ISSN 0258-7122
Bangladesh J. Agril. Res. 37(4): 721-728, December 2012

EVALUATION OF TROPICAL SUGARBEET *(Beta vulgaris L).* GENOTYPES UNDER BANGLADESH CONDITION

M. S. ISLAM[1], S. AHMAD[2], M. N. UDDIN[3] AND M. A. SATTAR[4]

Abstract

An investigation was undertaken to study the feasibility of sugarbeet cultivation under Bangladesh condition during winter season of 2009-2010. Seeds of 14 sugarbeet genotypes were sown in the experimental field of Horticulture Research Centre of BARI, Gazipur on 10 November 2009. Visible root swelling in all genotypes started between 36 and 40 days after sowing (DAS). Nine genotypes had white root colour while rest were red purple. Plant height varied from 26.8 cm to 55.0 cm at 165 DAS. Similarly, whole plant weight among the genotypes ranged from 0.76 kg to 1.60 kg. Mean root yield in all genotypes was 66.22 t/ha when harvested at 165 DAS, which was decreased to 56.29 t/ha at 180 DAS. However, the highest root yield was recorded from the genotypes SB001 (85.30 t/ha) closely followed by SB006 (84.40 t/ha) at 165 DAS. All the genotypes showed lower yield potential at 180 DAS compared to 165 DAS. Severe leaf shedding and drying up of the root in the later stage might be the reason for yield reduction. Nine genotypes had more than 10% sucrose and can be considered for sugar producing genotypes. Five genotypes had very less sucrose content in the root and can be useful for vegetable purpose. The genotypes SB001 and SB006 had comparatively high amount of sucrose (13.0%) in the root. The fungal disease *Sclerotium* root rot and the insect *Spodoptera litura* were found the most limiting factor for sugarbeet cultivation.

Keywords: Sugarbeet, root, sucrose, *Beta vulgaris.*

Introduction

Sugarbeet (*Beta vulgaris* L.), a member of Chenopodiaceae family, is a plant whose root contains a high concentration of sucrose. It is grown commercially for sugar production mostly in temperate countries (Rashid, 1999). The European Union, the United States, and Russia are the world three largest sugarbeet producers in the world. This crop is also a promising alternative energy crop for the production of ethanol (BSRI, 2005). Recently, some tropical sugarbeet varieties have been developed which can be grown in tropical as well as subtropical region of the world. In Bangladesh, sugarbeet is a new crop and few farmers are growing in limited areas for vegetable purpose (Rashid, 1999). Production of sugarbeet has got many benefits compared to sugarcane production. It is short duration crop (5-6 months) with high sucrose contents (14-

[1]Associate Professor, Sylhet Agricultural University (SAU), [2]Chief Scientific Officer, [3]Scientific Officer and [4]Senior Scientific Officer, Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh.

20%) while sugarcane is a long duration crop (12-14 months) with low sucrose (10-12%) contents (Anon., 2004). Since sugarcane is long duration crop thus farmers are moving to grow short duration crop for higher profit. Therefore, in Bangladesh most of the sugar mills remain idle for a particular period due to acute shortage of sugarcane availability. In this regard, sugarbeet might be an excellent alternative of sugarcane if processing facilities are developed in the sugar mills. Before that, feasibility study for sugarbeet cultivation in Bangladesh need to be assessed properly and in this regard, no systematic research work has so far been done in Bangladesh. Therefore, the present study was undertaken with a view to evaluating some tropical sugarbeet genotypes under Bangladesh condition.

