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Influence of High-Sugar Early and Mid-Late Genotypes on Yield and Quality of Sugarcane (*Saccharum* spp. Hybrid Complex) at Wider Row Spacing

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ABSTRACT

A field experiment was conducted in Pusa during spring season of 2016-17, to evaluate 7 sugarcane genotypes ('CoP 11436', 'CoP 11437', 'CoP 11438', 'CoSe 11451', 'BO 130', 'CoSe 95422' and 'BO 153') in early maturing group and 7 sugarcane genotypes viz., 'BO 155', 'CoSe 11453', 'CoSe 11454', 'CoSe 11455', 'BO 91', 'CoP 9301' and 'CoSe 92423' in mid late maturing group at 120 cm row spacing. In early group, genotype 'CoP 11436' produced the higher tillers (1, 38000/ha), millable canes (1, 04800/ ha), cane (88.2 t/ha) and sugar yield (11.1 t/ ha). Genotype, 'CoP 11438' showed the higher brix (20.6) and pol (18.39%) per cent juice among test genotype, followed by standard check 'BO 153'. Under mid late maturing group, higher germination count (46.2%), tillers (1, 52, 100/ha) and millable canes (1, 07800/ ha) was noticed due to the genotype 'BO 155' which was followed by the standard check 'CoSe 92423'. However, 'CoSe 11455' recorded the highest cane (103.7 t/ha) and sugar yield (13.18 t/ ha), followed by 'BO 155' in case of cane yield and CoSe 11453 in sugar yield. Among mid late genotype 'CoSe 11453', 'CoSe 11454' and standard check 'CoP 9301' obtained similar brix values of 20.7%. However, standard check 'CoP 9301' was found significantly superior to 'BO 155' with respect to pol and commercial cane sugar percent.

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INTRODUCTION

Sugarcane (*Saccharum* spp. hybrid complex) is one of the most important crops in India. It is the second-largest agro-based industry in rural India, after cotton textile, is the sugar industry, which has greater than 450 sugar factories operating nationwide. It is grown on 5.3 million ha of land with an average productivity of 61.3 t/ha. It is grown in Bihar on an area of 0.26 million ha with average cane yield of 50.0 t/ha (ISMA 2021). A key factor in increasing sugarcane productivity is selecting the right genotype for the specific agro-ecological condition. Genotype potential and agronomic practices determine sugarcane productivity. The key factor influencing increased sugarcane productivity is biomass productivity. A genotype's potential biomass is reached when growth and development phases coincide with management strategies and favorable environmental circumstances. Having sugarcane genotypes with high sugar content available throughout the crushing season is a crucial tactic for achieving high sugar recovery in the mills. To achieve this, it is essential that early and mid-late maturing high sugar genotypes be evolved. The genotypes developed exhibited varying responses to different agronomic techniques, and genotype significantly influences sugarcane productivity (Kumar *et al.* 2023a). The ideal row spacing is determined by a number of factors such as agro climates, soils, genotypes, management techniques, and other factors. By increasing the amount of optimal solar radiation reaching the ground surface, row spacing is one of the agronomic management techniques that contribute significantly to increasing the biomass and sugar yield of sugarcane genotypes. Wider row spacing gives each plant more scope for overall development and growth. Wider row spacing allows for more space and sunlight to be available for longer periods of time, which considerably increases the output of biomass and provides a lot of potential for mechanizing field operations from planting to harvesting. Identification of high sugared early and mid-late duration sugarcane genotypes that are adapted to certain environments is therefore necessary. To find the suitable early and mid-late genotypes of sugarcane with wider row spacing under this situation, the current experiment was conducted.

