Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [2] 2017: 292-295

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Identification And Evaluation Of Different Sugar Beet Germplasm For High Yield And Sucrose Content Under Indian Agro-Climatic Conditions

Varucha Misra, Upagya Sah, A.K. Mall*, Ram Kishor and A.D. Pathak
ICAR-Indian Institute of Sugarcane Research, Lucknow
*Ashutosh.Mall@icar.gov.in

ABSTRACT
Several researches have been made to establish Sugar beet in Indian Agro-climatic conditions for enhancing the raw material required for sugar production but high yielding and rich sucrose content varieties in Indian scenario is always in demand. Thus, the purpose of this study is to identify and evaluate the different sugar beet germplasm for high yield and sucrose content under Indian agro-climatic conditions. Evaluation of thirteen different sugar beet germplasm were performed with LS 6 and IISR Composite 1 as check varieties. Out of all the thirteen germplasm, Shubra germplasm performed best in terms of highest population survival as well as high root yield, sucrose content and CCS per cent than best check. While, for root diameter and root length, the germplasm namely R06, SHUBRA, L 33, LKC 2007 showed better performance in comparison to both the checks, however, LK 4 showed better performance for root diameter.
Key words: *Commercial cane sugars, germplasm, sugarbeet, sucrose, yield*

Received 25.07.2017 Revised 15.08.2017 Accepted 28.08.2017

INTRODUCTION

Sugarbeet is the second most important sugar crop after sugarcane and accounts for nearly a quarter of the world sugar production. This is the product of human endeavor and is an alternate crop for fulfilling the world's requirement for sugar. About 40 per cent of sugar produced in the world is obtained from this crop. This crop is perfect not only in terms of diversification but also in ethanol production which is one of the emerging needs of the day. Besides, cultivation of this crop has revived the sugar industries going in losses as this crop possess same amount of sugar as that of in sugarcane and that too in short period of time [1].

Sugarbeet is one amongst the efficient plants that utilizes solar energy to convert it in a product useful for animals as well as humans [2]. It offers an attractive option to the Indian farmers and the sugar industry. It brings a hope of better buffering against natural and market forces. Coupled with sugarcane, sugarbeet completes the picture of total sugar scenario [3]. India happens to be the few amongst the fortunate countries blessed with the agro-climatic diversity to be capable of cultivating both the major sugar crops of the world. The successful cultivation of sugarbeet in sub-tropical Indian agro-climates is well established. The cultivation of sugarbeet in sub-tropical regions is of new interest. Thus, this study aims to identify and evaluate different sugarbeet germplasm for high yield and sucrose content. Improving sugarbeet yield and quality are the main goals of plant breeders to increase sugar production in order to gradually cover the gap between consumption and production. Sugarbeet has emerged as a promising entity to be adopted in crop rotation as a winter crop not only in fertile soils, but also in poor, saline, alkaline and calcareous soils. Hence, sugarbeet is capable of occupying an important place in the sugar economy of the country [4].

MATERIALS AND METHODS

Sugarbeet germplasm seeds were sown on 16th October, 2016 on ridges at depth of 2-3 cm with row-to-row spacing of 50 cm and 20 cm from plant to plant. Before sowing the seeds were treated with 0.2 per cent Thiram (2g/kg). The experiment laid out in Randomized Bock Design with three replications to evaluate thirteen germplasm against two checks, *viz*., LS 6 and IISR Composite 1. All the IISR developed

package and practices for sugarbeet cultivation under Indian Agro-climatic conditions were undertaken for raising good and healthy crop. Ten irrigations were supplied for proper germination and growth after evaluating the soil moisture condition. To maintain the same population, thinning and gap filling practices has been also processed. Population counting was determined manually both at the initial stage of germination as well as at the time of harvest. Observations were taken on leaf weight, root weight by weighing balance while, quality parameters also determined on Brix by refractometer and sucrose content (%) by sucrolyzer. Furthermore, commercial cane sugars (%) were calculated by formulae CCS= {(1.022* sucrose)-(0.292*Brix)} and Purity (%) by following formula: [Sucrose (%)/ Brix] x 100

RESULTS AND DISCUSSION

Variation in population: Out of eleven germplasm, Shubra showed highest population rate followed by L 33, LKC HB, LKS 10, LKC LB in comparing with checks while LKC 2000 showed lowest population rate. The data revealed that mortality (%) rate was highest in LK 7 (61.00) and least in Shubra (30.2) than the checks. Results indicated that Shubra germplasm performed best in terms of highest population survival (Table 1).

