Indian Journal of Agronomy **59** (2): 341–343 (June 2014)

Research Communication

Response of sugarcane (*Saccharum* spp. hybrid complex) varieties to various planting geometry

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Received : November 2013; Revised accepted : March 2014

ABSTRACT

A field experiment was conducted at Sugarcane Research Institute, Bihar, Pusa (Samastipur) during spring season of 2012–13 on sandy-loam soil, to examine the performance of sugarcane (*Saccharum* spp. hybrid complex) varieties to different planting geometries. The treatments comprised 4 planting geometries, viz. 120, 150, 30: 120 and 90 cm row spacing as main plots with 4 varieties, ('BO 139', 'BO 153', 'CoP 9301' and 'CoLk 94184') as sub-plots and replicated thrice in split-plot design. Millable canes were significantly higher at 90 cm row spacing (1,18,200/ha) as compared to wider row spacing of 150 cm (68,900/ha). The maximum cane yield (91.7 tonnes/ha), net returns (₹169.5 × 10^3/ha) and benefit: cost ratio (2.64) were obtained under 90 cm row spacing, being higher to the tune of 1.8, 3.0 and 4.3; 24.1, 34.4 and 30.7; 49.1, 77.3 and 69.2% over 30: 120, 120 and 150 cm row spacing respectively. There were no significant differences due to 90 and 30: 120 cm row spacings. Among the varieties, 'BO 153' gave the highest number of millable canes (117.8 × 10^3/ha) whereas in respect of cane diameter, number of nodes/cane and single cane weight 'BO 139' was superior to 'BO 153'. The variety 'BO 153' indicated significant superiority to rest of the varieties in terms of cane yield (89.8 tonnes/ha) resulting in significantly higher net returns (165.7 × 10^3 ₹/ha) and benefit: cost ratio (2.61). However, significantly higher sucrose content in juice was recorded by the variety 'CoP 9301' (17.81%) followed by 'CoLk 94184' (17.46%) and the lowest was with 'BO 139' (16.82%). Sugarcane should be planted at 90 or 30:120 cm (paired row) row spacing and variety 'BO 153' may be adopted to enhance productivity of sugarcane.

Key words: Crop production, Cane yield, Economics, Planting geometry, Varieties

Sugarcane is an important commercial crop in India being cultivated on 5.06 million ha, with an average productivity of 66.9 tonnes/ha (ISMA, 2013). As it is a long-duration crop, spacing may vary with variety and region. Of the many variables involved in the production of higher cane and sugar yield from sugarcane plant, probably the most important factor is the millable canes per unit area of land at harvest, which can be achieved by manipulating plant densities to greater extent by way of maximizing efficient interception of radiant energy incident upon. Since closer spacing hinders the mechanized intercultural operation, adoption of wider spacing is increasing in many parts of India. In recent past wider row spacing is very popularized, as it helps mechanization of several field operations, thereby results in minimum cost of production. However, as spacing increases, number of millable canes can become a limiting factor in sugarcane productivity (Singh *et al.,* 2006a; Bhullar *et al.,* 2002). Yield potential of different sugarcane varieties may differ under different agro-climatic conditions because of their inherent capabilities for adaptation. Varieties with high tillering capacity respond more to wider row spacing compared to low tillering varieties. Based on the canopy characteristics and tillering habit of the variety, it requires an appropriate planting geometry for economic yield. Of late, some varieties evolved for commercial cultivation, may be suitable for wider row spacing. Since no work has so far been done on wider row spacing of these recently released varieties an experiment was conducted on this aspect.

A field experiment was conducted during the spring season of 2012-13 at Sugarcane Research Institute, Rajendra Agricultural University, Pusa, Bihar. The treatments comprised 4 planting geometries viz., 120 cm, 150 cm, 30:120 cm and 90 cm row-to-row distance in the main-plots and 4 varieties of sugarcane, namely 'BO 139', 'BO 153', 'CoP 9301' and 'CoLk 94184', in the sub-plots, and were laid out in split-plot design with 3 replications.

Based on a part of M.Sc. Thesis of the first author submitted to RAU, Pusa, Samastipur, Bihar during 2013 (Unpublished)

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The soil was sandy loam, calcareous (pH 8.3), low in organic carbon (0.43%) and available N (225 kg/ha) and medium in available P (11.9 kg/ha) and K (120 kg/ha). Farmyard manure @ 20 tonnes/ha was applied uniformly in the experimental area at the time of last ploughing and then layout was done. The recommended fertilizer dose was 150 kg N, 37.1 kg P and 49.8 kg K/ha. Half of total N and full dose of P and K were applied basal and remaining N in 2 splits–after first irrigation and earthing up. Sugarcane was planted in the last week of February and harvested in the following year in the last week of January. The planting was done in furrow at a different row distance using same seed rate of 3 budded setts. The total rainfall of 851.4 mm was received during the crop period. Five random canes were selected from each plot for estimation of yield attributes and sucrose per cent in juice. Millable canes were counted in November. Observations on cane length, diameter, nodes/cane and single cane weight were recorded at the time of harvesting. Whole cane samples were taken at the time of harvest and cane juice was extracted with power crusher and juice sucrose content was estimated as per method given by Spencer and Meade (1955). Net returns were calculated by deducting the total cost of cultivation from gross returns for each treatment and expressed as ₹/ha. Benefit: cost ratio was calculated as ratio of net returns to cost of cultivation. All the agronomic and plant-protection operations were carried out uniformly as and when required.