MATERIALS AND METHODS

A field experiment was completed during the spring season of 2016 -17 at Sugarcane Research Institute, Dr Rajendra Prasad Central Agricultural University, Pusa, Bihar. The investigation site soil had sandy loam in texture with low in organic carbon (0.46%), N (224 kg N/ ha), P (9.4 kg/ ha) and available K (98.4 kg/ ha) content with pH 8.3. Treatments comprising 7 sugarcane genotypes ('CoP 11436', 'CoP 11437', 'CoP 11438', 'CoSe 11451', 'BO 130', 'CoSe 95422' and 'BO 153') in early maturing group and 7 sugarcane genotypes ('BO 155', 'CoSe 11453', 'CoSe 11454', 'CoSe 11455', 'BO 91', 'CoP 9301' and 'CoSe 92423') in mid late maturing group at 120 cm row spacing and 125% fertility level were arranged in 3 replication in Randomized Block Design. 150 kg N, 37.1 kg P and 49.8 kg K/ha were the recommended fertilizer dosages. The 50% N with the full doses of P and K applied as basal. Remaining N was applied in two splits, after the first irrigation and at tillering stage. Rest inputs and practices were adopted as per recommendation of the region. Sugarcane crop was grown in 03.3.2016. Early maturing genotypes were harvested in third week of December whereas, mid late maturing genotype harvested in the next year in the second fortnight of January. Utilizing three budded setts, the planting was done in a furrow with 120 cm row spacing. The temperature and rainfall received during formative (tillering) and grand growth stage was normal. During the crop period, there were 59 rainy days, with a total rainfall of 1016.2 mm (Fig. 1). At 300 and 330 days after planting, whole cane samples were collected, cane juice was extracted using a power crusher, and the quality of the juice was assessed (Spencer and Meade 1955).

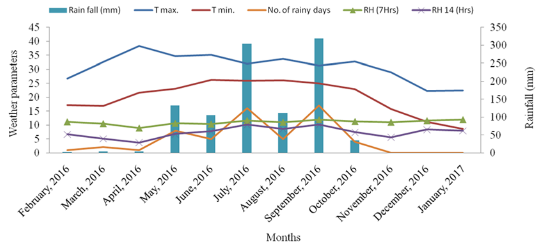

Fig. 1. Monthly weather parameters during field experimentation. T max : Maximum temperature (0°C), T min: Minimum temperature (ºC), RH: Relative Humidity (%).

RESULTS AND DISCUSSION

Germination percentage

Data relating to germination percentage at 45 days after planting (DAP) have been recorded for both

Table 1. Influence of spring planted early and mid-late genotypes on growth, yield attributes and yield of sugarcane.

Treatments	Germination (%)	Tillers (×10³/ha)	Millable canes (×10³/ha)	Cane yield (t/ha)
Early genotypes				
CoP 11436	46.5	138.0	104.8	88.2
CoP 11437	34.4	116.9	90.5	76.5
CoP 11438	22.0	64.0	53.3	62.6
CoSe 11451	34.2	102.1	79.2	87.0
BO 130	31.8	116.4	89.0	81.1
CoSe 95422	41.3	109.8	95.9	78.0
BO 153	47.7	124.6	89.1	74.1
SEm±	2.44	8.15	7.07	4.77
CD (p=0.05)	7.5	25.1	21.8	14.7
Mid-late genotypes				
BO 155	46.2	152.1	107.8	91.4
CoSe 11453	32.4	117.4	90.4	89.3
CoSe 11454	37.0	138.6	85.5	74.0
CoSe 11455	36.4	116.5	95.1	103.4
BO 91	31.3	97.2	74.8	55.4
CoP 9301	31.6	105.7	75.5	57.0
CoSe 92423	40.8	140.6	107.5	80.6
SEm±	2.80	10.93	5.39	4.07
CD (p=0.05)	8.6	33.7	16.6	12.5

early and mid late genotypes (Table 1). The early genotype 'CoP 11436' and standard check 'BO 153' and 'CoSe 95422' recorded statistically comparable germination percentage of 46.5, 47.7 and 41.3%, respectively but all of them were recorded significantly higher germination percentage over 'BO 130' and 'CoP 11438' (22.0%). However, under mid-late group, genotype 'BO 155' noticed significantly higher germination count (46.2%) than the genotype 'CoSe 11454' (37.0%), 'CoSe 11455' (36.4%) and 'CoSe 11453' (32.4%) but was at par to the standard check 'CoSe 92423' (40.8%). The genetic variability in the soluble solids in juice as well as the enzymes and hormones present in cell sap were responsible for the variation in germination percentage. Similar observations were also reported by other researchers (Singh *et al.* 2013, Singh *et al.* 2015 and Kumar *et al*. 2014)

