Plant Archives Vol. 24, Special Issue (GABELS), 2024 pp.136-141 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.SP-GABELS.020

EVALUATION OF PROMISING MIDLATE SUGARCANE GENOTYPES FOR YIELD AND QUALITY TRAITS IN NORTH CENTRAL ZONE

Satendra Kumar* and S. C. Singh
UPCSR-Genda Singh Sugarcane Breeding and Research Institute, Seorahi, Kushinagar
Uttar Pradesh, India
*Corresponding author Email: satendrasbri@gmail.com

ABSTRACT

The evaluation of mid-late sugarcane genotypes involves assessing various characteristics and performance indicators to determine their suitability for cultivation. The performance of the crop depends on the planting methods, balanced use of fertilizer, and types of genotypes. The most important factor is the ability of genotypes to efficiently utilize the applied nutrients, especially NPK. A field experiment was conducted during 2022-23 at the research farm of Genda Singh Sugarcane Breeding and Research Institute, Seorahi, Uttar Pradesh. The experiment consisted of three promising genotypes and three check varieties for comparison, three genotypes i.e. CoSe 16455, CoP 17446 and CoSe 17452 with three zonal checks varieties i.e. Bo 91, CoP 06436 and CoP 9301, second factor two fertility levels i.e. F_1-100 per cent recommended dose of NPK and F_2-125 percent recommended dose of NPK were tested in factorial randomized block design with three replications with an objective to assess the performance of promising midlate sugarcane genotypes of the advanced varietal trial (AVT). The recommended dose of N-P-K was 180-80-60 kilogram per hectare and applied as per treatment requirement. The experimental field was medium in organic carbon (0.68 per cent), low in available phosphorus (13.47 kg/ha) and low in potash (70.38 kg/ha) with a pH of 8.15. Sugarcane crop was planted on 06 March 2022 in spring planting season and harvested on 18 February 2023. The yield of mid late set of sugarcane genotypes were found significantly superior over checks for their performance. The results of mid late set of sugarcane genotypes revealed that all new midlate tested genotypes produced significantly effect on shoot population. Genotypes CoSe 16455 (148.61 thousand per ha) produced higher shoot population over all standard except CoP 06436. Genotypes CoSe 16455 (127.38 thousand per ha), CoP 17446 (123.56 thousand per ha) noted significantly higher NMC from compared two zonal checks i.e. Bo 91 and CoP 06436. Tested genotypes CoSe 16455 (94.59 t/ha) and CoSe 17452 (85.89 t/ha) produced significantly higher cane yield over all rest zonal check except CoP 06432. 125 per cent RDF obtained significantly higher shoot population (142.23 thousand per ha) and cane yield (89.21 t/ha) as compared to 100 percent application of RDF. No significant variation was observed in germination, NMC and sucrose per cent between 100 and 125 per cent recommended dose of fertilizer application but maximum value was obtained in 125 per cent recommended dose of fertilizer applied plots. Sucrose per cent was not affected significantly by different genotypes against all checks but maximum value noted in genotype CoSe 17452 (16.74 per cent).

Keywords: Promising, Evaluation, Sugarcane, Fertility level, Genotypes, productivity, quality

