YIELD AND QUALITY PARAMETERS OF SUGAR BEET (*BETA VULGARIS* L.) GROWN UNDER AGRO-CLIMATIC CONDITIONS OF THATTA

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ABSTRACT

Yield and quality performance of seven exotic sugarbeet varieties was investigated under agro-climatic conditions of Thatta, Sindh during 2020-21. Experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications in separate plots at experimental farm of PARC-National Sugar and Tropical Horticulture Research Institute (NSTHRI), Thatta. The data on different yield, and quality parameters was obtained at the time of harvesting. The highest mean beet yield of 78.67 and 76.0 t ha^{-1} was obtained from sugarbeet varieties SB-20030 and SB-20025, respectively. The highest mean sugar recovery of 12.73% 12.48, 12.39 and 12.14% was recorded from SB-20012, SB-20025, SB-20030 and SB-20017, respectively. Hence, on account of beet yield and quality performance sugarbeet varieties SB-20025 and SB-20030 were found promising.

Key words: Sugarbeet, varieties, yield, quality, Thatta, Sindh

INTRODUCTION

Sugarbeet (*Beta vulgaris* L.) belongs to *Chenopodiaceae* family has been regarded as an important sugar crop in the world (Alice *et al.* 2019). It occupies second important position as a sugar crop after sugarcane (Iqbal and Saleem 2015); contributing annually about one-fifth of total sugar production worldwide (Singh and Sidana, 2018) and is found highly adjustable to diverse environmental factors including climate (El-Hag *et al.* 2015). Sugarbeet being a a short period crop, takes growth phase of about half of sugarcane. Thereby, its productivity per unit time has been observed relatively higher than sugarcane. In addition, its water requirement is also fairly less as compared to sugarcane (Brar *et al.* 2015). Sugarbeet needs about 1.4 m^3 of water for the production of one kilogram of sugar, at the same time as, for the production of equal amount of sugar from sugarcane around 4.0 m^3 of water will be required (Sohier and Ouda, 2001). Most of the sugarbeet is grown for commercial sugar production, but its by products like sugarbeet pulp and molasses are of great use for feeding animals (Singh *et al.* 2013). Beet molasses for possessing the vast chemical value is being well thought-out as a priced item with great prospective for export (Brar *et al.,* 2015). In recent times, the breeding improvement have made about half of the enhancement in yield and quality of sugarbeet (Ho_mann and Loel, 2015) and increased capability of beet cultivars to successfully withstand under specific environmental conditions (Studnicki *et al.* 2019) but it on the whole is highly dependent on the soil type and location or on the both as well as on the accessibility of water during the time of high requirement of the plants (Podlaski *et al.* 2017). Expanding sugarbeet cultivated area and sugar production per unit area are thought to be the vital national objective to reduce the gap between sugar production and utilization. The

significance of this crop is not only specified from its capability to thrive well in varying type of soils (saline, alkaline and calcareous soils) but also sugarbeet plants could profitably be grown in the recently reclaimed soils without competition with other conventional winter crops on account of its tolerance to salinity and ability/ to exhibit high root production and sugar yields under stressed environmental condition and its relatively low water utilization than sugarcane (Gobarah *et al.* 2019). Different agricultural scientists in Sindh (Memon *et al.* 2004 ;Tunio *et al.* 2004; Oad *et al.* 2007; Kaloi *et al.* 2014; Mari *et al.* 2017 and Kaloi *et al.* 2020) in their studies have reported that sugarbeet is found highly adoptable for cultivation in areas of lower Sindh in Pakistan (Kaloi *et al.* 2020). The growers in recent times have come across with many concerns and problems during sugarcane cultivation. In the prevailing scenario, the potential production feasibilities related to sugarbeet production specify a well-thought-out outlook for its cultivation as economically feasible and possible sugar crop for crop diversification in the sugarcane cultivated regions (Lamani and Halikatti, 2019). Sugarbeet yield and quality is affected by several environmental and agronomic factors. Thus, in order to exploit greater economic gains from sugarbeet, it is mandatory to select the most suitable varieties adoptable to agro-climatic conditions of Thatta, Pakistan. Therefore, the present study was conducted at Pakistan Agricultural Research Council (PARC)-National Sugar and Tropical Horticulture Research Institute, Thatta, Pakistan.

