COMPARATIVE EVALUATION OF SOME SUGARCANE GENOTYPES FOR CANE YIELD AND QUALITY ATTRIBUTES IN ADVANCED VARIETAL TRIAL

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ABSTRACT

A comparative study was conducted to evaluate the performance of eight newly developed sugarcane genotypes against the standard variety Thatta-10 in advanced varietal trial. The experiment was laid out according to a randomized complete block design (RCBD) with three replications. All sugarcane genotypes exhibited different behavior with regard to cane yield and Commercial Cane Sugar Percentage (CCS%). The genotype Thatta-910 exhibited highest cane yield (112.50 t ha^{-1}) and CCS (13.71%) against Thatta-10 (Cane yield 100.0 t ha^{-1} and CCS 12.85%). While, rests of the genotypes in the trial could not surpass the standard variety in terms of cane yield and CCS%. It is suggested that the genotype Thatta-910 should be further tested for cane yield and quality performance under different agro-climatic conditions of Sindh to draw out its substantial conclusion.

Key words: ***Sugarcane genotypes, cane yield, yield components, CCS%, Thatta***

INTRODUCTION

Sugarcane, in Pakistan, keeps the place of second major cash crop and it is source of raw material for the manufacture of white sugar (Khan *et al.*, 2010 and Junejo *et al.*, 2010). In Pakistan, it is grown on about one million hectares area and base of raw material to 84 sugar mills and confers employment to many individuals as well as source of income for farming community (Soomro *et al.*, 2016). In addition to this, it produces several economically viable byproducts such as alcohol for pharmaceutical industries, ethanol for fuel production, pressmud for organic matter and nutrient source in crop production and baggase for manufacture of chip board and papers (Khan *et al.*, 2013).

The area under sugarcane cultivation in Pakistan has increased manifold and now it is being grown on area of 1, 171, 687 hectares with total annual production of 67,427,975 tones (PSMA-SZ 2015). Although our domestic sugarcane production and sugar recovery has enhanced steadily with the passage of time, yet our national average cane yield is 57.55 t ha^{-1} and average sugar recovery is 9.90% (PSMA-SZ 2015), which is very low than the production potential of 200 t ha^{-1} and sugar recovery of 12% in the indigenous varieties available in the commercial pool. In spite of distinct progression in sugarcane research and speedy growth in sugar industry, low cane yield and sugar recovery is being recorded in Pakistan. In addition to this, high cost of cultivation is the foremost concern being faced by farmers. One of the solutions recommended to counteract these problems is planting of advanced cane varieties (Chattha and Eshsanullah, 2003; Chattha *et al.*, 2006 and Kadam *et al.*, 2007). The achievement of a variety relies upon its adaptability to specific agro-climatic conditions of the region to be aware of maximum yield. The selection of variety alone makes better the cane yield in the range of 28-60 per cent (Kathiresan *et al.*, 2001).

The promising varieties adapted to different climatic conditions have been reported from time to time by many workers (Mari *et al.*, 2011; Chohan *et al.*, 2007;

Kaloi *et al*., 2007 and Chattha *et al*., 2004) these varieties have a large adoptability and being successfully grown throughout the areas. But still there is need to add new potential varieties in the exiting commercial pool.

Most of the sugarcane varieties under commercial cultivation are getting obsolete and losing their production potential with the passage of time, therefore, a large number of sugarcane varieties were slowly phased out due to their unstable productive behavior under various biotic and abiotic stresses. Thus in the existing level, evaluation of new sugarcane varieties bearing higher cane and sugar yield potential is the need of the time for sustaining cane and sugar productivity as well as betterment of growers and millers. Keeping in view the basic and highly important aspect of grower and millers, the study was conducted to evaluate the best suitable sugarcane varieties for commercial cultivation in Sindh.