Introduction

The primary goal is to assess the sugar yield potential of mid-late varieties. This involves measuring the quantity and quality of sugarcane produced per unit of land. The sucrose content in the cane is a crucial indicator of sugar quality. Evaluations assess the sugar content to ensure it meets industry standards. Sugarcane is an important cash crop of India grown in an area of 5.28 Mha with an annual production of 401.80 million tonnes and an average yield is 75.98 t/ha (sources: ISMA website. It is the second-highest producer of sugarcane in India after Brazil. In Uttar Pradesh, it occupies an area of 28.53 lakh ha with a production of 2394.62 lakh tones and productivity is 83.95 t/ha (sources: U.P. cane department). Improve the profitability of sugarcane farming by reducing input costs. Factors such as tillering ability, stalk thickness, and overall plant health are evaluated to determine the agronomic suitability of the genotype. The performance of midlate sugarcane genotypes can vary depending on various factors including climate, soil conditions, and management practices. These genotypes may exhibit improved resistance to pests and diseases. Resistance traits are often integrated into newer varieties to reduce the need for chemical treatments, lowering production costs and potential harm to the environment. One of the primary goals of sugarcane breeding is to increase sugar content and productivity. Midlate genotypes may have essential for maintain the continue cane supply to sugar mill during crushing season. Newer genotypes may have different management requirements, including nutrient needs and planting density. Farmers need to adapt their cultivation practices to optimize the performance of these genotypes. The main reasons for lower cane yield are a lack of high-potential varieties, limited irrigation resources, and technology (Bahadar *et al*., 2002). Nazir *et al*. (1997) reported that higher cane yield is the function of the higher genetic potential of a variety. Efforts are made to increase cane production by introducing high-yielding varieties and adopting improved crop production techniques (Gill, 1995). There are several reasons for lower cane yield and one of those is the planting of low-yielding varieties. Therefore, it is necessary to introduce new high-yielding varieties in the country. Variety plays a key role in both increasing and decreasing per unit area sugar yield, while the use of unapproved, inferior quality cane varieties affects sugarcane production negatively as the situation prevails today (Mian, 2006). The solution to the low cane yield and sugar recovery problem lies in the planting of improved cane varieties (Chattha *et al*., 2006). The success of variety depends upon its adaptability to agro-climatic conditions of the area. Selection of a proper variety to be planted in a particular agroecological zone is a primary requisite to explore its yield and sugar recovery potential. The productivity of sugarcane in India is quite low owing to several factors viz. poor management of crop, poor soil condition, abiotic and biotic stresses, etc. Adoption of balanced and judicious use of all needed nutrients can help in improving cane productivity and enhancement of sugar recovery by rendering resistance against biotic and abiotic stresses and better synthesis and storage of sugar (Yadav *et al*., 1993). Balanced use of plant nutrients is essential for sustaining the productivity of crops and soil. Yadav (1990) and Yadav *et al*. (2014) explored that among various inputs in sugarcane production, fertilizers contribute the maximum to the crop yield. It is known that sugarcane varieties are significantly affected by genetic makeup (El-Geddaway *et al*., 2002).The variation is found in sugarcane yield and yield attributing traits due to their different genetic makeup (Varghese *et al*., 1985 and Mali and Singh, 1995) . Memon *et al*. (2005) and Panhwar *et al*. (2008) identified incredible diversity among the sugarcane entries for cane yield and yield traits. There are many reasons behind low cane yield however developing of low yielding varieties are one of them. Subsequently, there is a need to introduce better high yielding varieties (Chattha and Ehsanullah, 2003).The role of nitrogen in plants is of prime importance due to its presence as an integrated structural constituent of the protein molecule. Phosphorus is essential for cell division which accounts for stalk and root elongation resulting in the growth of the plant. It is also involved in the regulation of sugar synthesis and storage. The sugarcane genotypes show variable performance under different agronomic practices. The most important factor is the ability of genotypes to efficiently utilize the applied nutrients, especially NPK. Moreover, the genotypes possess variable characteristics and potential for higher productivity of sugarcane. Keeping this in view the present study was carried out on evaluation of promising mid late sugarcane genotypes for yield and quality traits in north central zone.