Materials and Method

The experiment was conducted at the experimental field of Olericulture Division of Horticulture Research Centre, BARI, Gazipur, during November 2009 to May 2010. Fourteen tropical genotypes viz., SB001, SB002, SB003, SB004, SB005, SB006, SB007, SB008, SB009, SB010, SB011, SB014, SB015, and SB016 of which nine were collected from Syngenta (India) and five were from ICARDA, Syria for the purpose of the present study. Soil of the experimental field was analyzed to know the initial status of the soil (Table 1). For Sugarbeet cultivation, the optimum soil pH level is 6.5 to 8.5. Since the pH of the experimental field was 5.4, therefore, dolomite was applied @ 1500 kg/ha (Rahman *et al*., 2007) to raise the soil pH. Therefore, the final pH of the soil was 6.6. The experiment was laid out in RCB design with four replications. Seeds were sown in 10 November 2009 in raised beds. Unit bed size was 5.0 m x 1.0 m and considered as a replication. Each replication consisted of 50 plants in which plant to plant and row to row distance were 50 and 20 cm, respectively. Two to three seeds were sown per pit. After completion of germination, only one plant was kept to grow. The crop was fertilized with cowdung, urea, TSP, MP, $ZnSO_4$ @ 10 t, 250 kg, 220 kg, 250 kg, and 10 kg per hectare, respectively. Entire amount of cattle dung, TSP, MP, and $ZnSO_4$ were applied at the time of land preparation. Urea was applied as top-dressed in two equal installments at 45 and 75 day after sowing (Anon., 2005). Weeding, irrigation and other intercultural operations were done regularly. To control jute hairy caterpillar, soon after infestation, the larvae were destructed by hand. To control *Spodoptera litura* (a Lepidopterous insect), an integrated approach was rendered. Tracer (0.1%) was sprayed twice at 7 days interval. Pheromone trap (Spodoptera pheromone) was also placed in the field to trap male insect. Predator insect (*Bracon hebetor*) was also released in the field to control *Spodoptera litura*. Ten plants were randomly harvested from each replication at 165 (five and half months) and 180 (six months) days after sowing to determine yield and yield attributes. Sucrose determination was made at Physiology and Sugar Chemistry Division of Bangladesh Sugarcane Research

Institute using Polarimeter (Model:Atago AP-300). Generated data were compiled and analyzed properly for interpretation of the results.

Table 1. Analytical data of soil sample.

Sample no.	pH	O.M.	K	Total N	P	S	B	Cu	Fe	Mn	Zn
		(%)	Meq/100ml	(%)	μg/ml						
1	5.4	1.85	0.18	0.098	45	13.1	0.38	3.2	135	6.1	5.5
Critical level			0.2		14	14	0.2	1	10	5	2

Results and Discussion

Some physio-morphological characteristics of sugarbeet genotypes are given in Table 2. Most of the genotypes had light to deep purple colour hypocotyls. Nine genotypes had green colour leaf, while five were purple in colour. Considering vein colour, genotypes can be grouped into two categories, green colour and deep purple colour. Root colour varied only white or red purple, of which nine genotypes had white, while the rest were red purple in colour. Visible root swelling in all genotypes was started from 36 to 40 days after sowing at which number of leaves varied from 6.5 to 8.0. However, it was reported that storage root development begins slowly at the age of two months, picks up speed at three months in temperate region (Anon., 2010). The genotypes differed among themselves in respect of number of leaves per plant. At 90 days after sowing, the genotype SB007 produced the maximum number of leaves per plant (31.0), while it was the minimum for the genotype SB011 (12.3).

Plant height, whole plant weight, root length, root girth, and plant survivability at 165 days after sowing (five and half months) are presented in Table 3. Plant height varied from 26.80 cm to 55.0 cm. Whole plant weight for the genotype SB001 was the highest (1.6 kg), which was very close to SB005 (1.45 kg). The genotype SB010 had the lowest whole plant weight (0.76 kg). Root length and root girth varied among the genotypes. The highest root length was recorded from the genotype SB008 (16.0 cm) while SB001 produced root having the highest root girth (12.9 cm). The average plant survivability was 89.43% indicating that more than 10 % plant died in the plot due to diseases and pest infestation. The genotype SB006 had the highest plant survivability (96%) in the field while SB002 was the lowest (84.0%).

A comparative performance of five and half months (165 DAS) and six months (180 DAS) aged crop was presented in Table 4. Results clearly indicated that individual root weights of all genotypes were decreased at 180 DAS than that of 165 DAS. The genotype SB001 produced the heaviest individual root (1.16

