Research Article

Performance of Sugarcane Var. Com 0265 with Different Row and Intra-Row Spacing

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Abstract

A Field experiments was conducted to assess the effect of row spacing and intra-row spacing on sugarcane in during 2013-14 and 2017-18 at the Central Sugarcane Research Station, Padegaon. The treatment comprised of five inter row spacing (120 cm, 150 cm, 180 cm, 210 cm and 240 cm) and four intra row spacing (45 cm, 60 cm, 75 cm and 90 cm) replicated thrice in split plot design. The cane yield (162.77 t/ha) was found significantly highest in treatment combination of row spacing 120 cm and intra-row spacing of seedling 60 cm. while it was found on par with the treatment combination 120 cm x 75 cm (159.19 t/ha,), 120 cm x 45 cm (157.70 t/ha), 150 cm x 45 cm. (158.51 t/ha) and 150 cm x 60 cm. (156.35 t/ha). While, CCS yield (22.17 t/ha) was found significantly highest in treatment combination of row spacing 150 cm and intra-row spacing of seedling 60 cm, while it was found on par with the treatment combination 120 cm x 60 cm. (22.13 t/ha,) and 120 cm x 75 cm (21.70 t/ha). The tillering ratio (8.77) was observed significantly higher in treatment combination 150 cm x 75 cm. The effect of the row spacing, intra-row spacing of seedling and their combination was found to be non significant in respect of quality parameter *viz.* Brix (c), Sucrose (%), Purity and CCS(%).

Keywords: Sugarcane, Cane, Row spacing and Yield

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Introduction

Sugarcane is the most important cash crop of Maharashtra. Sugar industry plays a pivotal role in the socio-economic and educational development in the rural areas of the state. Maharashtra sugar industry has been under sugarcane was about 9.22 lakh ha. in Maharashtra with the sugarcane production of 950.65 lakh tons and growing for the last 70 years without any impediments. During 2017-18, the area average productivity was 103.10 t/ha, average sugar recovery was 11.23 % and the sugar production was 106.77 lakh ton. The area under sugarcane in Maharashtra reached to the peak and there is very little or no more scope to increase the area. The productivity is stagnating around 85 t ha^{-1} i.e. 35 t $acre^{-1}$ [1]. The number and crushing capacity of sugar factories was increasing year by year. In such situation, we have the only option to increase the sugarcane productivity by means of generating the improved technologies and varietal development considering the global warming and the climate change. The sugarcane productivity of the country is reducing day by day due to cluster of factors. The selection of suitable inter and intra spacing for proper growth and development and improve yield in the range of 28 to 60 per cent [2].

Sugarcane is a perennial crop and put forth dense canopy cover throughout the life period. This causes problems in aeration of the crop yield, which indirectly reduce the crop yield. The techniques like spaced planting with various row spacing have brought out promising results in this respect with very low additional cost in preparation of layouts. The population per unit area and distance between cane rows play a significant role in influencing the yield. Wide row sugarcane planting technology is spreading fast particularly in tropical states [3]. The technique has been proved in much sugar factory areas to give higher cane yield with quality juice. The technique facilitates mechanization at various field operations through the use of power tiller and other machinery for operations like weeding and earthing up. In addition, it will be very easy for human labour to move inside the field for operation like detrashing, plant protection, guiding irrigation water etc. This helps in reducing cost of production of cane, which is urgent need of the hour. Improving profitability of sugarcane farming. Hence, there is a need to manipulate the plant geometry/density under late planted sugarcane in order to increase its productivity. In the light of above, the present study was undertaken to find out the suitable method and density/ geometry of planting for enhancing the germination, growth and yield of late planted crop.

