (CoB 94164) yielded significantly highest number of millable ratoon canes (77, 120 and 69,460 ha^{-1} in first and second ratoon, respectively), sucrose (16.94 and 15.81%), commercial cane sugar (11.24 and 10.41%), commercial cane sugar yield (7.99 and 5.55 t ha^{-1}) and ultimately cane yield (71.04 and 53.24 t ha^{-1} in first and second ratoon, respectively) followed by var. BO 91 and Rasbhari. Significantly highest ratoon cane yield (64.52 and 52.68 t ha^{-1} in first and second ratoon) was recorded in 90 cm spacing followed by 60 and 110 cm spacing. The significant interaction between row spacing and genotype showed that the highest ratoon cane yield exhibited with Madhuri (cv. COB 94164) variety at 90 cm row spacing.

Key words**:** High sugar genotypes, row spacings, ratoonability, quality

Ratooning is an integral part of the sugarcane production system. The ratoon cropping lies in reduced cost of cultivation, better utilization of early growing period, shorter crop cycle and saving of post monsoon irrigation. In terms of energy utilization, production of one tonne of ratoon cane requires only 89.04 million calories against 204.55 million calories needed for plant cane (Shahi, 1998). Though sugarcane ratoon occupies about 50 – 55% of the total cane acreage in India, its contribution towards total cane production is only 30-35%. An average gap between plant and a ratoon yield is 20-25% especially in subtropical regions (Chauhan, 2002). As long ratoon will continue to be an integral part of 'produce to product chain' as at least 50% ratoon cane is required to start the sugar factory in mid October. Moreover, jaggery units that utilize 28% of the total cane early in the crushing season are dependent on ratoon. In subtropical belt, the availability of sugarcane varieties with higher sugar accumulation early in the crushing season with good ratoonability is an important strategy to fetch high sugar recovery in the mills and ensure higher margin of profit to cane growers. The high sugar genotypes are, however, low yielder in plant crop in general and poor ratooner under winter initiation condition in particular. These twin production related constraints could, however, be tackled by reducing the row spacing. It was in this context that the present investigation was taken up to asses the ratoonability of high sugar genotypes and their requirement of spacing.

MATERIALS AND METHODS

A field experiment was conducted for three years (plant – ratoon – ratoon cycles) from 2009 to 2011 at the Sugarcane Research Station, Bethuadahari, Nadia (W.B.), India. The experiment was laid out in a split plot design keeping combinations of three row spacings (S_1 - 60, S_2 - 90 and S_3 - 110 cm) in main plots_and three sugarcane genotypes viz. V_1 - Madhuri (CoB19164), V_2 - BO-91 and V_3 - Rasbhari (CoSe 95422) in sub-plots replicated thrice. The soil was clay loam with pH 7.3, organic carbon 0.26%, available N, P and K was 127.3 15.1 and 258.3 kg ha^{-1}, respectively. Planting of sugarcane was done during third week of February and ratoon was initiated during first week of January, 2011. The plant crop and subsequent ratoons crop were fertilized with 200 kg nitrogen, 100 kg P_2O_5 and 100 kg K_2O ha^{-1}. Half amount of nitrogen and total amount of phosphate and potash were applied as basal and rest half amount were applied in two split doses *i.e.* 1/4th at 45 DAP and 1/4th at 90 DAP. All the recommended plant protection measures were undertaken during the course of investigation. The observations, like germination (%), number of canes at harvest ('000 ha^{-1}), number of millable canes (NMC) at harvest ('000 ha^{-1}), single cane weight (SCW) at harvest (kg), commercial cane sugar (CCS) in % and t ha^{-1}, brix, sucrose and purity (%) of cane juice at harvest etc. were recorded systematically. For determination of qualitative parameters of sugarcane juice, polarimeter, hand refractometer instruments were used in the laboratory. The observations thus recorded were statistically analyzed following the methods of Gomez and Gomez (1984). Pooled analysis of two years data is presented here for interpretation of results of the experiment.

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RESULTS AND DISCUSSION

Yield attributes, cane yield and quality of sugarcane

Different sugarcane genotypes showed significant variation in their ratoon production potentiality. Genotype Madhuri (CoB 94164) gave significantly higher germination (38.9%), tiller number (83,800 ha^{-1}), number of millable cane (77,120 ha^{-1}), cane diameter (2.43 cm), cane height (231 cm) and single cane weight (0.86 kg), respectively. The highest ratoon cane yield (71.04 t ha^{-1}), commercial cane sugar (11.24%) and commercial cane sugar yield (7.99 t ha^{-1}) were obtained with the genotype Madhuri (Table 1). This might be due to the fact that higher values of yield attributes were found with this variety. Genotypic yield variations were also reported by Shrivastava *et al.* (1999).