MATERIALS AND METHOD

In order to evaluate the yield and quality performance of seven exotic sugarbeet varieties the experiment was carried out at experimental farm of Pakistan Agricultural Research Council (PARC)-National Sugar and Tropical Horticulture Research Institute (NSTHRI), Thatta (24.70o N and 67.91o E), during 2020-2021. Sugarbeet varieties SB-20009, SB-20010, SB-20012, SB-20017, SB-20018, SB-20025 and SB-20030 were planted in separate plots under Randomized Complete Block Design (RCBD) with three replications. Each treatment plot had six meters long four rows at three meter space with 18 cm plant space. Three seeds were sown in each hole on both sides of rides and finally plant population was maintained by thinning. The fertilizer application was made @ 120, 100 kg NP ha^{-1} in the form of Urea and DAP. Thinning and gap filling was done at 3-4 leaf stage. Total 5 irrigations were applied as per crop water requirement. Germination was recorded after 30 days of sowing, while beet yield, sugar recovery and sugar yield on harvesting during mid of April 2021. Ten beets were randomly selected from whole plot for the record of yield parameters. Yield was recorded by weighing total beets of the whole plot. The sugar recovery was measured through randomly collected five beets per plot. The beets were washed with distilled water, cut into small pieces and crushed with Fiberator machine (Model: NOSCF-L4). Total 26 g of crushed beets were obtained and 175 ml of distilled water was added for obtaining juice through juicer machine. The collected juice was filtered with filter paper and used for the record of pol (sucrose) by using digital Polarimeter. The sugar recovery was worked out by using formula: Sugar recovery% = (Pol% in beet) – 0.5 (Brix% in beet - Pol% in beet) as given by Asdi (2007). The statistical values/results were analyzed was done by using software program Statistix 8.1 (Analytical Software 2005). The means were separated by significant Difference (LSD) (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Exotic sugarbeet varieties were investigated under agro-climatic conditions of Thatta, Sindh for yield and quality parameters. The mean squares values of statistical analysis in Table 1 and 2 indicated that the effect variety was non-significant (P<0.05) for number of leaves per beet and highly significant for beet length, beet girth and yield. In case of quality parameters, effect of variety was significant (P<0.05) for brix% and pol%, while highly

significant for purity % and sugar recovery%. The mean data of beet yield and yield parameters of different exotic sugarbeet varieties is depicted in Table 3, which indicated that sugarbeet variety SB-20030 produced maximum mean number of leaves per beet (30.0) followed by SB-20010 and SB-20025 with 29.11 and 27.89 leaves per beet, respectively. In contrast, statistically a smaller number of leaves per beet (21.77) were produced by sugarbeet variety SB-20009. As regards the beet length, the variety SB-20030 exhibited significantly maximum mean beet length of 37.00 cm followed by SB-20025, SB-20017 and SB-20018 which differed significantly with mean beet length of 35.22, 30.0 and 28.22 cm, respectively. In case of beet girth, sugarbeet varieties SB-20030 and SB-20025 remained on top with statistically highest mean beet girth of 128.11 and 117.22 mm, respectively. While, beet varieties SB-20012 and SB-20009 remained statistically at par with minimum mean beet girth of 73.89 and 82.44 mm, respectively. In terms of beet yield, the varieties SB-20030 and SB-20025 maintained their superiority by producing statistically maximum mean beet yield of 78.67 and 76.0 t ha^{-1}, respectively. However, the beet variety SB-20009 produced statistically lowest mean beet yield of 55.0 t ha^{-1}(Table 3). The results are in agreement with the findings of Memon *et al,* (2004), Tunio, *et al,* (2004), Oad *et al*, (2007), Mari *et al*, (2017) and Kaloi *et al,* (2020) who found significant variation in yield and yield parameters of different sugarbeet varieties under agro-climatic conditions of Thatta and other locations of lower Sindh.