Materials and Methods

A field experiment was conducted at research farm of Central Sugarcane Research Station, Padegaon during

preseason of years 2013-14 to 2017-18 to assess effect of row spacing and Intra-row spacing on sugarcane. The experiment was laid out in split plot design with three replications. Four intra row spacing viz., S_1- 45 cm, S_2-60 cm, S_3-75cm and S_4- 90cm were tried as sub plot treatment and five inter row spacing viz., R_1- 120 cm, R_2- 150 cm, R_3- 180 cm, R_4- 210 cm and R_5- 240 cm were tried as main plot treatment. The 35 days old ploytray seedlings of sugarcane variety CoM 0265 were planted as per spacing and fertilized with 340: 170: 170 kg NPK ha^{-1}. N was applied in four splits (10:40:10:40) and P_2O_5 and K_2O as applied at the time of planting and at final earthing up with two equal splits (50:50). The recommended cultural practices were adopted for raising sugarcane during preseason (Autumn) of both the years. At the time of harvesting, five canes from each plot were randomly selected and recorded growth and yield attributes. The data pertaining to growth, yield and quality parameters were statistically analyzed as per the procedure laid out by [4].

Results and Discussion

Effect on Cane and CCS Yield:

The pooled data with respect to cane and CCS (Commercial Cane Sugar) yield, biometric observations, quality parameters and economics are presented in **Table 1 to 4E**. Pooled results are presented in Table 1 revealed that cane and CCS yield (155.15 t/ha and 21.10 t/ha) was found significantly highest in planting of sugarcane seedlings with row spacing of 120 cm than rest of the spacing , which was followed by row spacing 150 cm (146.24 t/ha, 19.80 t/ha). The cane yield (130.37 t/ha) and CCS yield (17.67 t/ha) was found significantly highest in treatment, intra-row spacing of seedling 45 cm than rest of the treatments, which was followed by 60 cm intra-row spacing of seedling (cane and CCS yield 122.85 t/ha and 16.63 t/ha, respectively).

Table 1 Cane and CCS yield (t/ha) of sugarcane as affected by various treatments (Pooled mean)

Treatments	Cane yield (t/ha)				CCS yield (t/ha)			
Row spacing (Planting of poly tray seedling)								
	14-15	15-16	16-17	Pooled Mean	14-15	15-16	16-17	Pooled Mean
R_1- 120 cm	143.65	162.96	158.83	155.15	19.58	22.20	21.53	21.10
R_2- 150 cm	135.15	151.48	150.79	146.24	18.39	20.60	20.28	19.80
R_3- 180 cm	108.89	128.07	123.86	120.27	14.81	17.37	16.88	16.35
R_4- 210 cm	79.30	98.17	93.96	90.66	10.78	13.44	12.67	12.30
R_5- 240 cm	68.57	83.44	71.74	74.52	9.33	11.30	9.64	10.09
SE±	2.14	4.41	4.06	1.63	0.27	0.59	0.58	0.22
CD at 5%	6.99	14.38	13.25	5.33	0.90	1.91	1.91	0.71
Intra-row spacing								
S_1- 45 cm	118.68	139.64	132.80	130.37	16.14	18.91	17.96	17.67
S_2- 60 cm	111.74	130.83	125.71	122.85	15.23	17.74	16.81	16.63
S_3- 75 cm	106.04	122.79	117.58	115.47	14.43	16.73	15.92	15.70
S_4- 90 cm	91.96	107.27	103.10	100.78	12.50	14.55	14.10	13.72
SE±	1.93	1.86	2.57	0.66	0.27	0.25	0.38	0.09
CD at 5%	5.57	5.38	7.42	1.89	0.90	0.73	1.09	0.25
Interaction								
SE±	4.31	4.16	5.90	2.07	0.61	0.57	0.84	0.19
CD at 5%	12.45	12.02	17.05	6.46	1.77	1.64	2.44	0.55
CV%	6.97	5.76	8.30	2.16	7.28	5.79	9.02	2.08
General mean	107.11	125.11	119.67	117.37	14.58	16.98	16.20	15.93

