Varietal Effects on Growth Attributes of Tropical Sugarbeet

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ABSTRACT

The study was carried out during 2012-2013 cropping season at Bangladesh Sugarcrop Research Institute (BSRI) farm, Ishurdi, Pabna, to investigate the varietal influence on growth attributes of tropical sugarbeet . The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The tropical sugarbeet genotypes CS 0327, CS 0328, HI 0044, HI 0473, Shubhra and Cauvery were used as treatment. The effects of genotypes were statistically significant over the growth period. The highest germination percentage (96.75 %), number of leaves plant^{-1} (34.73), root length (32.93 cm), shoot length (48.31 cm), root fresh weight (692.48 g plant^{-1}), shoot fresh weight (489.11 g plant^{-1}), root dry weight (106.25 g plant^{-1}), shoot dry weight (42.05 g plant^{-1}) and the highest crop growth rate (2.52 g day^{-1}) were obtained from Cauvery which was statistically similar with CS 0328. Therefore, tropical sugarbeet variety Cauvery appeared as the best one followed by CS 0328 under Bangladesh condition in respect of seed germination and growth attrib utes.

Key words: Sugarbeet genotype, dry weight, crop growth rate, tropical sugarbeet

INTRODUCTION

Sugarbeet (*Beta vulgaris* L.) is the second important sugarcrop after sugarcane; produce about 30% of world production and have readily adaptable to different environmental factors. Sugarcane (*Saccharum officinarum* L.) is one of the major food-cum-industrial cash crops in Bangladesh. Sugarcane crop serves as a raw material for production of white sugar and jaggery. In addition, presently average cane yield in Bangladesh is around 40 to 46 t ha^{-1} with average recovery of sugar around 7.16% (BBS, 2008). Currently, all the sugar processed in Bangladesh comes from sugarcane. Sugar is essential for making meritorious nation. According to FAO (1982) recommendation the minimum per capita consumption of sugar should be 13.0 kg. The total requirement of sugar is 1.95 million tons based on 160 million populations of the country. The amount of sugar produced from sugarcane is not sufficient to meet the demand of our country. At present, total production of sugar including goor (jaggery) is only 0.47 million tons in Bangladesh, which covers 25% of total national demand (Patil and Patil, 2011). The main causes of lower sugar production include less supply of sugarcane in the factories and very poor sugar recovery. In Bangladesh, due to acute shortage of sugarcane as raw materials most of the sugar mills remain

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inoperative for longer period of time in every year. Sugarbeet is a temperate crop and its root contains high concentration of sucrose. Sugarbeet is grown nearly in 40 countries and accounts for up to 40 to 45% of the total world sugar production (Shah *et al*., 2000). Sugarbeet is a short duration crop (5-6 months) with high sucrose content (14-20%) compared to long durable sugarcane (12-14 months) with lower sucrose (10-12%) content (Syngenta, 2004). Sugarbeet has got many benefits compared to sugarcane due to short duration with high sucrose contents. In this regard sugarbeet might be an excellent alternative to sugarcane in Bangladesh by little modification of processing facilities in the existing sugar mills. Sugarbeet is mainly temperate crop, but for tropical region such as India, Pakistan, Bangladesh etc. Recently, some tropical sugarbeet varieties have been developed which can be grown in tropical and subtropical regions of the world. The international seed company "Syngenta" and "Sesvanderhave" successfully developed some sugarbeet genotypes that can be grown under tropical climatic conditions, therefore, that beet is known as "tropical sugarbeet". The role of variety on growth, yield and quality attributes in the production of all agricultural crops is very important. It is a known fact that cultivar yield depends on two groups of factors: a) variety and b) processing technology.

In Europe, many researchers have been involved in studies on growth performances (Burba and Harling, 2003) of sugarbeet as well as in quality management in sugarbeet cultivation (Burba and Jansen, 2000). Bairagi *et al.* (2013) observed that growth and yield parameters of sugarbeet differed significantly among the varieties/lines. 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. Due to the different genetic make-up varietal performance differs from each other. By considering the above facts, the research work was undertaken to find out the effect of varieties on growth pattern of tropical sugarbeet in Bangladesh.