Materials and Methods

The present investigation entitled "evaluation of promising mid late sugarcane genotypes for yield and quality traits in north central zone" was carried out under AICRP on Sugarcane, at the research farm of Genda Singh Sugarcane Breeding and Research Institute, Seorahi, Uttar Pradesh during spring season 2022-23. The experiment consisted of three mid late promising genotypes and three check varieties for comparison, three genotypes i.e. CoSe 16455, CoP 17446 and CoSe 17452 with three zonal checks varieties i.e. Bo 91, CoP 06436 and CoP 9301, of mid late group of sugarcane were evaluated in the factorial randomized block design with three replications for their yield performance and other yield & quality attributing traits. The genotypes of sugarcane were collected from the plant breeding division, Genda Singh Sugarcane Breeding and Research Institutes Seorahi Kushinagar. Evaluation of elite genotypes under two fertility levels i.e. F_1-100 percent recommended dose of NPK, F_2–125 percent recommended dose of NPK. The heterozygous and polyploid nature of this crop has resulted in the development of greater genetic variability. The soil of the experiment plot was medium in organic carbon (0.68 per cent), low in available phosphorus (13.47 kg/ha), and potash (70.38 kg/ha) with a pH of 8.15. The recommended dose of fertilizers was 180, 80, and 60 (NPK) kg per ha for spring-planted sugarcane crops. The nitrogen 1/3 and full dose of P and K were applied at the time of planting and the remaining nitrogen was applied in two equal split doses as top dressing before the onset of monsoon season. Sources of nitrogen, phosphorus, and potash were urea, diamonium phosphate and murate of potash, respectively. The improved crop management practices were followed during experimentation periods. Shoot population and number of millable cane were recorded from each net plot and the data were computed in thousands on a hectare basis. The crop was harvested from ground level and green and dry leaves were stripped off. The weight of millable cane from each net plot was recorded and calculated on a hectare basis. Brix value was recorded by using a brix hydrometer dipped in a measuring cylinder filled with cane juice. Temperature corrections were made to correct observed brix readings by using temperature correction as described by Spencer and Meade (1955). The Juice Sucrose value was recorded by Horne’s dry lead Acetate Method. In this method, About 100 ml of juice was taken in the conical flask and one g of lead acetate was added to it. The impurities were filtered through the Whatman 42 paper. Filtrate was taken in a 20 ml polarimeter tube to record pol readings with the help of a polarimeter following Horne’s dry lead Acetate Method as described by Spencer and Meade (1955). Schmitz’s table was used to calculate juice sucrose. The sugar yield per hectare at harvesting stage was computed as follows

$$Sugar yield\ (\text{t ha}^{-1}) = \frac{\text{Available sugar per cent in cane}}{100} \times \text{cane yeild (t ha}^{-1})$$

Available sugar per cent in cane juice was calculated by using the following formula (Spencer and Meade, 1955).

$$\text{Available sugar per cent} = [S - \{0.4(B - S)\}0.73]$$

Where, S = Sucrose per cent in juice

B = Corrected brix of juice

0.4 & 0.73 are constant

The cost of cultivation per hectare was worked out by considering the current price of the input/commodity used. The gross return was worked out keeping in view the yields of cane and their (SAP) State advisory price of U.P. Government. Cost of cultivation was deducted from gross return to get net return per hectare. The benefit cost ratio was calculated on the basis of net returns obtained and cost of cultivation incurred. The experimental data obtained during course of investigation were subjected to statistical analysis. The techniques of analysis of variance (ANOVA) prescribed for randomized block design was used to test significance of the differences among treatments mean by the ‘F’ test. (Cochran and Cox, 1959) was used.

Results and Discussion

Effect of genotypes on growth, yield influence characters, productivity, quality and economics

The effect of genotypes on germination percent was noted significantly higher in all tested genotypes as compared to three of the checks varieties. All new tested genotypes produced significantly effect on shoot population. Germination percent was recorded significantly higher in CoSe 16455 (52.28) and CoSe 17452 (51.29) as comparison to two zonal checks i.e. Bo 91 and CoP 9301. Genotypes CoSe 16455 (148.61 thousand per ha) produced higher shoot population over all standard except CoP 06436. Genotypes CoSe 16455 (127.38 thousand per ha), CoP 17446 (123.56 thousand per ha) note significantly higher NMC from compared two zonal checks i.e. Bo 91 and CoP 06436. Tested genotypes CoSe 16455 (94.59 t/ha) and CoSe 17452 (85.89 t/ha) produced significantly higher cane yield over all rest zonal check except CoP 06432. Sucrose per cent was not affected significantly by different genotypes against all checks but maximum value noted in genotype CoSe 17452 (16.74 per cent). Genotype CoSe 16455 produced significantly higher CCS (10.32 t/ha) over all zonal checks and other midlate genotypes. Single cane weight (1.10 kg), cane length (258.89 cm) and cane thickness (2.39 cm) were obtained desired result in genotype CoSe 16455. Data indicated in table 02 showed that Cost of cultivation varies in genotypes plots due to vary quantity of seed and harvest the crop on the basis of crop yield. Genotypes CoSe 16455 produced significantly higher gross income (Rs. 321591 ha^{-1}), net income (Rs. 165172 ha^{-1}), and B: C ratio (1.05) overall all checks and other genotypes. Genotype CoP 17446 could not obtained significantly results in gross income, net return and B;C ration against all three zonal checks. CoSe 17452 genotype recorded significantly higher gross income (Rs. 290151 ha^{-1}), net income (Rs. 137431 ha^{-1}), and B: C ratio (0.88) over two checks i.e. Bo-91 and CoP 9301 but at par with CoP 06436. Juice quality was not affected significantly by different genotypes against all checks. It may be due to different potentiality /capacity of the genotypes to express in a particular environment. The variation in germination percent was owing to the chemical composition of soluble solids in juice as well as enzymes and hormones present in cell sap which varies from genotype to genotype. It had different potentialities and hence caused significant variation in cane yield this may be due to the inherent superiority of various growth characters and assimilating capacity in the same varieties. This suggested that all sugarcane genotypes were genetically variable and a considerable amount of variability existed among them, therefore, these sugarcane genotypes would respond positively to select as promising. It is accepted that sugarcane varieties are greatly affected by genetic makeup (El-Geddaway *et al.,* 2002). The variation in cane yield and yield components among the varieties may be attributed to their dissimilarity in genetic makeup (Varghese *et al*., 1985, Mali and Singh, 1995). Memon *et al*., 2005, Panhwar *et al*., 2008, Kumar *et al*., 2017 and Nirmodh 2021 reported great variability among the sugarcane genotypes for cane yield and yield components.