kg), which was very close to SB006, SB002 (1.1 kg), and SB008 (1.12 kg) at 165 DAS. The genotype SB010 had the lowest individual root weight (0.67 kg). This variation might be attributed due to inherent potential of the genotype. Similarly the highest root yield was recorded at 165 DAS from the genotype SB001 (85.3 t/ha) followed by that of SB006 (84.4 t/ha). BSRI (2005) also recorded 82.0 t/ha root yield from the variety Dorotea in 2002-2003. This result was also supported by Anonymous (1992), where it was recorded that the tropical sugarbeet variety could produce 80-100 tons of roots per hectare in the tropical and subtropical region. The yield decreased to 69.9 and 70.6 t/ha, respectively. for the genotype SB001 and SB006 when the crop was harvested at 180 DAS. The yield reduction in later harvest might be attributed due to severe dropping of the leaves and dehydration of the roots. This trend of yield reduction in the later harvest was similar for the all genotypes. In temperate region, if the plant is not harvested at end of first season, nutrients in the root will be used to produce new leaf, flowers, and seeds and the root will decrease in size (Campbell and Klotz, 2006). Under this study, it was observed that after severe dropping of the leaves due to insect attack and senescence, many new leaves were emerged from each plant causing reduction in the size and weight of roots. Brix (%) of all the genotypes were almost similar in both of the harvests. At 165 DAS, brix (%) varied from 5.50% to 21.8%. Sucrose (%) of the root was almost similar for all the genotypes for both the harvests. The genotypes SB010, SB011, SB014, SB015, and SB016 had very low sucrose (1.26 to 5.88%), therefore, these varieties may be considered for vegetable purpose. Among the genotypes, SB001, SB003, SB006, SB007, SB008, and SB009 had higher amount of sucrose (more than 12.0%). Considering yield potential and sucrose content of the root the genotypes, SB001, SB003, SB006, SB007, SB008, and SB009 can be considered as promising under Bangladesh condition. The mean yield of all the genotypes was much higher at 165 DAS (66.22 t/ha) than that of 180 DAS (56.29 t/ha). Therefore, it is better to harvest sugarbeet roots within 165 DAS.

Disease and insect reaction of the genotypes, physiological disorders, etc. are presented in Table 5. Eight genotypes were infected with *Sclerotium* root rot. Incidence of the disease was 0-20%. Three genotypes were infested with hairy caterpillar at 75 DAS. All the genotypes were severely (80-100% plant) infested with *Spodoptera litura* (a lepidopterous insect) at 125 DAS. Physiological disorders like root cracking, crown rot were also observed in some genotypes (Table 5). The reason of the physiological disorders is needed to be investigated.

Table 2. Some physical characteristics of sugar beet genotypes.

Lines	Hypocotyl colour	Leaf colour	Vein colour	Root swelling started (DAS)	No. of leaves at root swelling	No. of leaves at max. growth stage	Root colour
SB001	Green	Green	Green	40	7.5	24.0	White
SB002	Light purple	Green	Green	38	6.5	23.0	White
SB003	Light purple	Green	Green	38	7.0	21.6	White
SB004	Light purple	Green	Green	38	6.7	29.3	White
SB005	Light purple	Green	Green	37	7.5	29.3	White
SB006	Light purple	Green	Green	38	6.6	24.3	White
SB007	Green	Green	Green	37	6.6	31.0	White
SB008	Light purple	Green	Green	36	7.6	26.6	White
SB009	Light purple	Green	Green	38	8.0	22.0	White
SB010	Deep purple	Purple	Deep purple	39	7.6	13.0	Red purple
SB011	Deep purple	Purple	Deep purple	40	8.0	12.3	Red purple
SB014	Deep purple	Purple	Deep purple	37	6.6	14.3	Red purple
SB015	Deep purple	Purple	Deep purple	36	6.6	15.3	Red purple
SB016	Deep purple	Purple	Deep purple	36	6.6	17.0	Red purple

Table 3. Yield parameters of Sugarbeet genotypes at 165 day after sowing.

Lines	Plant height (cm)	Whole plant wt (kg)	Root length (cm)	Root girth (cm)	Plant survivability (%)
SB001	49.50	1.60	14.0	12.90	92
SB002	40.10	1.33	15.3	11.13	84
SB003	48.60	1.36	13.5	10.10	88
SB004	52.00	1.10	14.2	9.80	92
SB005	49.10	1.45	14.7	11.33	88
SB006	54.20	1.33	16.4	10.10	96
SB007	55.00	1.10	14.5	10.10	86
SB008	54.00	1.23	16.0	9.73	90
SB009	45.50	1.00	16.1	9.10	90
SB010	26.80	0.76	9.53	9.23	86
SB011	36.20	0.97	11.8	10.73	92
SB014	34.50	0.80	11.0	10.30	86
SB015	43.50	0.82	12.8	9.23	92
SB016	39.20	0.77	10.9	10.60	90
Mean	44.87	1.12	13.63	10.31	89.43
Range	26.8-55.0	0.76-1.60	9.53-16.4	9.1-12.9	84.0-96.0
SD	8.52	0.27	2.15	1.01	3.27
CV (%)	18.9	24.6	15.7	9.7	3.6

Table 4. Yield and quality of sugar beet genotypes at 165 and 180 days after sowing