MATERIALS AND METHODS

The study was carried out at National Sugar and Tropical Horticulture Research Institute, PARC, Makli, Thatta, during 2011-12. Eight promising sugarcane genotypes viz. Thatta-903, Thatta-907, Thatta-910, Thatta-911, Thatta-912, Thatta-913, Thatta-914 and Thatta-920 developed from local sugarcane fuzz were tested in advanced varietal trial for their cane yield, yield components and quality parameters against commercial variety Thatta-10 in an experiment laid out in randomized complete block design (RCBD) with three replications and a plot consists of five rows of six meter length spaced one meter apart. A seed rate of 30,000 three budded setts/ha was followed. The soils of the experimental site were characterized by clay loam with pH (7.6), EC (1.3 d Sm^{-1}), poor available nitrogen (0.05%), low available phosphorus (3.90 mg kg^{-1}) and adequate exchangeable potassium (227 mg kg^{-1}).

Recommended dosage (230:115:125 kg ha^{-1}) of N: P_2O_5: K_2O fertilizers were applied in the form of Urea, TSP and SOP. All phosphorus, potassium and 1/3 nitrogen were applied as basal dose at the time of planting, whereas remaining nitrogen was applied in two equal splits at 45 and 90 days after planting. All other agronomic practices, *viz.* weeding and earthing up, etc as well as insect pest and disease control measures were taken as per recommendation.

Irrigations were given as and when necessary as per crop water requirements. The data on cane yield, yield components, *viz.* cane thickness, cane height, number of internodes per plant and number of millable canes were recorded at harvest. Five canes of each sugarcane genotype were randomly selected from each plot for juice analysis. Juice quality parameters, *viz.* Fiber %, Brix %, Pol %, Purity% and Commercial Cane Sugar Percentage (CCS %) were recorded at harvest by following standard procedures (Spencer and Mead 1963). Data collected were analyzed statistically using computer software (MSTAT-C software 1991).

RESULTS AND DISCUSSION

Mean squares computed through analysis of variance are presented in Table-1 indicated that there were highly significant ($P \leq 0.01$) differences among the genotypes for cane thickness, cane height, number of internodes $plant^{-1}$ and cane yield, while significant ($P \leq 0.05$) differences were observed for millable canes.

Mean performance of the genotypes for cane yield and yield components is depicted in Table-3 which revealed that genotypes Thatta-910 showed excel in cane thickness and remained statistically at par with check variety Thatta-10. While, the genotypes Thatta-907, Thatta-911 and Thatta-920 exhibited significantly lowest cane thickness and remained statistically similar to each other. In case of cane height, the genotypes Thatta-910, Thatta-912 and Thatta -913 were statistically at par with maximum cane height as compared to Thatta-10, while, the genotypes Thatta-903 and Thatta-907 produced significantly next better cane

height as compared to check variety. In contrast, the lowest cane height was exhibited in Thatta-914. The number of internodes plant^{-1} were significantly higher in Thatta-913 followed by Thatta-912, Thatta-920, Thatta-910 and Thatta-903 with comparatively next better performance and surpassed Thatta-10 in terms of number of internodes plant^{-1}. The data regarding millable canes revealed that the genotype Thatta-910 maintained its superiority by producing significantly maximum millable canes, while, the genotypes Thatta-912, Thatta-911, Thatta-903, Thatta-913 and Thatta-907 displayed significantly next better performance in terms of millable canes and remained statistically similar to Thatta-10. In case of cane yield, the genotype Thatta-910 showed dominance over Thatta-10. While, rests of the genotypes in the trial could not out yield the check variety.