Tillers

Significant improvement was also observed in tillers count due to different genotypes. Under early maturity group, data on tillers count indicated that the maximum number of tillers was recorded in genotype 'CoP 11436' (1, 38000/ ha) which was significantly better than standard check 'CoSe 95422' and 'BO 130'. The genotype 'CoP 11438' produced lowest number of tillers (64, 000/ ha) and it was significantly less than even the all standard check 'BO 153' (1, 24600/ ha), 'BO 130 (1, 16400/ ha) and 'CoSe 95422' (1, 09800/ ha). These results confirm the findings of Singh and Uppal (2013). In mid late group, maximum tillers (1, 52, 100/ ha) was noticed due to the genotype 'BO 155' which was statistically comparable to test genotype 'CoSe 11454' (1, 38600/ ha) and significantly superior over others.The results were in conformity with the findings of Kumar *et al.* (2012) and Kumar *et al.* (2023a).

Leaf area index

Data pertaining to LAI at three stages have been recorded for both early and mid-late genotype (Fig. 2). LAI increased at a rapid rate from 120 DAP to 180 DAP. Thereafter, its increase was at decreasing

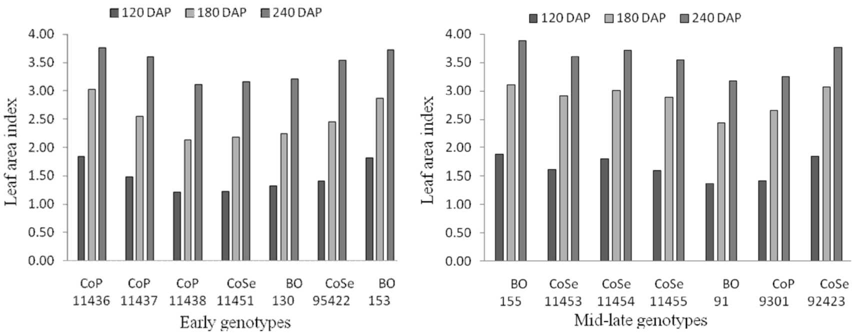

Fig. 2. Leaf area index of sugarcane as influenced periodically by early and mid-late genotypes.

rate under both the maturity groups. The reduction in LAI towards maturity of sugarcane was due to natural senescence of older leaves and mortality of late formed water shoots. Apparent genotypic variation was obtained in terms of LAI. Genotype, CoP 11436 exhibited the higher values of LAI (1.84, 3.03 and 3.77) at 120, 180 and 240 DAP, respectively. The next best genotype with respect to LAI was BO 153. Under mid-late maturity group, higher LAI was obtained due to the genotype BO 155 which was followed by CoSe 92423 and CoSe 11453 at all the stages (Fig. 1). This was due to the genetic makeup of the genotypes which facilitates higher germination resulting in higher tillers count at maximum tillering stage (120 DAP). Kumar *et al.* (2023b) also noticed significant variations in leaf area index due to different sugarcane genotypes.

Millable canes

The data on millable canes indicated that the maximum number of millable canes (1, 04,800/ ha) in early genotype was obtained with ‘CoP 11436’ which was significant edge over ‘CoP 11438’ (53,300/ ha) and ‘CoSe 11451’ (79, 200/ ha). Bhilala *et al.* (2023) also observed good response of early genotype under wider spacing on millable canes. Under mid late maturing group, genotype BO 155 gave the maximum number of millable canes (1,07,800/ ha) but was at par to standard check ‘CoSe 92423’ (1,07,500/ ha) and ‘CoSe 11455’ (95,100/ ha) and significantly higher over rest of the genotypes.The increase in millable canes may be attributed to enhanced tillers production and growth of cane under these genotypes. The results are in corroboration with Kumar *et al.* (2023a), Kumar *et al.* (2023b) and Tayade *et al*. (2017).

