Bangladesh Agron. J. 2021, 24(2): 55-61

YIELD AND QUALITY OF SOME TROPICAL SUGARBEET GENOTYPES UNDER BANGLADESH CONDITIONS

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(**Received**: 17 August 2021, **Accepted**: 19 September 2021)

Keywords: Genotype, yield and quality, tropical sugarbeet

Abstract

The experiment was conducted at the experimental farm of Agronomy and Farming Systems Division, Bangladesh Sugarcrop Research Institute (BSRI), Ishurdi, Pabna, Bangladesh during 2012-13 cropping season to assess the comparative performance of yield and quality of six tropical sugarbeet genotypes viz., CS 0327, HI 0473, CS 0328, HI 0044, Shubhra and Cauvery. The different genotypes showed significant differences in their yield and yield components, such as beet length, beet girth, beet yield, shoot yield, sugar yield and harvest index. The quality parameters, such as total soluble solids or brix, sucrose percentage and apparent purity percentage of sugarbeet were also different among the genotypes. Maximum beet length (31.38 cm), beet girth (36.09 cm), beet yield (75.46 t ha^{-1}), shoot yield (38.46 t ha^{-1}) and sugar yield (11.82 t ha^{-1}) were found in Cauvery followed by CS 0328. In case of sugarbeet quality, the maximum total soluble solids (TSS) and sucrose percentage (21.90% and 15.68%, respectively) were recorded in Cauvery followed by the genotype CS 0328 (21.52% and 15.50%, respectively). So, it was concluded that tropical sugarbeet genotype Cauvery appeared as the best one with respect to yield and quality parameters followed by CS 0328 under Bangladesh conditions.

Introduction

Sugarbeet (*Beta vulgaris*) is one of the most important sugar crops of temperate climates (Abdel-Motagally and Attia, 2009). It ranks the second as sugar crop after sugarcane in the world. Sugarbeet is a fleshy root crop processed for sugar production. Sugarbeet is mainly a temperate crop but can be successfully grown under tropical climatic conditions. Sugarbeet growth, yield and quality are influenced by different variety, spacing, various agronomic practices, fertilizer management, date of sowing etc. Choosing the sugarbeet hybrid with high yield potential is important as well as good adapted agronomic measures and practices, synchronized with requirements and needs of the plant (Ulakovic *et al.*, 2015).

Variety plays an important role on the performance of tropical sugarbeet. All sugarbeet genotypes cultivated in Bangladesh are imported from foreign countries; so, it is preferable to evaluate them under Bangladesh conditions especially under newly reclaimed soil to select the best suited ones. Yield and yield parameters of sugarbeet differed significantly among the varieties /lines (Bairagi *et al.*, 2013). Lamani and Halikatti (2019) observed that the genotype Cauvery recorded significantly higher yield, yield attributes and quality parameters than genotype Indus. BRAC (2010) conducted field experiment with nine varieties/lines in Patuakhali and Noakhali, i.e. in the coastal area of Bangladesh. Among the nine sugarbeet varieties/lines Cauvery gave the highest beet yield (120 t ha^{-1}) and proved to be highly tolerant to salinity. Hossain *et al.* (2011) conducted an experiment in Bangladesh Agricultural University farm, Mymensingh with five sugarbeet varieties/lines, where EB-0809 gave the highest yield (89.74 t ha^{-1}) compared to other varieties. Sugarbeet is a new crop in Bangladesh and until now it has not been grown commercially in a large scale. Systematic research to improve the yield and quality of sugarbeet through best agronomic practices is also scare. Considering the above facts, the present study was carried out to evaluate yield, yield related parameters and quality of six selected tropical sugarbeet genotypes under Bangladesh conditions.

Materials and Methods

The experiment was conducted at BSRI farm, Ishurdi (AEZ-11) during rabi cropping season of 2012-13 following a Randomized Complete Block Design with three replications. Each plot size was 4.0 m × 4.0 m i.e. 16 m^2. The seeds were sown on 04 November 2012 at about 2 cm depth at a distance of 50 cm from line to line and 20 cm from plant to plant. Six tropical sugarbeet genotypes, viz. CS 0327, HI 0473, CS 0328, HI 0044, Shubhra and Cauvery were used as treatment materials. The land was uniformly fertilized with 260 kg urea, 100 kg triple super phosphate (TSP), 225 kg muriate of potash (MoP), 100 kg gypsum, 10 kg zinc sulphate and 7 kg boric acid ha^{-1} (BSRI, 2011). Three weedings were done at 30, 50 and 70 DAS for the study. Plants were thinned at the age of 35 days after sowing to obtain one plant per hill. Earthing-up was done to cover the root base and to facilitate drainage operation. The experimental field required 3 irrigations applied at 45, 90 and 125 DAS.

