RESEARCH ARTICLE

RESPONSE OF EARLY MATURING ELITE SUGARCANE GENOTYPES TO VARIED ROW SPACING AND FERTILIZER LEVELS

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Abstract

Field experiment was conducted at ICAR-Sugarcane Breeding Institute, Coimbatore, Tamil Nadu during 2016-‘17 to study the effects of different row spacing and fertilizer levels on yield and quality of early maturing elite sugarcane genotypes. The response of six elite genotypes to varied row spacing (90 and 150 cm) and fertilizer levels (75, 100 and 125% RDF) was studied. The experiment was laid out in split-split plot design with three replications. The newly released Co 09004 early genotype was found more promising amongst six elite genotypes in terms of yield (94.81 t/ha) and juice quality i.e. Brix (22.90%), sucrose (20.89%), CCS% (14.65), purity (91.14%), higher cane and CCS yields. Planting sugarcane at 90 cm row spacing was found beneficial in improving the cane and CCS yield than 150 cm of row spacing, however, response to graded levels of fertilizer application, yield were non-significant. all parameters except CCS yield. Based on the results of the field experiment, it is concluded that for realising maximum cane yield, cultivation of elite sugarcane genotype Co 09004 at 90 cm row spacing with the application of 280:62.5:120 kg N:P_2O_5:K_2O/ha in sandy clay soil under tropical condition can be recommended.

***Key words*:** Elite sugarcane genotypes, row spacing, fertilizer level, yield and quality parameters

Introduction

Sugarcane (*Saccharum* spp.) is an important commercial crop in India and plays a pivotal role in agricultural and industrial economy. In India, sugarcane is cultivated on an area of 4.5 million hectares, producing nearly 306 million tonnes (Anonymous 2017). The demand for sugar is consistently increasing and it is estimated that by 2020, the total sugarcane requirement of our country would be nearly 625 million tons (Sundara 1998). But the scope for the expansion of area under sugarcane is limited due to industrialization of cultivable land, the production has to be enhanced only through improved sugarcane genotypes and good management practices such as optimum plant spacing, nutrient management and in-situ trash management (Tayade et al. 2016). With adoption of improved variety (Co 86032) in tropical India, cane yield and sugar recovery improvement was 17.50 to 25.00 t/ha and 0.40 to 1.50%, respectively, over the old varieties (Bakshi Ram 2017). However, for realizing maximum cane yield potential of improved genotypes, crop geometry is more important as row spacing determines tiller development and effective utilization of incident solar radiation and its conversion to biomass and stalk yield. The results of Singles and Smit (2002) experiment on effect of row spacing on tiller population revealed a linear increase of 5.7 tillers m^{-2} with decrease in row spacing (from 0.73 to 2.66 m row spacing) and at 12 month for 1 m decrease in row spacing, there

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was 13% increase in stalk dry mass. Similarly, at ICAR-SBI, Coimbatore, a differential response of varieties to row spacing was observed, i.e. lowest millable cane in wide row spacing (150 cm) as compared to narrow spacing (75 cm) (Vasantha et al. 2014). With this background the study was conducted to evaluate the response of six elite sugarcane genotypes to varied row spacing and fertilizers levels for maximizing sugarcane productivity.

Materials and methods

Field experiment on response of different row spacing and application of graded levels of fertilizer on sugarcane, yield and juice quality of elite genotypes was conducted during 2016-'17 at ICAR-Sugarcane Breeding Institute, Coimbatore (11°N latitude and 77°E longitude at an altitude of 427 above mean sea level), India. The experiment with three replications was laid out in split-split plot design with two row spacing (90 and 150 cm) and three fertilizer levels (75, 100 and 125% RDF) in main plot and six elite genotypes *viz*. Co 10005, Co 10026, Co 09004, CoC 671, Co 0403 and Co 94008 were accommodated in sub-plot. The soil of the experimental site was low in organic carbon (0.53), medium in N (213 kg/ha), P (37.48 kg/ha) and high in K (551 kg/ha). A uniform seed rate of 45 two budded setts per six meter row length was used in both 90 and 150 cm row spacing. Four rows of sugarcane spaced at 90 and 150 cm were planted in a plot size of 3.6 × 6 m and 6 m × 6 m, respectively. Fertilizer application was done as per the fertilizer levels i.e. for 75% RDF (210:46.5:90), 100% RDF (280:62.5:120) and 125% RDF (350:78.12:150) kg N:P_2O_5:K_2O /ha was applied as per treatment schedule. Before planting setts in the furrows, full dose of P_2O_5 was applied as basal whereas N and K_2O were applied in two splits at partial (45 DAP) and full earthing up (90 DAP) respectively. The trial was initiated during February 2016 and harvested 12 months later in February 2017. The climatic condition during the period was, mean temperature ranging between 21.24 to 33.9 °C with a mean relative humidity of 54.58 to 83.7%. As against the average rainfall of 674.2 mm, only 386.5 mm of rainfall was received during 2016-'17 crop season indicating the deficit of 42.67% rainfall. Observations on germination count were taken on 30 and 45 days after planting. At harvest, five plants were randomly selected from each plot for estimation of yield attributes (cane height, single cane weight, and cane girth) and juice quality parameters. NMC and cane yield per plot was recorded and converted to cane yield in tonnes per hectare. Sugarcane juice was analyzed for Brix, Pol (%) and purity (%) as per standard methods of Meade and Chen (1977). Commercial cane sugar% was worked out using the formula [(Sucrose% × 1.022) - (Brix × 0.292)]. CCS yield (t/ha) was calculated by following the formula [(CCS% × cane yield t/ha)/100]. Analysis of variance was performed for cane yield, yield attributes and juice quality parameters according to Gomez and Gomez (1984). Differences between mean values were compared using least significant differences (LSD) at $P < 0.05$.