Mean squares computed through analysis of variance for quality parameters presented in Table-2 indicated that there were highly significant ($P < 0.01$) differences among the genotypes for fiber %, brix %, Pol%, purity % and CCS %. Mean performance of the genotypes for CCS and other quality parameters is depicted in Table-4 which revealed that the genotypes Thatta-903, Thatta-907, Thatta-911, Thatta-912, Thatta-914 and Thatta-920 exhibited statistically similar results and appeared to be highly fibrous content genotypes. While, the genotypes Thatta-910, Thatta-913 and check variety Thatta-10 produced comparatively less fiber percentage and remained statistically identical to each other. In case of brix content, check variety Thatta-10 and Thatta-903 remained statistically at par with significantly maximum brix % followed by Thatta-912 and Thatta-910. The data in Table-4 further revealed that the genotype Thatta-910 and check variety Thatta-10 remained statistically at par with significantly maximum Pol% followed by Thatta-913 and Thatta-913. Moreover, the genotype Thatta-914 produced statistically minimum Pol % followed by Thatta-920, Thatta-907, Thatta-911 and Thatta-903 with statistically similar results. As regards purity %, check variety Thatta-10 and Thatta-910 remained statistically at par with maximum Pol % followed by Thatta-913 and Thatta-907. While, the genotypes Thatta-914 and Thatta-912 exhibited significantly lowest results with statistically similar Pol%.

Maximum purity (84.08 %) was produced by Thatta-910 followed by Thatta-913, Thatta-10 and Thatta-907 with purity of 80.75, 80.13 and 78.17 %, respectively. In case of commercial cane sugar percentage (CCS), the genotype Thatta-910 surpassed all the genotypes by producing significantly maximum CCS % followed by check variety Thatta-10 and Thatta-913. Moreover, CCS % in rests of the genotype was lower than that of check variety.

Cane yield and sugar percent in the juice are two main characters of foremost importance, for which sugarcane is cultivated on a commercial level. Acceptance of a new sugarcane variety at farmer's level requires to have high cane yield potential, while, for sugar mills it must contains high sugar percent. Therefore, for improving the cane and sugar production of the crop, the sugarcane breeders are continually looking for the varieties possessing inherent capability to produce better cane yield and sugar recovery, mutually beneficial to all stakeholders.

Cane yield and its components are the main traits in sugarcane production, of which stalk weight and number of millable canes are two major parameters of cane yield (Okaz *et al*., 2011). The highest cane yield in sugarcane variety Thatta-910 as compared to other sugarcane genotypes in the trial may be associated to the production of thicker, taller cane stalks and sufficient number of millable canes per hectare. These results are further supported by (Khan *et al*., 2002) who reported that increase in cane yield of sugarcane might be due to maximum plant height, weight per stool and cane girth. Naidu *et al*. (2007) stated that plant height and cane girth are known to be the major

contributing factors for high cane yield. According to Hossain and Islam (2008) stalk diameter plays a significant role for cane weight and cane yield. Khalid *et al.* (2010) reported that number of tillers is playing a main part in raising the final yield of sugarcane. In case of quality, maximum Commercial Cane Sugar (CSS%) in variety Thatta-910 was due to less fiber content and more purity percentage.

Kent *et al.* (2010) reported that sugar recovery reduces by about 0.9 units for each 1 unit increase in cane fiber content. Furthermore, the sugarcane genotypes in this trial exhibited varying behaving trend with regard to cane yield, yield components and CCS %. The difference among the genotypes for these traits may be attributed to their inherent genetic makeup and response to environmental factors in which they were grown (Okaz *et al.*, 2011). Similarly Abo-El-Hamd *et al.* (2013) confirmed that commercial cane varieties are inter-specific hybrids and thus vary in their yield and quality characteristics because of great inequality in their genetic composition. Mari *et al.* (2011) stated that genetically superior genotypes might have aptitude to generate satisfactory results for per hectare yield and sugar percentage under particular set of environmental conditions. El-Geddaway *et al.* (2002) and Panhwar *et al.* (2008) were of this view that sugarcane varieties are highly influenced by genetic makeup.

According to Keerio *et al* (2003) unless the genetic capabilities of a variety are high, mere provisions of growing conditions such as manuring, irrigation etc. will not lead to substantial improvement in cane or sugar content. Similarly Sohu *et al* (2008) stated that cane yield per hectare is a product of well-matched interaction of genetic as well as environmental factors towards the growth and development of the sugarcane plant. Hence, it is also presumed that the highest cane yield and CCS% in Thatta-910 as compared to other sugarcane genotypes might be due to its inherent genetic potential and more efficient utilization of existing resources under given set of environmental conditions towards its economic production.