Data on yield and yield contributing components, viz. beet length, beet girth, beet yield, shoot yield, sugar yield, harvest index, total soluble solids or brix, sucrose percentage and apparent purity percentage were collected following standard methods. All data were statistically analyzed according to the technique of analysis of variance (ANOVA) by means of “STATISTIX-10” Computer software package for windows version (Statistix-10, 2013) and least significant difference (LSD) method was used to test the differences between treatment means at 5% level of probability.

Results and Discussion

Yield, yield contributing characters and quality in respect of beet length (cm), beet girth (cm), beet yield (t ha^{-1}), shoot yield (t ha^{-1}), sugar yield (t ha^{-1}), harvest index (HI), total soluble solids (TSS %) or brix (%), sucrose percentage (%) and apparent purity percentage (%) are presented and discussed here under:

Yield and Yield Components

Beet length and beet girth

Beet length and beet girth were significantly responded to different sugarbeet genotypes at harvest (Fig. 1 and Fig. 2). The maximum beet length and beet girth (31.38 cm and 36.09 cm) was obtained from the variety Cauvery which was statistically similar with CS 0328 (29.99 cm and 35.01 cm), respectively. The lowest beet length (27.80 cm) and beet girth (30.33 cm) was measured from HI 0044 and Shubhra, respectively. Enan *et al.* (2009), Hossain *et al.* (2011) and Bairagi *et al.* (2013) were also found genotypic differences in beet length and girth.

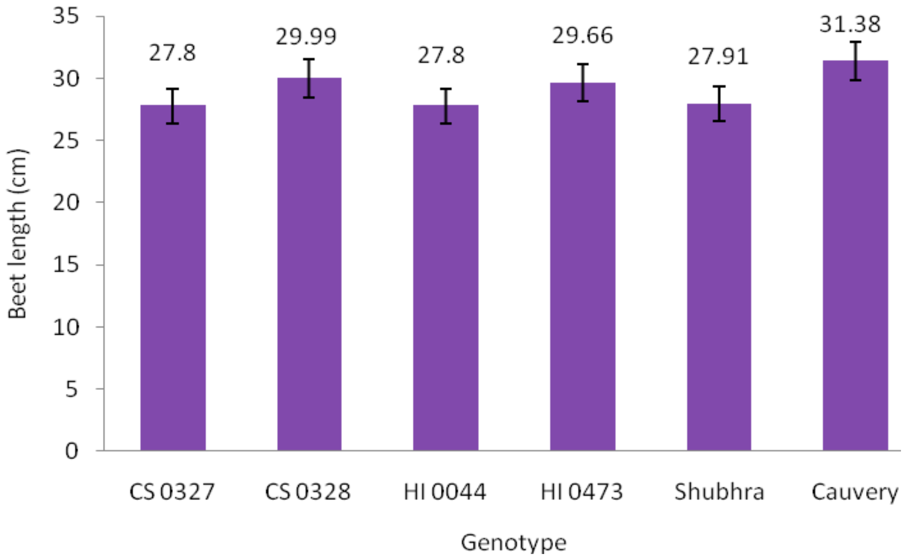

Fig. 1. Effect of genotypes on beet length of six tropical sugarbeet genotypes at harvest.