Results and discussion

Growth and yield attributes

The data on germination count (Table 1) revealed that observation taken at 30 and 45 days after planting differed significantly with sugarcane varieties whereas no significant effect of varied row spacing and graded levels of fertilizer application was noticed. Among the elite sugarcane

Table 1. Effect of varied row spacing and fertilizer levels on growth and yield attributing parameters of elite sugarcane genotypes

Treatment	Germination count 30 DAP	Germination count 45 DAP	Cane height (cm)	Single cane weight (kg)	Cane girth (mm)	NMC (000/ha)	Cane yield (t/ha)	CCS yield (t/ha)
Row spacing (cm)								
90	56.88	73.70	183.39	0.98	25.39	104.67	93.27	12.61
150	60.09	78.24	201.60	1.06	25.42	72.98	74.01	10.18
SEd	1.66	3.29	12.14	0.01	0.22	6.83	1.29	0.16
CD at 5%	NS	NS	NS	0.05	NS	29.40	5.56	0.69
Fertilizer dose								
75% RDF	58.17	74.72	191.18	1.17	25.37	85.17	82.46	11.42
100% RDF	60.09	76.97	190.76	0.94	25.42	91.54	85.79	11.83
125% RDF	57.57	76.22	195.54	0.96	25.43	89.47	82.67	10.91
SEd	1.30	2.12	8.95	0.12	0.65	5.47	3.39	0.28
CD at 5%	NS	NS	NS	NS	NS	NS	NS	0.64
Genotypes								
Co 10005	52.75	74.0	189.34	1.11	24.20	104.56	84.68	10.85
Co 10026	60.77	77.11	191.52	1.03	27.20	92.98	90.05	11.55
Co 09004	64.25	80.22	212.01	1.05	25.26	90.75	94.81	13.87
CoC 671	51.13	70.88	186.47	1.09	26.17	71.46	74.46	10.58
Co 0403	63.22	87.22	185.28	0.89	24.20	92.44	83.18	11.43
Co 94008	59.53	66.38	190.33	0.97	25.14	80.76	74.68	10.05
SEd	2.02	2.83	11.08	0.19	0.75	6.53	5.05	0.51
CD at 5%	4.04	5.65	NS	NS	1.52	13.06	10.11	1.03

NS denotes CD values not significant at 5% probability level

genotypes, Co 09004 recorded significantly higher germination count of 64.25% and 80.22% over the check variety CoC 671 at 30 and 45 days after planting, respectively. This shows the early vigour of elite Co 09004 genotype in terms of cane length (212.01 cm) at harvest over the standard check CoC 671 (Tayade and Bhaskaran 2016, Anonymous 2017). Single cane weight was influenced significantly due to varied row spacing wherein planting sugarcane at wider row spacing of 150 cm recorded higher single cane weight than 90 cm spacing. The improvement in single cane weight observed in the present experiment corroborated the finding of Vasantha et al. (2014) who reported significant improvement in single cane weight under wide row planting. Genotypic variation in cane girth was significant. Sugarcane genotypes *viz*. Co 10026 and CoC 671 recorded significantly thicker cane (27.20 and 26.17 mm) than Co 10005 and Co 0403 genotypes (24.20 and 24.20 mm). These differences could be attributed to the genetic make-up of the elite sugarcane varieties. Application of graded levels of fertilizers and varied row spacing did not influence the average cane diameter to any appreciable extent though the general indication was that it had slight favourable effect.