Effect of fertility levels on growth, yield influence characters, productivity, quality and economics

The effect of fertility levels on shoot population, cane yield, CCS, cost of cultivation, gross income, net income, benefit: cost ratio, and were recorded as significant whereas germination percent, number of millable cane, CCS percent, brix, internodes per cane and weight per cane, cane diameter, and sucrose percent were noted non significant. Data indicated in table 01 and 02 that cane yield was increased with increased fertility levels .125 percent recommended dose of fertilizer treatment produced significantly higher shoot population (142.23 thousand per ha), CCS (10.19 t/ha) and cane yield (89.21 t/ha) over 100 percent recommended dose of fertilizer treatment. Cane yield and CCS t/ha were increased up to 19.56 and 23.26 percent, respectively as compared to 100 percent RDF. Germination (47.12), Brix (18.87), CCS percent (11.42), Sucrose (16.56), cane diameter (2.22 cm), single cane weight (0.910 kg), and internodes (26.95) and cane length (226.87cm) were obtained higher in 125 percent RDF application. Results showed that shoot population, NMC, and cane yield increased with increasing doses of fertilizers. Cost of cultivation (Rs.155687 ha^{-1}), gross income (Rs.303309 ha^{-1}), net income (Rs.147621 ha^{-1}), and B: C ratios (0.94) were recorded significantly higher in 125 percent RDF treatment as compared with 100 percent RDF. This might be due to the conversion of shoots into millable canes, increased protein synthesis, and promoted root development which resulted in increased nutrient uptake and photosynthesis that enhanced the growth and yield attributes. These results are in agreement with earlier findings of Singh *et al*. (2011), Kumar *et al*., 2017 and Dev *et al*. (2011).

Integration effect

Data showed in table 03 indicated that genotypes CoP 17446 and CoSe 17452 recorded significantly higher cane yield and B:C ratio under 125 percent RDF as comparison to 100 percent RDF, meanwhile, these two genotypes required higher dose of fertilizers for obtain the desired performances. Genotype 16455 was resulted non significant between 100 and 125 per cent RDF dose of fertilizers, it means genotype 16455 performed good also under low fertilizer dose and also suitable for low soil fertility condition. CoSe 16455 required less fertilizer demand as comparison to other two genotypes.

Conclusion

Based on the above investigation, it may be concluded that cane yield was obtained significantly more in genotypes CoSe 16455 (94.59 t/ha) and CoSe 17452 (85.89 t/ha) produced significantly higher cane yield over all the zonal checks except CoP 06436. Genotype CoSe 16455 performed well under low ferity soil level. Sucrose per cent was not affected significantly by different midlate genotypes. Recommended dose of fertilizer 125 per cent application improved the shoot population, NMC and cane yield significantly but there was no significant improvement observed in sucrose per cent.