Effect of interaction between row spacing and intra-row spacing with respect to cane and CCS yield was found to be significant. The pooled results presented in Table 2A revealed that cane yield (162.77 t/ha) was found significantly highest in treatment combination of row spacing 120 cm and intra-row spacing of seedling 60 cm. while it was found on par with the treatment combination of row spacing 120 cm and intra-row spacing of seedling 75 cm (159.19 t/ha,),.row spacing 120 cm and intra-row spacing of seedling 45 cm (157.70 t/ha)., row spacing 150 cm and intra-row spacing of seedling 45 cm. (158.51 t/ha) and row spacing 150 cm and intra-row spacing of seedling 60 cm. (156.35 t/ha). The pooled results presented in Table 2B revealed that, CCS yield (22.17 t/ha) was found significantly highest in treatment combination of row spacing 150 cm and intra-row spacing of seedling 60 cm, while it was found on par with the treatment combination of row spacing 120 cm and intra-row spacing of seedling 60 cm. (22.13 t/ha,), and row spacing 120 cm and intra-row spacing of seedling 75 cm (21.70 t/ha).

Table 2A Pooled mean Main x sub interaction cane yield (t/ha)

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm row spacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	157.70	158.51	154.30	96.19	85.17	**130.37**
S_2- 60 cm	162.77	156.35	123.94	94.90	76.31	**122.85**
S_3- 75 cm	159.19	150.57	109.22	87.90	70.47	**115.47**
S_4- 90 cm	140.93	119.58	93.62	83.65	66.12	**100.78**
Mean	**155.15**	**146.24**	**120.27**	**90.66**	**74.52**	**117.37**
Interaction SE $\pm$ 2.07 CD at 5% 6.46						

Table 2B Pooled mean Main x sub interaction CCS yield (t/ha)

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm rows pacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	21.42	21.43	20.91	13.04	11.50	**17.67**
S_2- 60 cm	22.13	22.17	16.81	12.83	10.36	**16.63**
S_3- 75 cm	21.70	20.93	14.82	11.96	9.54	**15.70**
S_4- 90 cm	19.70	16.30	12.81	11.35	8.96	**13.72**
Mean	**21.10**	**19.80**	**16.35**	**12.30**	**10.09**	**15.90**
Interaction SE + 0.19 CD at 5% 0.55						

Effect on Biometric observation

The pooled results presented in Table 3 observed that tillering ratio (7.43) and millable height (252 cm) was observed significantly highest in row spacing 150 cm and row spacing 240 cm, respectively. Number of internodes per plant (28) was significantly highest in row spacing 210cm and 240cm.whlie it was on par with row spacing 180cm (27.69). Number of millable cane per hectare (94468/ha) was significantly highest in treatment row spacing 120 cm than rest of the row spacing treatments. Weight per cane (1.71kg) was significantly highest in treatment row spacing 210 cm it was on par with all spacing except row spacing 120cm (1.65 kg). Girth (cm) and quality parameters are found to be non significant. The tillering ratio (7.87) was significantly higher in with intra-row spacing of seedling planted at 90 cm than rest of the treatments followed by intra-row spacing of seedling 75cm (7.35). The cane girth (12.19cm) was significantly highest in intra row spacing of seedling planted at 90cm and it was on par with intra row spacing of seedling planted at 75cm (12.05cm).Number of millable cane per hectare (80889 /ha) was significantly highest in intra-row spacing of seedling with 45 cm than rest of the treatments followed by intra-row spacing of seedling 60 cm (72131/ha). Weight per cane (1.72 kg) was significantly higher in treatment intra-row spacing of seedling planted at 90 cm but it was on par with intra-row spacing of 75 cm and 60cm (1.71 and 1.70cm respectively). Millable height (cm).Number of internodes per plant and quality parameters found to be non significant. Interaction effect between row spacing and intra-row spacing of seedling for tillering ratio, millable height (cm), girth (cm), number of internodes per plant, and number of millable cane per hectare was found to be significant. The tillering ratio (8.77) was observed significantly higher in treatment combination row spacing 150cm and intra-row spacing of seedling 75 cm than rest of the treatment combinations. Followed by treatment combination row spacing 150cm and intra-row spacing of seedling 90 cm.(8.44) (Table -4A) The girth (12.61cm) was found significantly higher in treatment combination row spacing 120cm and intra-row spacing of seedling 90 cm. but it was found on par with the treatment combination row spacing 120cm and intra-row spacing of seedling 75 cm (12.17cm), row spacing 150cm and intra-row spacing of seedling 90 cm (12.16cm), row spacing 180cm and intra-row spacing of seedling 60 cm.(12.56cm), row spacing 240cm and intra-row spacing of seedling 75 cm (12.33cm) and row spacing 240cm and intra-row spacing of seedling 90 cm.(12.28cm), (Table -4B). No. of millable cane (100899/ha) was observed significantly higher in treatment combination row spacing 120cm and intra-row spacing of seedling 45 cm but it was found on par with the treatment combination row spacing 150 cm and intra-row spacing of seedling 45 cm (99862/ha). Millable height (254cm) was significantly higher in treatment combination row spacing 240cm and intra-row spacing of seedling 75 cm but it was found on par with all the treatment combination row spacing 240 cm and intra-row spacing of seedling 45 cm, 60cm and 90cm. Number of internodes per plant(28.56) was highest in treatment combination row spacing 240cm and intra-row spacing of seedling 90 cm but it was found on par with the treatment combination R_5xS_1, R_5xS_2, R_4xS_2, R_4xS_3, R_4xS_4, R_3xS_4, R_3xS_1,R_1xS_1, and R_1xS_2. (28.22, 27.89, 27.89, 28.33,27.67,28.11,27.67, 28.33, 28.00) (Table -4C) . Interaction effect between row spacing and intra-row spacing of seedling treatment combination was found to be non significant with respect to millable height, no. of internodes per plant and weight per cane (kg). (Table- 4D). This could be attributed to the fact that more area of land per shoot was available for growth and