MATERIALS AND METHODS

The present investigation was conducted at BSRI farm, Ishurdi, Pabna, Bangladesh during the cropping season of 2012-2013. The purpose was to identify the suitable tropical variety in respect of growth parameters with the treatments of T_1: CS 0327, T_2: CS 0328, T_3: HI 0044, T_4: HI 0473, T_5: Shubhra and T_6: Cauvery. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The experimental field was first opened with a disc plough on 15 October, 2012 and the land was made ready for laying out the experiment on 04 November, 2012. Six varieties/lines of sugarbeet seeds were sown 05 November, 2012 followed by line sowing method. The size of each plot was 4.0 mx4.0 m i.e. 16 m^2. The total number of plots in the experiment was 24. The adjacent replications were separated from one another by keeping 2m space and between two plots was 1.0 m while each plot was organized by plant to plant 20 cm with row to row 50 cm distance. 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} i.e. 120 kg N, 105 kg P_2O_5, 150 kg K_2O, 18 kg S, 3.5 kg Zn and 1.2 kg B ha^{-1} respectively as per BSRI recommendation (BSRI, 2011). Whole amount of TSP, gypsum, $ZnSO_4$ and Boric acid were applied at the time of final land preparation. In case of Urea and MoP fertilizers, respectively were applied in three times that was one basal and two equal doses in side dressing, one was 35 days after sowing and the other was 70 DAS. The cultural operations such as gap filling, irrigation, weeding, insect control through hand picking, pheromone trap and insecticide spraying etc. were done as and when necessary. Five samples were taken during the growth period (30, 60, 90, 120 and 150 days after sowing), i.e. five plants were chosen at random from each plot. Each sample was separated into roots and shoots, then the roots and shoots were cut to small pieces. In case of root and shoot dry weight, all root and shoot fractions were air-dried, and then oven dried at 70^0 C till constant weight obtained which was converted to g $plant^{-1}$. The crop growth rate (CGR) was determined according to Radford`s (1967), where: W_1 and W_2 refer to dry weight of plant at sampling time T_1 and T_2, respectively and which was expressed as g day^{-1}.

$$\text{CGR} = \frac{W_2 - W_1}{T_2 - T_1}$$

Necessary data were collected and statistically analyzed by Statistix 10 and treatment means were compared using the least significant difference (LSD) method to examine the treatment effects on sugarbeet.

RESULTS AND DISCUSSION

Germination percentage (%)

Variety showed a significant response to germination percentage (Figure 1). The result indicated that the variety Cauvery represents the highest germination percentage (96.75%) which was statistically similar with CS 0328 (94.00%) and Shubhra (90.75%), while the lowest was found from the variety HI 0044 (86.75%) and it was statistically similar with the variety CS 0327 (89.25%). Ahmad & Rasool (2011) revealed that sugarbeet varieties performed differently with respect of germination.

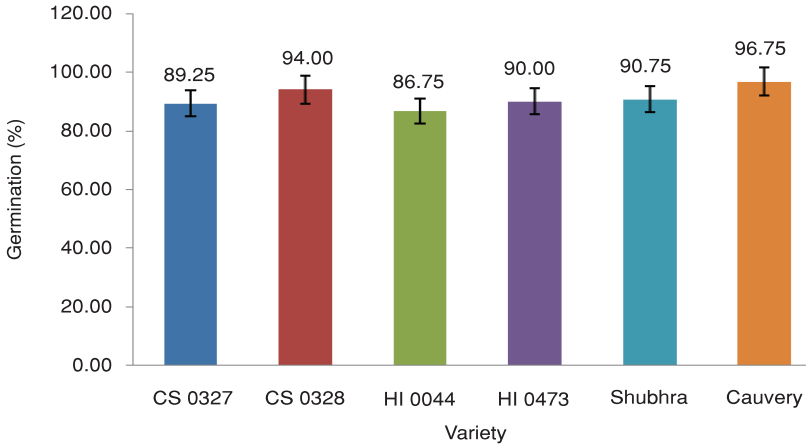

Figure 1. Effect of variety on germination percentage (%) of tropical sugarbeet at 15 DAS. Vertical bar indicates LSD at 0.05.