Significant variation in number of millable canes at various row spacing was recorded. However, row spacing had shown non-significant effect on cane length, cane diameter, nodes/cane and single cane weight (Table 1). Planting of sugarcane at row distance of 90 cm exhibited significantly higher number of millable canes being statistically similar to that at 30: 120 cm and 120 cm row spacings and significantly superior by 71.5% to widest row spacing of 150 cm (Table 1). This might be ascribed to uniform row planting at 90 cm row spacing. Manimaran *et al.* (2009) and Singh *et al.* (2006) also observed significantly higher number of millable canes at 90 cm row spacing than the other spacings. Comparatively higher cane length, cane diameter and single cane weight were obtained at 150 cm row spacing than the other spacings, though more nodes/cane were obtained at 30: 120 cm (paired) row spacing. Significantly higher number of millable canes were observed with 'BO 153', being 13.4, 33.4 and 34.6% higher than 'CoLk 94184', 'CoP 9301' and 'BO 139' respectively. It was mainly because of the higher tiller production by the variety 'BO 153' than the other varieties during pre-monsoon period which led to higher retention of millable canes by the variety at harvest. The results confirm the findings of Shukla (2007) and Kumar *et al*. (2012). The variety 'BO 139' showed longer canes, and more diameter, number of nodes/cane and single cane weight than the others. Kamat and Pandey (2004) also reported similar results.

Row spacing of 90 cm resulted in higher cane yield, which was significantly superior to that obtained with 120 and 150 cm row spacing and statistically comparable to paired row (30: 120 cm) spacing (Table 1). The extent of reduction in cane yield at 150, 120 and 30: 120 cm row spacing compared to 90 cm row spacing was to the tune of 32.9, 19.4 and 1.7% respectively. The reduction in cane yield due to widening of row spacing was directly related

Table 1. Effect of planting geometry and varieties on growth, yield attributing characters, cane yield, sucrose content and economics of spring sugarcane

Treatment	Millable canes ($\times10^3$/ha)	Cane length (cm)	Cane diameter (cm)	Nodes/ cane	Single cane weight(g)	Cane yield (t/ha)	Sucrose in juice (%)	Cost of cultivation ($\times10^3$₹/ha)	Net returns ($\times10^3$₹/ha)	Benefit: cost ratio
Planting geometry (cm)										
120	93.6	254.6	2.43	23.3	796	73.9	17.18	62.4	126.1	2.02
150	68.9	266.8	2.52	23.2	901	61.5	17.03	61.3	95.6	1.56
30:120 (paired row)	116.8	250.2	1.96	24.5	774	90.1	17.40	65.2	164.6	2.53
90	118.2	251.6	2.22	23.6	781	91.7	17.59	64.3	169.5	2.64
SEm$\pm$	10.23	22.66	0.182	1.71	59.1	5.09	0.203	-	9.17	0.198
CD (P=0.05)	35.4	NS	NS	NS	NS	17.6	NS	-	31.7	0.69
Variety										
'BO 139'	87.5	275.6	2.54	25.7	943	81.5	16.82	63.3	144.6	2.28
'BO 153'	117.8	264.5	2.20	22.1	771	89.8	17.11	63.3	165.7	2.61
'CoP 9301'	88.3	221.2	2.41	23.0	787	68.5	17.81	63.3	111.5	1.75
'CoLk 94184'	103.9	261.9	1.98	23.7	751	77.4	17.46	63.3	134.0	2.11
SEm$\pm$	3.77	9.17	0.058	0.62	20.7	2.23	0.098	-	3.89	0.096
CD (P=0.05)	11.0	26.8	0.17	1.8	61	6.5	0.29	-	11.4	0.28

to the number of millable canes at harvest. Similar results were also reported by Singh *et al.* (2008). Variety 'BO 153' significantly out yielded the other varieties. The magnitude of increase in cane yield by 'BO 153' over the varieties 'BO 139', 'CoLk 94184' and 'CoP 9301' was 10.2, 16.0 and 31.1% respectively. The higher cane yield of variety was owing to higher number of millable canes at harvest. Moreover, the marked variation in cane yield could be ascribed on account of their genetic makeup to exploit available resources more efficiently. This corroborates the findings of Shukla (2007). The sucrose per cent juice did not undergo significant changes due to different spacing, but higher values were observed at 90 cm (17.59%). These results are in conformity with those of Rana *et al*. (2006), who observed non-significant difference in juice quality in terms of sucrose per cent juice under different planting geometry. The variety 'CoP 9301' showed its superiority to others in respect of sucrose (17.81%) in juice, followed by 'CoLk 94184' (17.46%). This could be ascribed to its genetic potential compared to other varieties.

The net returns and benefit: cost ratio was influenced significantly by planting geometry (Table 1). The maximum cost of cultivation was observed at 30: 120 cm followed by 90 cm and 120 cm and the lowest in 150 cm. Planting of sugarcane at 90 cm or 30: 120 cm row spacing gave significantly higher net returns than wider row spacing of 120 cm and 150 cm. The magnitude of increase in net returns at 90 cm row spacing over 150, 120 and 30: 120 cm row spacing was 77.3, 34.4 and 2.9% respectively. Since 150 and 120 cm row spacings were found poor yielder hence gave significantly lower net returns. The benefit: cost ratios recorded with 90 cm and 30: 120 cm were at par and significantly superior to that obtained under row spacing of 150 cm. Among the varieties, the maximum net returns and benefit: cost ratio were obtained from 'BO 153' followed by 'BO 139'.

Thus, it may be concluded that, in sugarcane cultivation row spacing of 90 cm or 30: 120 cm (paired row) can be adopted for getting higher yield and monetary returns. Among the varieties tested, 'BO 153' has a great promise for increased productivity and profitability of sugarcane under Bihar condition.

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