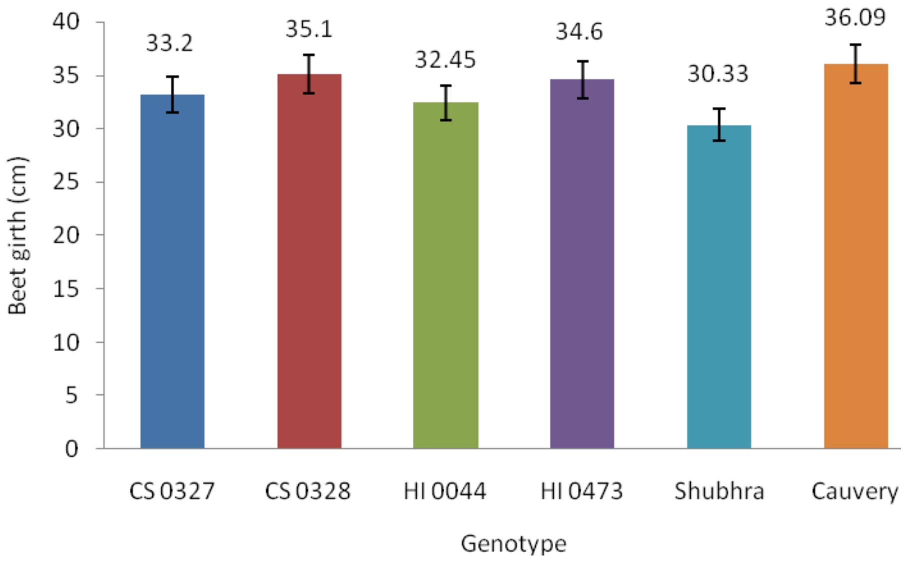

Fig. 2. Effect of genotypes on beet girth of six tropical sugarbeet genotypes at harvest.

Beet yield and shoot yield

Beet and shoot yield were significantly influenced by sugarbeet genotypes at harvest (Fig. 3 and 4). Among the genotypes, the maximum beet yield and shoot yield (75.46 t ha^{-1} and 38.46 t ha^{-1}, respectively) was recorded in Cauvery, which was statistically similar with CS 0328 (72.07 t ha^{-1} and 37.59 t ha^{-1}, respectively), while the lowest yield (57.57 t ha^{-1} and 25.25 t ha^{-1}, respectively) obtained from Shubhra. The highest beet yield and shoot yield were attributed to the higher number of leaves $plant^{-1}$, individual beet and shoot fresh weight $plant^{-1}$. These results agreed with the findings of BRAC (2010), Jozefyova (2004), Rahman (2011) and Badawi *et al.* (2003) that genotypic differences influenced the plant morphological characters.

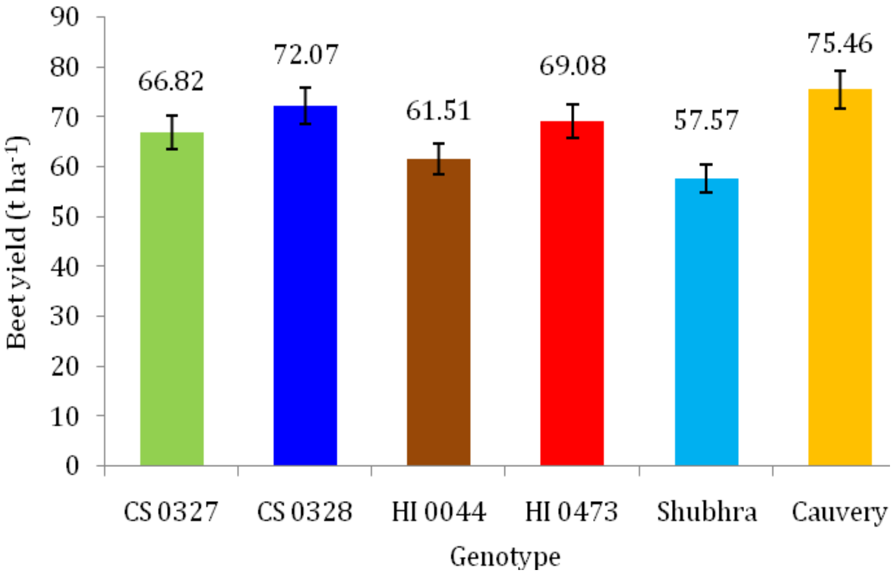

Fig. 3. Effect of genotypes on beet yield of six tropical sugarbeet genotypes at harvest.