Table 1: Qualitative and quantitative characters of 1st year sugarcane ratoon under different spacing and varieties

Treatments	Ger. (%)	Tillers ('000 ha^{-1})	NMC ('000 ha^{-1})	Cane dia. (cm)	Cane ht. (cm)	SCW (kg)	Brix (%)	Sucrose (%)	Purity (%)	CCS (%)	Yield (t ha^{-1})	CCS (t ha^{-1})
Varieties of sugarcane (V)												
V_1	38.9	83.80	77.12	2.43	231	0.86	21.15	16.94	80.05	11.24	71.04	7.99
V_2	34.2	80.66	74.19	2.37	217	0.78	20.00	16.15	80.68	10.76	62.49	6.71
V_3	30.0	77.80	69.44	2.27	201	0.63	19.14	16.02	83.69	10.79	48.38	5.22
SEm (±)	**0.70**	**0.99**	**1.48**	**0.06**	**3.06**	**0.02**	**0.26**	**0.02**	**1.29**	**0.165**	**2.07**	**0.02**
LSD (0.05)	**2.11**	**2.97**	**4.44**	**0.19**	**9.18**	**0.05**	**0.77**	**0.06**	**N.S.**	**N.S.**	**6.21**	**0.06**
Spacing (S)												
S_1	39.4	89.23	78.42	2.29	202	0.66	19.53	15.38	78.76	10.11	59.11	5.98
S_2	35.8	84.30	76.14	2.26	218	0.76	20.22	16.52	81.76	10.97	64.52	7.08
S_3	27.8	68.73	61.33	2.43	229	0.84	21.54	17.22	83.90	11.70	58.28	6.86
SEm (±)	**1.26**	**1.44**	**1.45**	**0.03**	**4.15**	**0.04**	**0.23**	**0.07**	**1.72**	**0.59**	**1.16**	**0.41**
LSD (0.05)	**3.78**	**4.33**	**4.34**	**0.09**	**12.44**	**0.12**	**0.68**	**0.22**	**NS**	**NS**	**3.49**	**1.22**
Interaction	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**Sig**	**Sig**	**NS**	**NS**	**Sig**	**Sig**

Note: N.S., not significant; Sig., significant; Ger., germination; dia., diameter; ht., height; NMC, number of millable canes; SWC, single cane weight; CCS, commercial cane sugar in % and yield in t ha^{-1}.S., row spacing; V., Sugarcane genotypes.

Regarding the quality parameters of sugarcane, highest brix, sucrose and purity (21.15, 16.94 and 80.05%) were found in case of variety Madhuri followed by BO 91 (Table 1). Increase in planting density though increased the germination (%), no. of tiller and no. of millable cane ha^{-1} but it reduced the cane diameter, cane height and single cane weight. The highest cane yield (64.52 t ha^{-1}) and commercial cane sugar yield (7.08 t ha^{-1}) were found with 90 cm row spacing (Table 1).

Highest brix (21.54%) and sucrose (17.22%) were found with 110 cm row spacing (Table 1). This might be due to the fact that higher row spacing promoted the better growth of plant and ultimately resulted the better quality of juice. The interaction effect between the different genotypes and row spacings indicated the 90 cm row spacing significantly increased cane yield (74.22 t ha^{-1}) in case of Madhuri variety. The findings of Mahadevaswamy (1997) are also in close conformity with the results obtained in the present study (Table 2).

Table 2: Combined effect of different varieties and spacings on the 1st year ratoon yield and CCS of sugarcane

Treatments	Yield (t ha^{-1})				CCS (t ha^{-1})			
	S_1	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**
V_1	68.37	74.22	70.52	71.04	6.99	8.24	8.74	7.99
V_2	63.26	66.91	57.29	62.49	6.39	7.28	6.46	6.71
V_3	45.69	52.42	47.02	48.38	4.57	5.73	5.37	5.22
Mean	59.11	64.52	58.27	--	5.98	7.08	6.86	--
	V×S	**S×V**	--	--	**V×S**	**S×V**	--	--
SEm (±)	**0.78**	**1.13**	--	--	**0.66**	**0.35**	--	--
LSD (0.05)	**2.33**	**3.39**	--	--	**1.99**	**1.05**	--	--

Yield attributes, cane yield and quality of second year ratoon

Among the different sugarcane genotypes, Madhuri (CoB 94164) gave the highest values of germination (30.01%), number of tillers (76,640 ha^{-1}), no of millable cane (69,460 ha^{-1}), cane diameter (2.37 cm), cane height (229 cm), single cane weight (0.77 kg), brix, sucrose, purity (19.66, 15.81 and 80.42%), commercial cane sugar (10.41%), ratoon cane yield (53.24 t ha^{-1}) and commercial cane sugar yield (5.55 t ha^{-1}, respectively presented in Table 3).