Genotypes	Individual root weight (kg)		Yield (t/ha)		Brix (%)		Sucrose (%)	
	165 DAS	180 DAS	165 DAS	180 DAS	165 DAS	180 DAS	165 DAS	180 DAS
SB001	1.16	0.92	85.3	69.9	18.50	17.5	12.95	13.03
SB002	1.10	0.93	73.9	62.5	16.10	16.8	10.97	12.27
SB003	1.05	0.94	73.9	66.1	18.00	17.4	12.3	11.65
SB004	0.93	0.84	68.4	61.2	15.60	16.2	10.62	9.24
SB005	0.98	0.88	68.9	61.9	19.00	17.1	11.88	13.02
SB006	1.10	0.92	84.4	70.6	18.00	18.5	12.58	13.57
SB007	0.90	0.75	61.9	51.6	19.00	18.4	12.07	12.47
SB008	1.12	0.91	80.6	65.5	21.80	17.8	12.22	13.39
SB009	0.86	0.82	61.9	59.0	20.00	16.5	12.81	12.78
SB010	0.67	0.61	46.1	41.9	10.80	7.6	3.40	**
SB011	0.86	0.72	63.3	53.0	5.50	5.6	1.26	**
SB014	0.76	0.58	52.2	39.9	7.20	6.2	4.10	**
SB015	0.76	0.52	55.9	38.2	6.20	7.2	3.49	**
SB016	0.70	0.65	50.4	46.8	10.00	9.3	5.88	**
Mean	0.93	0.78	66.22	56.29	14.69	13.72	9.04	12.38
Range	0.67-1.16	0.52-0.94	46.10-85.3	38.2-70.6	5.5-21.8	5.6-18.5	1.26-12.95	9.24-13.57
SD	0.16	0.15	12.51	11.09	5.58	5.16	4.33	1.32
CV(%)	17.8	18.9	18.9	19.8	37.9	37.6	47.5	10.6

**Sucrose was not determined since these genotypes contain very low sucrose at 180 DAS.

Table 5. Disease, insect infestation and physiological disorder of sugar beet genotypes.

Items	Incidence (%)	Infected genotypes	Remarks
1. Sclerotium root rot	0-20	SB002, SB004, SB005, SB007, SB010, SB014, SB015, SB016	Crop can be infected at any growth stage
2 Hairy caterpillar	0-5	SB005- SB006, SB011	Observed at 75 day after sowing
3.Spodoptera litura	80-100	All genotypes	Severe infestation was observed at 125 day after sowing (March 15-20)
4. Root cracking	0-30	SB010, SB011, SB014, SB015, SB016	Physiological disorder
5. Crown rot	0-20	SB010, SB015	Reason need to be investigated

From the above results and discussion, it may be concluded that sugarbeet cultivation is possible in Bangladesh. Among the genotypes, SB001, SB003, SB006, SB007 SB008, and SB009 were very promising in respect of yield and sucrose content. However, sugarbeet is a new crop in Bangladesh. Selection of location specific suitable genotypes, development of management practices, storage and processing facilities are very important for its commercial cultivation as an economic crop.

References

Anonymous. 1992. Tropical Sugarbeet. Seeds Division (Folder). 1170/27, Revenue Colony, Shivajinagar, Pune, India. P. 6.

Anonymous. 2004. Sugarbeet cultivation in Bangladesh. Syngenta Bangladesh Ltd. P. 4.

Anonymous. 2005. Tropical Sugarbeet production technology, Soil and Crop Management Studies, Tamil nadu Agricultural University, Coimbatore, India. Pp. 10.

Anonymous. 2010. Research report on vegetable crops 2009-2010. Horticulture Research Centre, BARI, Gazipur. P. 215

BSRI. 2005. Sugar beet cultivation in Bangladesh. Bangladesh Sugarcane Research Institute, Ishurdi. P. 10

Campbell, L. G. and K. L. Klotz. 2007. Characterizing sugerbeet varieties for post harvest storage losses is complicated by environmental effects and genotype x environment interactions. *Can. J. Plant Sci*. **87:** 121-127.

Rahman, M.A., M. A. Samad, M. Saifuzzaman, M. A. H. S. Zaman and M. Z. A. Chowdhyry. 2007. Procedure for removal of soil acidity for crop production. Wheat Research centre, BARI, Gazipur, Bangladesh. P. 9

Rashid, M. M. 1999. Sabji Biggan (in Bengali), Rashid Publishing House, 94, Old DOHS, Dhaka. P. 455