CONCLUSION

It is concluded that sugarcane genotype Thatta -910 can provide better economic returns to the farming community as well as sugar mills due to its better cane yield and sugar content capacity. Therefore, the same variety is recommended for further testing in terms of cane yield and quality as well as its stability under different agro-climatic zones of Sindh.

Table-1 Mean squares from analysis of variance for cane yield and yield components of sugarcane genotypes in advanced varietal trial during 20011-12

Source	DF	Cane Thickness	Cane Height	Number of Internodes	Millable Canes	Cane Yield
Replications	2	0.19340	1411.98	17.3415	577.778	650.93
Treatments	8	5.20410 **	2100.92 **	25.9083 **	362.500 *	1244.16 **
Error	16	0.48188	843.46	5.3171	325.694	167.33

*Significant ** Highly Significant

Table-2 Mean squares from analysis of variance for CCS and quality parameters of sugarcane genotypes in advanced varietal trial during 20011-12

Source	DF	Fiber	Brix	Pol	Purity	CCS
Replications	2	3.61507	4.35444	9.30250	679.471	3.85468
Treatments	8	1.11298**	1.08333**	2.11943**	66.316**	2.74538**
Error	16	0.27387	0.14694	0.17550	17.293	0.15888

** Highly Significant

Table-3 Cane yield and yield components of different sugarcane genotypes in advanced varietal trial (plant crop) at NSTHRI, Thatta during 2011-12

Genotypes	Cane thickness (mm)	Cane height (cm)	Number of internodes plant^{-1}	Millable canes 000 ha^{-1}	Cane yield (t ha^{-1})
Thatta-903	23.74 cd	251.66 ab	24.88 abc	101.67 ab	78.33 bcd
Thatta-907	23.59 d	238.89 ab	23.10 c	95.00 ab	62.50 de
Thatta-910	26.98 a	266.33 a	25.66 abc	121.67 a	112.50 a
Thatta-911	23.41 d	223.88 abc	22.55 c	103.33 ab	68.33 cde
Thatta-912	23.86 bcd	259.67 a	27.21 ab	106.67 ab	83.33 bcd
Thatta-913	25.04 b	259.11 a	27.99 a	96.67 ab	90.00 bc
Thatta-914	24.81 bc	190.00 c	18.22 d	85.00 b	55.00 e
Thatta-920	23.36 d	203.22 bc	26.10 abc	88.33 b	53.33 e
Thatta-10	26.24 a	236.22 abc	23.95 bc	106.67 ab	100.00 ab
CV%	2.83	12.28	9.45	17.95	16.55
LSD 0.05	1.20	50.26	3.99	31.23	22.39
LSD 0.01	1.65	69.26	5.49	NS	30.84

Table-4 Quality parameters of different sugarcane genotypes in advanced varietal trial (plant crop) at NSTHRI, Thatta during 2011-12

Genotypes	Fiber%	Brix%	Pol%	Purity%	CCS%
Thatta-903	13.28 a	22.7 a	17.12 bc	75.41 bc	11.29 d
Thatta-907	13.33 a	21.4 cd	16.73 bc	78.17 ab	11.35 d
Thatta-910	12.19 b	22.5 ab	18.92 a	84.08 a	13.71 a
Thatta-911	13.20 a	21.8 cd	16.75 bc	76.83 bc	11.22 d
Thatta-912	13.36 a	22.6 ab	17.19 b	70.06 c	11.42 d
Thatta-913	12.40 b	21.3 d	17.20 b	80.75 a	12.11 c
Thatta-914	13.55 a	21.6 cd	16.42 c	70.01 c	10.90 d
Thatta-920	13.61 a	22.0 bc	16.60 bc	75.45 bc	10.94 d
Thatta-10	12.21 b	22.9 a	18.35 a	80.13 a	12.85 b
CV%	4.04	1.74	2.43	5.42	3.39
LSD 0.05	0.90	0.66	0.72	3.39	0.68
LSD 0.01	1.24	0.91	0.99	9.91	0.95

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