Number of millable canes

Number of millable canes per hectare (NMC) being one of the important yield attributing parameter in sugarcane was influenced significantly by the elite genotypes and varied row spacing, whereas graded level of fertilizer application could not improve it significantly. The effect of row spacing was found more pronounced on NMC wherein planting sugarcane at 90 cm row spacing recorded significantly more NMC (104.67×10^3 /ha) than planting sugarcane at 150 cm (72.98×10^3 /ha). In case of elite genotypes Co 10005, Co 10026 and Co 09004 recorded significantly higher NMC of (104.56×10^3, 92.98×10^3 90.75×10^3 /ha) than standard check variety CoC 671 (71.46×10^3 /ha). Significantly lowest NMC observed in CoC 671 was primarily due to its shy tillering behaviour. In earlier studies Gaddanakeri et al. (2007) also reported shy tillering and poor ratoonabilty of sugarcane genotype CoC 671.

Table 2. Effect of varied row spacing and fertilizer levels on juice quality of elite sugarcane genotypes

Treatment	Brix (%)	Sucrose (%)	Purity (%)	CCS (%)
Spacing(cm)				
90	22.04	19.45	88.20	13.45
150	22.12	19.65	88.87	13.70
SEd	0.12	0.11	0.58	0.14
CD at 5%	NS	NS	NS	NS
Fertilizer dose				
75% RDF	22.06	19.60	88.74	13.59
100% RDF	22.21	19.69	88.69	13.35
125% RDF	22.91	19.37	88.17	13.76
SEd	0.30	0.30	0.67	0.21
CD at 5%	NS	NS	NS	NS
Genotypes				
Co 10005	21.61	18.67	86.63	12.83
Co 10026	21.37	18.59	86.95	12.75
Co 09004	22.90	20.89	91.14	14.65
CoC 671	22.40	20.32	90.55	14.22
Co 0403	22.44	19.87	88.50	13.90
Co 94008	21.71	18.98	87.42	13.06
SEd	0.23	0.33	0.83	0.29
CD at 5%	0.47	0.66	1.66	0.59

NS denotes CD values not significant at 5% probability level

Cane yield and CCS yield

Data on mean cane yield (t/ha) (Table 1) revealed a significant variations in cane yield among the genotypes wherein Co 09004 recorded significantly higher cane yield and CCS yield over rest of the genotypes except Co 10026 which was on par with Co 09004 with respect to cane yield. Taller cane and more NMC might have improved the cane yield in Co 09004 than the standard check CoC 671. Similarly, in the Zonal varietal trials of AICRP(s), the clone Co 09004 was tested between 2012-'13 and 2015-'16 across 17 centres of Peninsular Zone wherein the results showed 17.89% and 17.84% higher CCS% and cane yield over the best standard CoC 671 (Anonymous 2017). The effect of application of graded levels of fertilizer on mean cane yield was non-significant whereas significantly higher CCS yield was observed with application of 100% RDF than 125% of RDF. The higher sucrose values (19.69%) recorded in 100% RDF probably improved CCS yield than 125% RDF. The cane yield and CCS yield was significantly influenced by row spacing. Planting sugarcane at 90 cm row spacing was found beneficial in improving the cane yield and CCS yield than a row spacing of 150 cm. Higher cane yield in 90 cm row spacing was primarily attributed to significantly higher NMC observed in it than planting sugarcane at row spacing of 150 cm. Similarly, studies on wide row spacing conducted at ICAR-SBI indicated no yield decline when row spacing was widen to 120 cm from 90 cm, but further increase in spacing caused significant reduction in yield (Anonymous 1996). The interaction effect between genotypes, varied row spacing and levels of fertilizer was not statistically significant.

Quality

Brix (%), sucrose content (%) and CCS% in cane juice of different elite sugarcane genotypes estimated at harvest varied significantly (Table 2). Elite sugarcane genotype Co 09004 registered highest Brix (22.90%), sucrose (20.89%), CCS% (14.65) and purity% (91.14) amongst the genotypes under study, proving its superiority over Co 10005, Co 10026 and Co 94008. In the zonal varietal trials of AICRP(s), the clone Co 09004 was tested during 2012-'13 and 2015-'16 across 17 centres of Peninsular Zone, which recorded average Pol% of 14.50% and juice sucrose 18.94% at 300 days across the zone. It showed 17.84% improvement over the best standard CoC 671 (Anonymous 2017). Juice quality was not influenced by the varied row spacing and fertilizer levels. The findings are in corroboration with the results of Bharathalakshmi et al. (2003) and Thakur et al. (1991).

Conclusion

With better juice quality i.e. Brix (22.90%) sucrose (20.89%) CCS% (14.65) and purity% (91.14) and, the newly released Co 09004 early genotype was found more promising amongst six elite genotypes tested. Planting sugarcane at 90 cm row spacing was found beneficial in improving the cane and CCS yield than a row spacing of 150 cm whereas response of graded level of fertilizer application to cane yield and juice quality was non-significant. Based on the results of the field experiment it is concluded that for realization of maximum cane yield, planting of elite sugarcane genotype Co 09004 at 90 cm row spacing with application of 280:62.5:120 kg $N:P_2O_5:K_2O$/ha in medium deep soil under tropical condition can be recommended.

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