Table 3: Qualitative and quantitative characters of 2nd year ratoon sugarcane under different spacing and varieties

Treatments	Ger. (%)	Tillers ('000 ha^{-1})	NMC ('000 ha^{-1})	Cane dia. (cm)	Cane ht. (cm)	SCW (kg)	Brix (%)	Sucrose (%)	Purity (%)	CCS (%)	Yield (t ha^{-1})	CCS (t ha^{-1})
Varieties (V)												
V_1	30.01	76.64	69.46	2.37	229	0.77	19.66	15.81	80.42	10.41	53.24	5.55
V_2	28.28	75.59	66.47	2.35	213	0.71	19.20	15.43	80.36	10.16	47.14	4.78
V_3	25.04	72.71	64.09	2.32	197	0.70	18.42	15.01	81.44	9.99	44.59	4.45
SEm (±)	**0.79**	**0.74**	**0.52**	**0.017**	**3.48**	**0.006**	**0.09**	**0.05**	**0.371**	**0.146**	**1.74**	**0.29**
LSD (0.05)	**2.37**	**2.22**	**1.56**	**N.S.**	**10.45**	**0.02**	**0.28**	**0.15**	**N.S.**	**N.S.**	**5.23**	**0.86**
Spacing (S)												
S_1	31.04	78.55	72.51	2.31	210	0.66	18.62	14.82	79.54	9.70	47.90	4.65
S_2	28.27	76.36	70.45	2.35	213	0.75	19.01	15.42	81.14	10.24	52.68	5.40
S_3	25.04	70.02	57.06	2.38	215	0.78	19.64	16.02	81.56	10.63	44.39	4.72
SEm (±)	**0.78**	**1.22**	**1.15**	**0.023**	**1.712**	**0.02**	**0.23**	**0.32**	**0.671**	**0.311**	**0.52**	**0.35**
LSD (0.05)	**2.33**	**3.65**	**3.44**	**N.S.**	**N.S.**	**0.05**	**0.68**	**0.96**	**N.S.**	**N.S.**	**1.56**	**1.06**
Interaction	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**Sig**	**Sig**	**N.S.**	**N.S.**	**Sig**	**Sig**

Note: N.S., not significant; Sig., significant; Ger., germination; dia., diameter; ht., height; NMC, number of millable canes; SWC, single cane weight; CCS, commercial cane sugar in % and yield in t ha^{-1}.S., row spacing; V., Sugarcane genotypes.

The highest values of germination (31.04%), number of tillers (78,550 ha) and number of millable cane (69,460 ha^{-1}) were recorded at 60 cm row spacing but the highest values of cane diameter (2.31cm), cane height (210 cm) were found with 110 cm row spacing (Table 3).

The highest ratoon cane yield (52.68 t ha^{-1}) and commercial cane sugar (5.40 t ha^{-1}) were recorded with 90 cm row spacing (Table 3). This might be due to the fact that cane diameter and single cane weight at 90 cm row spacing was higher than 60 cm row spacing.

Regarding the quality parameters the highest values of brix, sucrose, purity (19.64, 16.02 and 81.56%) and commercial cane sugar (10.63%) were found with 110 cm row spacing. This might be due to better growth of plant at higher row spacing and this results better quality of juice (Table 3). The findings of Prasada Rao (1982) are also in conformity with this finding. The interaction effect between the genotypes and row spacings revealed that maximum ratoon yield and commercial cane sugar yield were found where Madhuri variety was planted with 90 cm row spacing (Table 4).

Table 4: Combined effect of different varieties and spacings on the yield and CCS of 2nd year ratoon sugarcane

Treatments	Yield (t ha^{-1})				CCS (t ha^{-1})			
	S_1	**S_2**	**S_3**	**Mean**	**S_1**	**S_2**	**S_3**	**Mean**
V_1	52.18	58.27	49.26	53.24	5.27	6.15	5.22	5.55
V_2	47.37	51.36	42.69	47.14	4.66	5.13	4.55	4.78
V_3	44.16	48.41	41.21	44.59	4.04	4.92	4.39	4.45
Mean	47.90	52.68	44.39	--	4.65	5.40	4.72	--
	V×S	**S×V**	**--**	**--**	**V×S**	**S×V**	**--**	**--**
SEm (±)	**0.79**	**0.72**	**--**	**--**	**0.06**	**0.11**	**--**	**--**
LSD (0.05)	**2.37**	**2.15**	**--**	**--**	**0.17**	**0.34**	**--**	**--**

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