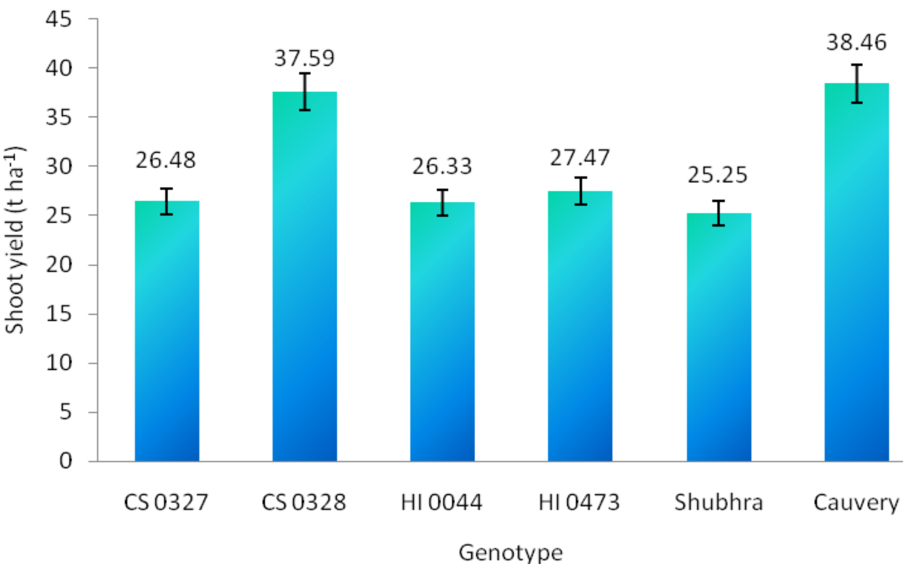

Fig. 4. Effect of genotypes on shoot yield of six tropical sugarbeet genotypes at harvest.

Sugar yield and harvest index (HI)

Sugar yield and harvest index were significantly influenced by tropical sugarbeet genotypes at harvest (Fig. 5 and 6). The maximum sugar yield (11.82 t ha^{-1}) was found in Cauvery followed by CS 0328 (11.17 t ha^{-1}) and genotype HI 0044 gave the lowest amount of sugar yield (8.58 t ha^{-1}). The highest value of harvest index was achieved in genotype CS 0327 (0.716), and the genotype CS 0328 gave the lowest (0.657). Sugar yield varied significantly due to significant difference in beet yield. The results reflected that genotype Cauvery and CS 0328 was the suitable genotype in terms of sugar yield. Similar findings were reported by Marlander and Rothe (2005), Azzazy *et al.* (2007) and Aly (2006) that there was a significant genotypic difference in producing sugar yield under tropical conditions.

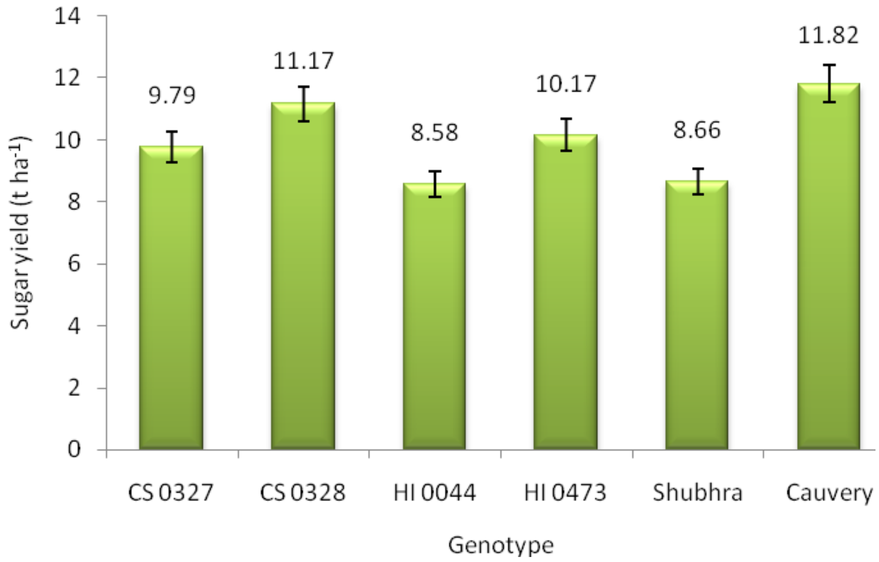

Fig. 5. Effect of genotypes on sugar yield of six tropical sugarbeet genotypes at harvest.