Number of leaves plant^{-1}

Number of leaves plant^{-1} of tropical sugarbeet at different DAS was significantly influenced by different varieties (Figure 2). From 30 to 120 DAS number of leaf increased rapidly but it decreased at 150 DAS. Number of leaf showed statistically similar trend up to 120 DAS, but differed at 150 DAS among the varieties. Throughout the growing period, the variety Cauvery produced the highest number of leaves plant^{-1} (34.73) at 120 DAS followed by CS 0328 (31.80) which were similar. Shubhra produced the lowest (24.75) number of leaves followed by rest of the varieties at 120 DAS. The findings agree to Bairagi *et al.* (2013) as they observed that growth attributes of tropical sugarbeet differed significantly among the varieties/lines.

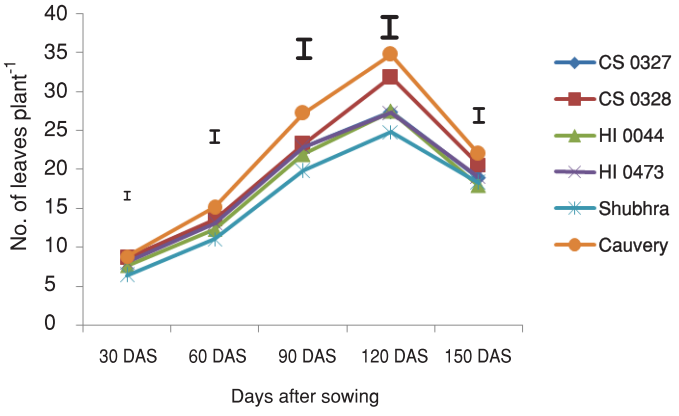

Figure 2. Effect of variety on number of leaves plant^{-1} over the growth period. Vertical bar indicates LSD at 0.05

Root length (cm)

A significant effect of varieties on root length was observed in the study at different DAS (Figure 3). The variety Cauvery showed significant increases in root length than other varieties and produced the maximum ones (32.93 cm) at 150 DAS followed by the variety CS 0328 (31.44 cm) and HI 0473 (30.03 cm) which were statistically similar. On the other hand, the lowest root length (28.14 cm) was recorded in the variety Shubhra which was similar to that of HI 0044 (28.50 cm) and CS 0327 (29.11 cm). This result corroborate the findings of Enan *et al.* (2009) who found the difference in root length differed among the varieties. The variation in root length as assessed might be due to varietal characters of tropical sugarbeet.

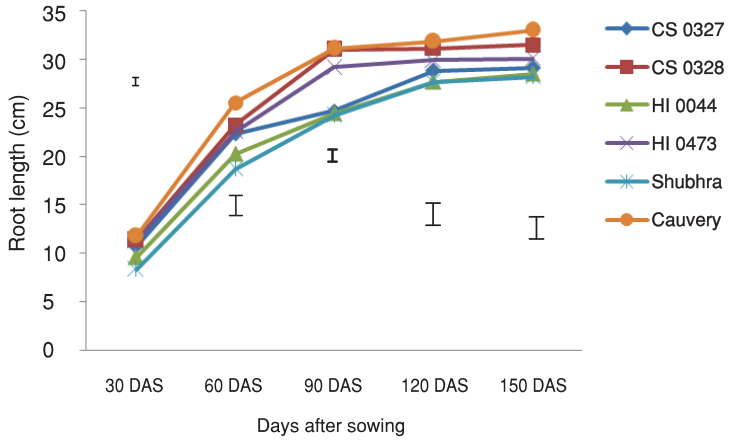

Figure 3. Effect of variety on root length plant^{-1} (cm) over the growth period. Vertical bar indicates LSD at 0.05