Acknowledgement

The authors express sincere thanks to the Director, U.P. Council of Sugarcane Research Shahajanpur, and Joint Director, Genda Singh Sugarcane Breeding and Research Institute, Seorahi Kushinagar for providing all the facilities timely. We are also thankful to Sri. Shakir Ali, field/lab assistant agronomy division, and Atul Kumar Srivastav, soil chemistry division, for help in lab work and sincerely devoted to project work.

Table 01: Performance of promising mid late genotypes in north central zone at Seorahi

Treatments	Germination	Shoot (000/ha)	NMC (000/ha)	Yield (t/ha)	CCS (t/ha)	Internodes /cane	Single cane weight (kg)	Cane length (cm)	Cane thickness (cm)
Genotypes									
CoSe 16455	52.28	148.61	127.38	94.59	10.32	27.72	1.10	258.89	2.39
CoP 17446	48.21	132.64	123.56	80.44	9.34	25.55	0.83	218.77	2.03
CoSe 17452	51.29	128.42	115.08	85.89	9.83	26.83	0.87	224.33	2.30
Zonal checks									
Bo 91	41.07	140.18	113.19	73.57	8.36	25.66	0.65	207.77	2.19
CoP 06436	45.93	137.15	109.72	82.96	9.22	27.16	1.01	252.78	2.40
CoP 9301	42.06	141.92	127.93	74.57	8.29	23.50	0.64	183.05	2.07
SEm±	1.24	3.98	5.21	3.46	0.42	1.18	0.08	14.81	0.11
CD(P=0.05)	3.67	11.76	15.37	10.22	1.25	NS	0.25	43.73	0.32
Fertility									
100 % RDF	45.90	134.08	115.93	74.61	8.26	25.19	0.79	226.87	2.26
125 % RDF	47.12	142.23	123.88	89.21	10.19	26.95	0.91	221.66	2.22
SEm±	**0.72**	**2.30**	**3.01**	**1.99**	**0.25**	**0.68**	**0.05**	**8.55**	**0.32**
CD(P=0.05)	**NS**	**6.79**	**NS**	**5.90**	**0.72**	**2.02**	**NS**	**NS**	**NS**

Table 02: Performance of promising mid late genotypes in north central zone at Seorahi

Treatments	Brix (%)	Sucrose (%)	CCS (%)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	B:C ratio
Genotypes							
CoSe 16455	18.02	15.84	10.93	156419	321591	165172	1.05
CoP 17446	18.93	16.71	11.55	150760	273485	122725	0.80
CoSe 17452	19.10	16.74	11.53	152720	290151	137431	0.88
Zonal checks							
Bo 91	19.48	16.70	11.37	148013	250140	102127	0.68
CoP 06436	18.40	16.09	11.07	151763	282015	130252	0.85
CoP 9301	18.50	16.18	11.14	148412	253527	105115	0.71
SEm±	0.42	0.39	0.30	1325	11264	9939	0.06
CD(P=0.05)	**NS**	NS	**NS**	3911	33250	29338	0.17
Fertility							
100 % RDF	18.61	16.19	11.11	147008	253661	106653	0.72
125 % RDF	18.87	16.56	11.42	155687	303309	147621	0.94
SEm±	**0.24**	**0.23**	**0.17**	**765**	**6503**	**5738**	**0.03**
CD(P=0.05)	**NS**	**NS**	**NS**	**2258**	**19697**	**16938**	**0.10**

Table 03 : Interaction effect of genotypes and fertility levels on yield and B:C ratio

Treatments	Yield (t/ha)		B:C Ratio	
	Fertility levels		Fertility levels	
	100 per cent	125 percent	100 per cent	125 per cent
Genotypes				
CoSe 16455	92.71	96.46	1.04	1.07
CoP 17446	71.51	89.27	0.67	0.93
CoSe 17452	76.90	93.70	0.76	1.02
Zonal checks				
Bo 91	67.36	79.77	0.59	0.78
CoP 06436	76.61	89.27	0.76	0.95
CoP 9301	72.44	76.68	0.68	0.73
SEm±	**4.68**		**0.08**	
CD(P=0.05)	**13.83**		**0.24**	

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