Cane and sugar yield

Yield is an important parameter to find out the economic potential of genotype. Maximum cane yield (88.2 t/ha) under early maturing group was noticed due to the genotype ‘CoP 11436’ was significantly higher over ‘CoP 11438’ (62.6 t/ ha) but was on par to other genotypes. Sugar yield of the genotypes ‘CoP 11436’ and ‘CoSe 11451’ were at par to each other and significantly higher over others. Lowest sugar yield of 7.99 t/ ha was observed due to ‘CoP 11438’ which was inferior over rest of the genotypes. In mid late maturing group, the genotype ‘CoSe 11455’ recorded the maximum cane yield (103.4 t/ ha) which was statistically similar to BO 155 (91.4 t/ ha) and significantly more over other genotypes. Sugar yield of ‘CoSe 11455’ was found significantly highest (13.18 t/ha) among mid late maturing genotypes, followed by ‘CoSe 11453’ (11.51 t/ ha) and ‘BO 155’ (10.42 t/ ha). This could be justified by the genotype’s inherent capacity to favor yield-enhancing characteristics over those of other genotypes. Results from the current investigation are consistent with those of many other researchers (Singh and Uppal 2013, Meena and Kumar 2015, Kumar *et al.* 2015).

Table 2. Influence of spring planted early and mid-late genotypes on quality of sugarcane.

Treatments	Brix (%)	Pol (%)	Purity (%)	CCS (%)	Sugar yield (t/ha)
Early genotypes					
CoP 11436	20.4	18.14	89.9	12.58	11.10
CoP 11437	20.5	18.36	89.5	12.77	9.77
CoP 11438	20.6	18.39	89.3	12.77	7.99
CoSe 11451	20.4	18.25	89.4	12.69	11.04
BO 130	20.5	18.23	88.9	12.64	10.25
CoSe 95422	19.3	17.05	88.3	11.79	9.20
BO 153	20.5	18.37	89.6	12.78	9.47
SEm±	0.45	0.422	1.27	0.167	0.522
CD (p=0.05)	NS	1.30	NS	0.52	0.61
Mid-late genotypes					
BO 155	18.8	16.53	87.9	11.40	10.42
CoSe 11453	20.7	18.52	89.5	12.89	11.51
CoSe 11454	20.7	18.59	89.8	12.96	9.59
CoSe 11455	20.5	18.34	89.5	12.75	13.18
BO 91	20.6	18.26	88.6	12.64	7.00
CoP 9301	20.7	18.71	90.4	13.08	7.46
CoSe 92423	20.6	18.40	89.3	12.78	10.30
SEm±	0.29	0.156	1.62	0.224	0.522
CD (p=0.05)	0.9	0.48	NS	0.69	1.61

Quality

Quality parameter of sugarcane genotypes were evaluated in terms of brix, pol, purity and commercial cane sugar per cent juice (Table 2). Different early genotypes have little impact on the brix percent in juice. Similar results observed by Kumar *et al.* (2023a) under 120 cm wider row spacing. Though, comparatively higher brix per cent (20.6%) under mid late maturing group was noticed due to the genotype 'CoP 11438'. Genotype, 'CoP 11438' registered the significantly higher pol percentage (18.39%) over standard check 'CoSe 95422' and statistically similar over other genotypes. However, purity percent juice did not varied significantly. Contrary to this, standard check 'BO 153' showed the highest commercial cane sugar (12.78%) which was statistically comparable to rest of the genotypes except 'BO 130' (Table 2). A perusal of the data presented in Table 2 revealed that mid late maturing genotypes 'CoSe 11453', 'CoSe 11454', and standard check 'CoP 9301' recorded almost similar and comparable brix, pol, purity and CCS percent juice. Since all of the genotypes were planted under similar agronomic conditions, the observed variation in the quality parameter of the genotypes may be related to their biochemical activities and the external environmental elements to which they were subjected along the course of maturity. This finding confirms the results of Kumar *et al.* (2014) who observed higher brix, pol and commercial cane sugar per cent in juice with 'CoP 9301'.

CONCLUSION

On the basis of overall performance of the genotypes it is concluded that early maturing genotype 'CoP 11436' and 'CoSe 11451' having higher cane and sugar yield may be recommended for commercial cultivation. Under mid late maturing group 'CoSe 11455' was most promising with respect to cane and sugar yield.

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