Shoot length (cm)

Shoot length exhibited significant differences among different varieties over the growth period (Figure 4). Shoot length increased rapidly up to 120 DAS, but declined at 150 DAS. The results indicated that the longest shoot was produced by the variety Cauvery (48.31 cm) followed by the variety CS 0328 and HI 0473 producing shoot length of 46.72 and 44.69 cm, respectively at 120 DAS. On the other hand, the lowest shoot length (38.35 cm) came out from the variety Shubhra at 120 DAS. Similar findings were reported by Shalaby *et al.* (2011) who stated that variety causes significant increase in shoot length more over the growth period.

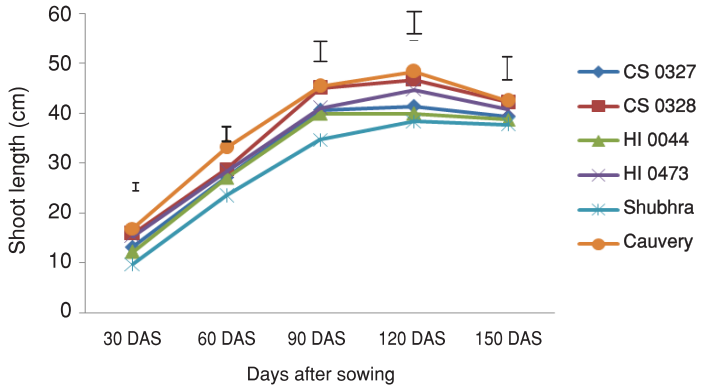

Figure 4. Effect of variety on shoot length plant^{-1} (cm) over the growth period. Vertical bar indicates LSD at 0.05

Root fresh weight (g plant^{-1})

Results revealed that the root fresh weight per plant was significantly influenced by variety (Figure 5). Among the varieties, root fresh weight plant^{-1} gradually increased from 30 DAS to 150 DAS. The highest root fresh weight (692.48 g plant^{-1}) at 150 DAS was obtained from Cauvery and the lowest root fresh weight (486.92 g plant^{-1}) was recorded in sugarbeet variety Shubhra followed by HI 0044 (487.92 g plant^{-1}). Azzazy *et al.* (2007) reported that the examined sugarbeet varieties varied significantly for root fresh weight plant^{-1}. Similar findings were reported by Enan *et al.*(2009). Moreover this result is in agreement with the findings of El-Sheikh *et al.* (2009) and Al-Gateem (2000) who stated that the root fresh weight plant^{-1} were influenced by the varieties due to their genetic in characteristics.

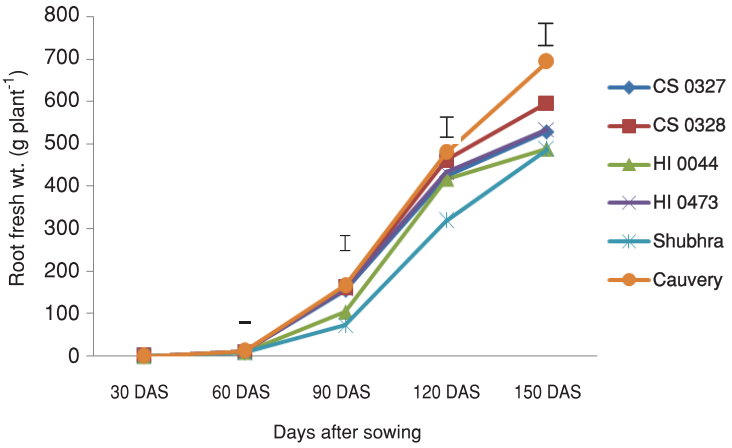

Figure 5. Effect of variety on root fresh weight (g plant^{-1}) over the growth period. Vertical bar indicates LSD at 0.05

Shoot fresh weight (g plant^{-1})

Shoot fresh weight plant^{-1} was significantly influenced by variety over the growth period (Figure 6). The results showed that shoot fresh weight plant^{-1} increased up to 120 DAS, but decreased at 150 DAS in all the varieties. The results also revealed that the highest shoot fresh weight (489.11 g plant^{-1}) was found in Cauvery at 120 DAS whereas the lowest shoot fresh weight (280.80 g plant^{-1}) was obtained from Shubhra. Shalaby *et al.* (2011), Refay (2010), Azzazy *et al.* (2007) and Enan *et al.* (2009) reported that sugarbeet varieties gave significant increase for shoot fresh weight (g plant^{-1}).