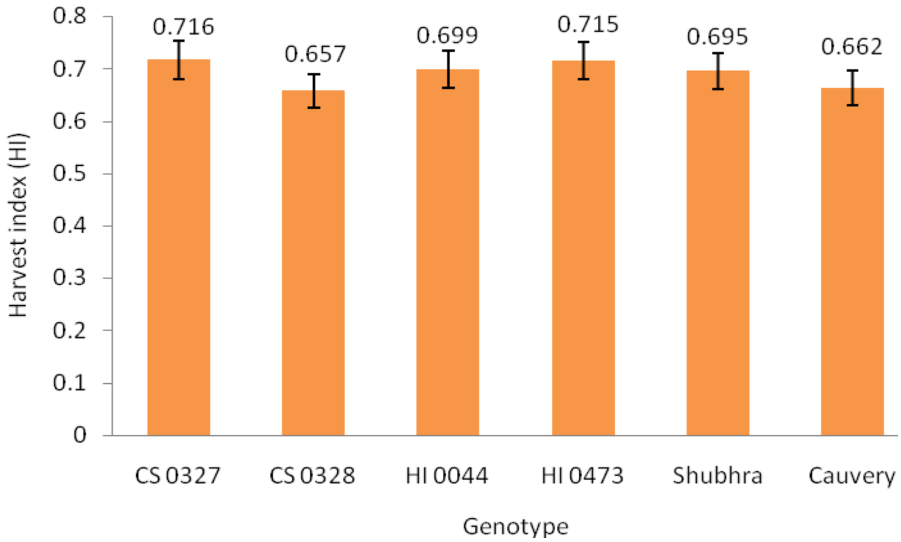

Fig. 6. Effect of genotypes on harvest index of six tropical sugarbeet genotypes at harvest.

Beet Quality Characters

Total soluble solids or Brix

Genotypes were significantly influenced the total soluble solids in juice of tropical sugarbeet root (Table 1). The maximum TSS (21.90 %) was recorded in Cauvery followed by CS 0328 (21.52 %) where the genotype HI 0044 gave the lowest TSS (19.79 %).

Sucrose percentage

Sucrose percentage in tropical sugarbeet was significantly influenced by the genotypes (Table 1). The results revealed that Cauvery had the maximum concentration of sucrose (15.68 %), which was statistically similar with CS 0328 (15.50 %). The lowest concentration (13.95 %) of sucrose was found in the genotype HI 0044. Superiority at TSS and sucrose % may be due to the genetic structure of this variety. This result was in agreement with the findings of Ntwanai and Tuwanai (2013), Osman *et al.* (2003), Islam *et al.* (2012) and Enan *et al.* (2009) also that sucrose content varied due to genotypic differences.

Table 1. Total soluble solids, sucrose percentage and apparent purity percentage of sugarbeet as affected by genotypes at harvest

Treatments (Variety)	**Beet quality characters**		
	Total soluble solids (TSS %) or Brix (%)	**Sucrose percentage (%)**	**Apparent purity percentage (%)**
CS 0327	20.41 c	14.65 c	71.79 a
CS 0328	21.52 a	15.50 a	72.04 a
HI 0044	19.79 d	13.95 d	70.50 b
HI 0473	20.65 bc	14.73 c	71.32 ab
Shubhra	21.04 b	15.03 b	71.41 ab
Cauvery	21.90 a	15.68 a	71.60 ab
CV (%)	1.28	1.05	1.15
$LSD_{(0.05)}$	0.40	0.24	1.23

In a column, figures with a similar letter do not differ significantly and those with dissimilar letter significant at 5% level.

Apparent purity percentage

Apparent purity percentage of tropical sugarbeet was significantly influenced by the different genotypes. The maximum apparent purity percentage (72.04 %) was obtained from CS 0328 followed by CS 0327 (71.79 %) and the lowest (70.50 %) purity percentage was appeared in genotype HI 0044.

Conclusion

It may be concluded that among the six genotypes, Cauvery showed the better performance in all aspect of yield and quality parameters of sugarbeet, except harvest index and apparent purity percentage followed by the genotype CS 0328 in all the studied charactyers. Hence, the sugarbeet genotypes Cauvery and CS 0328 could be selected for further evaluation under different field conditions before going for cultivation commercially in Bangladesh.

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