The data regarding quality performance of different sugarbeet varieties is given in Table 4, which indicated that sugarbeet variety SB-20012 had significantly highest mean brix of 20.32%, followed by SB-20025, SB-20017 and SB-20030 which remained statistically at par by giving mean brix of 20.11, 20.08 and 20.03%, respectively. In case of pol%, sugarbeet varieties SB-20012, SB-20025, SB-20030 and SB-20017 remained best over other varieties with mean pol of 15.48, 15.23, 15.14 and 14.89%, respectively and remained statistically at par. The data with respect to purity in Table 4 further indicated that significantly higher purity (76.18%) was obtained from SB-20012 followed by SB-20025 and SB-20030 with statistically at par purity of 75.73 and 75.58%, respectively. The lowest purity (67.77%) was noted in SB-20009. The sugarbeet variety SB-20012 was found superior by producing significantly maximum mean sugar recovery of 12.73% followed by SB-20025, SB-20030 and SB-20017 with mean sugar recovery of 12.48, 12.39 and 12.14%, respectively. The sugar beet varieties tested by Memon *et al,* (2004), Tunio, *et al,* (2004), Oad *et al*, (2007), Mari *et al*, (2017) and Kaloi *et al,* (2020) at Thatta and different other locations of southern zone of Sindh showed significant variation in different quality parameters (brix, pol, purity and sugar recovery).

CONCLUSION

After evaluation under field conditions sugarbeet varieties SB-20025, SB-20030 were appeared to be promising on account of their better performance in terms of beet yield and quality parameters. However, this one year data is not sufficient to work out the substantial conclusion, therefore, the said exotic sugarbeet varieties are needed to be tested for more years under agro-climatic conditions of Thatta, Sindh for their proper adoptability investigation.

Table-1 Mean squares of beet yield and yield parameters of different sugarbeet varieties at PARC-NSTHRI, farm during 2020-21.

Source	Df	No. of leaves/beet	Length (cm)	Grith (mm)	Beet yield (t/ha)
Replication	2	22.35	22.35	14.24	20.905
Variety	6	89.30 NS	89.30 **	1060.91 **	267.783**
Error	12	11.67	11.67	351.31	33.683

Table-2 Mean squares of quality parameters of different sugarbeet varieties at PARC-NSTHRI, farm during 2020-21.

Source	Df	Brix%	Pol%	Purity%	Sugar Recovery%
Replication	2	0.38290	0.29691	7.4951	0.29691
Variety	6	0.29109 *	2.80154 **	43.4847 *	2.80154 **
Error	12	0.06110	0.42270	10.4043	0.42270

Table-3 Mean data of beet yield and yield parameters of different sugarbeet varieties at PARC-NSTHRI, farm during 2020-21.

Variety	No. of leaves beet^{-1}	Beet length (cm)	Beet girth (mm)	Beet yield (t ha^{-1})
SB-20009	21.77	23.56 d	82.44 c	55.00 d
SB-20010	29.11	24.11 cd	94.67 bc	66.00 bc
SB-20012	25.22	24.44 cd	73.89 c	57.33 cd
SB-20017	24.77	30.00 bc	95.22 abc	61.00 cd
SB-20018	24.99	28.22 cd	96.00 abc	57.67 cd
SB-20025	27.89	35.22 ab	117.22ab	76.00 ab
SB-20030	30.00	37.00 a	128.11 a	78.67 a
SE	4.79	2.78	15.10	4.73
CV%	22.39	11.81	19.08	8.99
LSD 0.05%	10.45	6.07	33.34	10.32

Table-4 Mean data of quality parameters of different sugarbeet varieties at PARC-NSTHRI, farm during 2020-21.

Varieties	Brix%	Pol%	Purity%	Sugar Recovery%
SB-20009	19.49 c	13.21 b	67.77 c	10.46 b
SB-20010	19.52 c	13.37 b	68.49 bc	10.62 b
SB-20012	20.32 a	15.48 a	76.18 a	12.73 a
SB-20017	20.08 ab	14.89 a	74.15 ab	12.14 a
SB-20018	19.86 bc	13.7 b	68.98 bc	10.95 b
SB-20025	20.11 ab	15.23 a	75.73 a	12.48 a
SB-20030	20.03 ab	15.14 a	75.58 a	12.39 a
CV%	1.24	5.51	4.45	5.57
SE	0.20	0.53	2.63	0.53
LSD 0.05	0.43	1.15	5.73	1.15

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