development under pair row planting as compared to single row planting. The results are in conformity with the findings of [5].

Table 3 Pooled Mean ancillary observation and quality parameters as affected by various treatments

Treatments	Tillering Ratio	Millable height (cm)	Girth (cm)	No.of I,nodes/plant	NMC (ha^1)	Wt/cane (kg)	Brix (c)	Sucrose (%)	Purity (%)	CCS (%)
Row spacing										
R_1- 120 cm	6.46	237.08	11.68	27.31	94468	1.65	19.97	19.01	95.21	13.60
R_2- 150 cm	7.43	237.28	11.78	27.08	87347	1.68	19.96	18.98	95.06	13.58
R_3- 180 cm	6.63	237.89	11.90	27.69	71306	1.69	19.91	18.94	95.08	13.60
R_4- 210 cm	6.32	243.67	11.81	28.00	53282	1.71	19.88	18.93	95.19	13.57
R_5- 240 cm	6.08	252.00	11.96	28.00	43690	1.70	19.89	18.93	95.29	13.54
SE+	0.08	1.34	0.07	0.16	1079	0.01	0.03	0.02	0.07	0.03
CD at 5%	0.20	4.38	NS	0.51	3521	0.03	NS	NS	NS	NS
Intra-row spacing										
S_1- 45 cm	5.01	243.02	11.21	27.89	80889	1.61	19.89	19.94	95.16	13.55
S_2- 60 cm	6.11	242.44	11.85	27.67	72131	1.70	19.97	18.79	95.08	13.51
S_3- 75 cm	7.35	240.47	12.05	27.38	67927	1.71	19.94	18.98	95.17	13.58
S_4- 90 cm	7.87	240.40	12.19	27.53	59127	1.72	19.89	18.93	95.26	13.60
SE+	0.05	1.12	0.07	0.15	462	0.01	0.02	0.02	0.10	0.03
CD at 5%	0.13	NS	0.20	NS	1335	0.02	NS	NS	NS	NS
Interaction										
SE+	0.10	2.51	0.15	0.34	1033	0.02	0.05	0.05	0.22	0.07
CD at 5%	0.29	7.25	0.45	0.98	2985	NS	NS	NS	NS	NS

Table 4A Pooled mean Main x sub interaction Tillering Ratio

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm row spacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	4.41	5.58	6.00	4.33	4.72	**5.01**
S_2- 60 cm	5.79	6.93	6.29	5.94	5.58	**6.11**
S_3- 75 cm	7.45	8.77	6.95	6.95	6.61	**7.35**
S_4- 90 cm	8.18	8.44	7.27	8.04	7.41	**7.87**
Mean	**6.46**	**7.43**	**6.63**	**6.32**	**6.08**	**6.58**
Interaction SE + 0.10, CD at 5% 0.29						