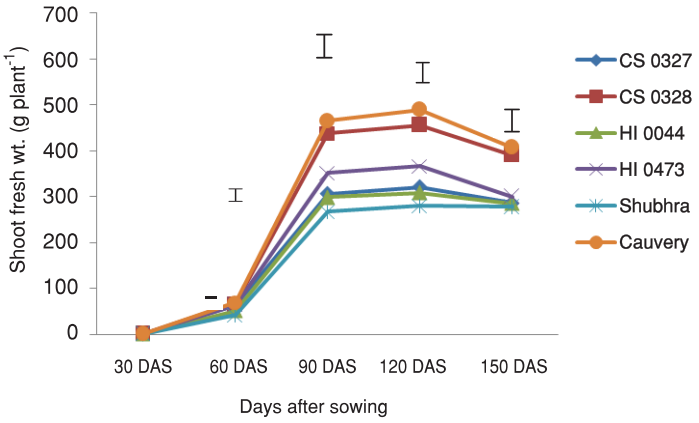

Figure 6. Effect of variety on shoot fresh weight (g plant^{-1}) over the growth period. Vertical bar indicates LSD at 0.05

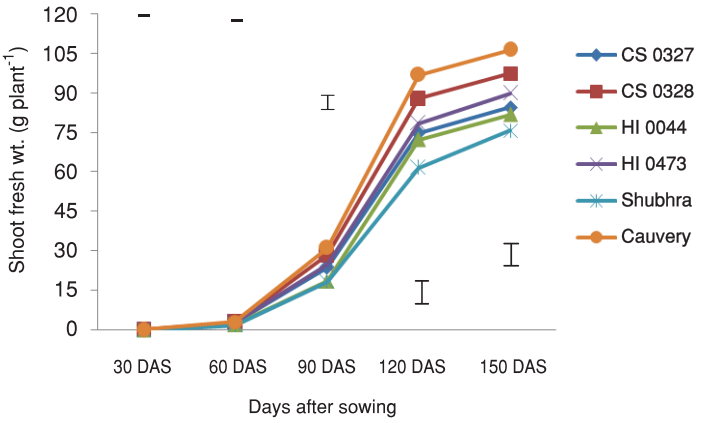

Figure 7. Effect of variety on root dry weight (g plant^{-1}) over the growth period. Vertical bar indicates LSD at 0.05

Root dry weight (g plant^{-1})

Variety exhibited significant effect on root dry weight per plant at 30 to 150 days after sowing (Figure 7). During the first few weeks of growth period the rate of root dry matter accumulation was very slow, and from 60 DAS turned more rapidly till 150 DAS. The maximum root dry weight (106.25 g plant^{-1}) was appeared in Cauvery at 150 DAS while, the lowest (75.68 g plant^{-1}) was obtained from Shubhra. This result is in agreement with the findings of Fallahpour *et al.* (2013). It might be occurred due to increased photosynthesis resulted by the highest number of leaf and thereby increased root dry weight production.

Shoot dry weight (g plant^{-1})

The varieties showed significant difference from 30 to 150 DAS in shoot dry weight accumulation (Figure 8). Dry weight accumulation into shoot increased up to 120 DAS and thereafter it declined at 150 DAS in all the varieties. The rate of accumulation of shoot dry weight was very fast till 90 DAS and thereafter it dropped at 150 DAS. Among the varieties, Cauvery produced the highest shoot dry weight (42.05 g plant^{-1}) while the variety Shubhra produced the lowest shoot dry weight (24.95 g plant^{-1}) at 120 DAS. Declining in the shoot dry weight accumulation at later growth stage might be supported by translocation of assimilates toward the root and shading of older leaves. Similar trend was found in sugarbeet by Follet *et al.* (1970).