Table 4B Pooled mean Main x sub interaction Girth (cm)

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm row spacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	10.39	11.06	11.33	11.61	11.67	**11.21**
S_2- 60 cm	11.56	11.89	12.56	11.67	11.56	**11.85**
S_3- 75 cm	12.17	12.00	11.94	11.83	12.33	**12.05**
S_4- 90 cm	12.61	12.16	11.78	12.11	12.28	**12.19**
Mean	**11.68**	**11.78**	**11.90**	**11.81**	**11.96**	**11.83**
Interaction SE + 0.15, CD at 5%, 0.45						

Table 4C Pooled mean Main x sub interaction No. of millable cane (ha)

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm rows pacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	100899	99862	94450	58036	51201	**80889**
S_2- 60 cm	97374	90624	72793	55536	44328	**72131**
S_3- 75 cm	94593	89025	63823	51192	41003	**67927**
S_4- 90 cm	85007	69878	54158	48364	38229	**59127**
Mean	**94468**	**87347**	**71306**	**53282**	**43690**	**70019**
Interaction SE + 1033, CD at 5%, 2985						

Table 4D Pooled mean Main x sub interaction Millable height (cm)

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm rows pacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	242.56	240.44	237.89	243.22	251.00	**243.02**
S_2- 60 cm	239.67	239.44	237.89	243.22	252.00	**242.44**
S_3- 75 cm	234.66	239.00	231.22	243.33	254.11	**240.47**
S_4- 90 cm	231.45	230.22	244.55	244.89	250.89	**240.40**
Mean	**237.08**	**237.28**	**237.89**	**243.67**	**252.00**	**241.58**
Interaction SE + 2.51, CD at 5%, 7.25						

Table 4E Pooled mean Main x sub interaction Number of internodes per plant

Treatment	R_1-120 cm row pacing	R_2- 150 cm row pacing	R_3- 180 cm row spacing	R_4- 210 cm rows pacing	R_5- 240 cm row spacing	Mean
S_1- 45 cm	28.33	26.67	28.11	28.11	28.22	**27.89**
S_2- 60 cm	28.00	27.00	27.55	27.89	27.89	**27.67**
S_3- 75 cm	26.44	27.33	27.44	28.33	27.33	**27.38**
S_4- 90 cm	26.45	27.33	27.67	27.67	28.56	**27.53**
Mean	**27.31**	**27.08**	**27.69**	**28.00**	**28.00**	**27.62**
Interaction SE + 0.34, CD at 5% 0.98						

The single cane weight under wider row spacing increased as compared to closer row spacing, similar findings were reported by several workers [5, 6]. [7] from their study reported that weight of stalk and millable cane population together account for more than 98 % of the variation in cane yield. [8] concluded that precise planting technique is important for improving sugarcane productivity as it plays a crucial role in sustaining higher number of millable canes. Thus, better spacing under small pit treatment with resultant reduction in competition in nutrient use and increased utilization of space and light led to greater number of millable canes and hence the higher cane yield. In appropriate row planting, main factors contributing towards cane yield was number of internodes and length of internodes, millable height of cane and weight of cane. These results corroborate the findings of [5] and [9].

Effect of quality parameter

The data presented in Table 3 observed that effect of the row spacing, intra-row spacing of seedling and their combination was found to be non significant in respect of quality parameter as Brix (c), Sucrose (%), Purity and CCS(%).The planting system not influenced the pol per cent of the cane juice. The non significant differences per cent sucrose value due to different spacing was also reported by [10]. The variation in juice quality between spacing was not significant [11].

Conclusion

Plantation of preseasonal sugarcane var.CoM 0265 at 120cm x 45cm or 120cm x 60cm or 120cm x 75cm or 150 cmx45 or 150cm x 60cm cm or 180 cm x 45cm was found to be suitable for producing higher cane yield and 150cm x 60cm or 120cm x 60cm or 120cm x 75cm was found to be suitable for CCS yield.

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