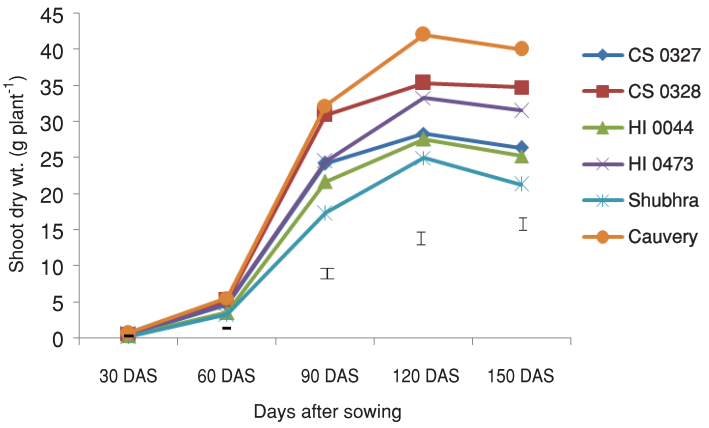

Figure 8. Effect of variety on shoot dry weight (g plant^{-1}) over the growth period. Vertical bar indicates LSD at 0.05.

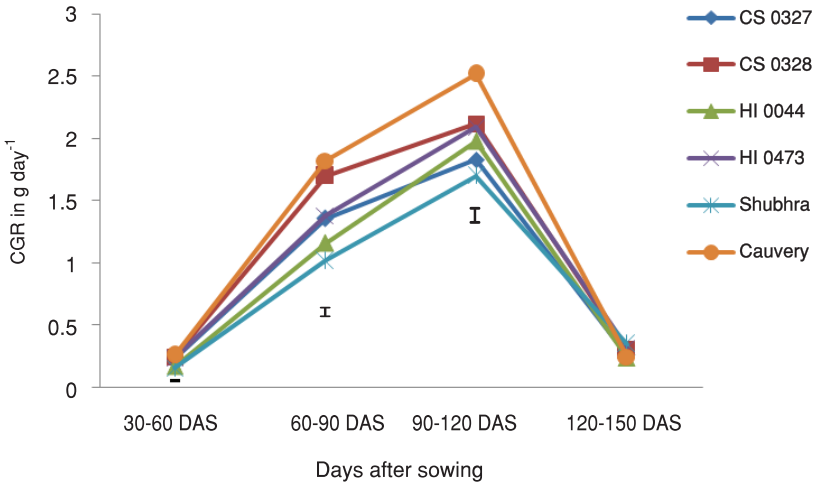

Figure 9. Effect of variety on crop growth rate (g day^{-1}) over the growth period. Vertical bar indicates LSD at 0.05.

Crop growth rate (CGR) in g day^{-1}

Crop growth rate (CGR) was significantly affected by the varieties in the first three growth phases except 120-150 DAS which was not significant (Figure 9). CGR was increased rapidly from 30 to 90 DAS which reached to the peak at 120 DAS and suddenly decreased up to 150 DAS in respect of all varieties. Among the six variety Cauvery showed the highest CGR (2.52 g day^{-1}) in the growth phases of 90-120 DAS while, the lowest one (1.70 g day^{-1}) was found from Shubhra followed by CS 0327 (1.83 g day^{-1}) which was statistically similar. Hossain (1999) and Shanthi *et al.* (1988) reported that the crop growth rate decreased when the plant got matured because of cessation of vegetative growth and senescence of leaves in peanut and groundnut, respectively.

From the results of the present study it may be concluded that the tropical sugarbeet variety Cauvery represents the highest value in all aspects of vegetative growth which followed by the variety of CS 0328. Therefore, for optimum growth, tropical sugarbeet variety Cauvery appeared as the best one followed by CS 0328 under Bangladesh condition.

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