Furthermore, leaf weight was recorded highest in LKC 2007 while lowest recorded in LK 4. In comparison to LS 6, all the germplasm had higher leaf weight except LK 4, however, in comparison to IISR Comp 1, two germplasm *viz*., L 33 and LKC 2007 showed increased leaf weight (Fig. 1). None of the germplasm showed increased root weight than LS 6 while, comparing the germplasm with IISR Comp 1, nine germplasm, namely, PAC 6008, LK 7, LKC LB, LKC HB, Shubra, L 33, LKC 2007, LKC 2006 and LKC 2000 showed relative higher root weight. This indicated that L 33 and LKC 2007 had higher leaf weight as well as root weight. Furthermore, as per root length and diameter concerned, highest was recorded in LKC 2000 while, lowest in LKC HB. Against LS 6 and IISR Comp 1, the R06, LKC HB, SHUBRA, L 33, LKC 2007 and LKC 2000 showed better performance in root length. For root diameter, five germplasm, *viz*., R06, Shubra, L 33, LKC 2007 and LK 4 showed better performance in root diameter against LS 6 and IISR Comp 1. This also revealed that both the parameters relatively increased in R 06, Shubra, L 33 and LKC 2007 (Table 2). In case of root: leaf ratio, LS 6 maintained its superiority with 48:5. Regarding another check variety IISR Comp 1, ten germplasm *viz*., PAC 6008 (42:5), R06 (6:1), LK 7 (17:3), LKC LB (130:24), LKC HB (140:22), L 33 (174:26), LK 4 (114:16), LKC 2007 (170:26), LKC 2006 (158:20) and LKC 2000 (126:26) showed higher root: leaf ratio.

In accordance with the market value of this crop for sugar production, extraction of juice depends on two vital parameters, *viz*., root weight and sucrose content. The latter has been reported to be influenced by number of factors [5]. So, the germplasm were evaluated for juice quality analysis.

Root yield (t ha^{-1}): Determination of economic potential of any germplasm is majorly dependent on sucrose content and root weight. For root yield (t ha^{-1}), LS 6 again maintained its superiority while, seven germplasm *viz*., Shubra (88.0 t ha^{-1}), LKC 2000 (87.7 t ha^{-1}), LKC 2007 (85.3 t ha^{-1}), L 33 (86.7 t ha^{-1}), PAC 6008 (84.0 t ha^{-1}), LKC 2006 (79.0 t ha^{-1}) and LKC HB (71.7 t ha^{-1}) showed relatively higher yield against IISR Comp 1. Sandhu *et al*. [5] also reported high yield with Shubra in their studies. Campbell [6] had showed that there are many reasons behind variation in root yields of different germplasm. In addition, difference in climatic conditions and light intensity are the other essential factors for attaining high root yield and sucrose content in sugarbeet [7].

Juice Quality Analysis:

Sucrose content (%): Evaluation of sucrose content in all the sugarbeet germplasm showed that sucrose content ranges between 12-18 per cent including the check varieties (Table 2). Of thirteen testing germplasm, only Shubra showed higher sucrose content (by 1.32 units) in comparison to LS 6 while four varieties, *viz*., Shubra, LKC 2000, SZ 35, PAC 6008 had relatively higher sucrose content (by 3.94, 0.12, 0.57, 0.54 units, respectively) than IISR Comp 1.

Commercial cane sugars (%): Shubra again maintained superiority with 13.70 in term of CCS (%) and CCS (t ha^{-1}) while, minimum CCS percentage was recorded in LKC LB with 6.95. Against LS 6, Shubra had maximum CCS per cent while minimum in LKC LB, however, in comparison to IISR Comp 1, highest and least CCS per cent was recorded by the same germplasm as that of against with LS 6 (Shubra and LKC LB, respectively) (Fig. 2).

Brix (%): It is an important parameter for sucrose content determination as well as for sugar recovery. Against LS 6, Brix was recorded relatively highest in LKC 2000 (18.7), R 06 (17.7) and LK 7 (17.2) while against IISR Comp 1, only two germplasm, namely, LKC 2000 (18.7) and R 06 (17.7) recorded highest Brix value. Similar Results also reported by Sanghera *et al.* [8].

Purity coefficient: High purity per cent is an also valuable economic quality traits for sugar industries and in present study only LKC 2007 had highest purity coefficient than IISR Comp 1 but in view of LS 6,

five germplasm, *i.e.*, LKC 2006, LKC 2007, LKC LB, LK 7 and SZ 35, showed higher value. Campbell [9] also reported that purity coefficient is directly associated with sucrose per cent of the sugarbeet.

CONCLUSION

The above mentioned results showed that the genotypes/varieties of sugarbeet, R 06, L 33, LKC 2007 have excellent performance characteristics. It is clearly depicted from the results that they are capable to produce high amounts of root yield and sugar content. Shubra was the most promising germplasm which can be used for crossing programme and other breeding activities to achieve the targets of inhabiting temperate sugar beet crop for sub-tropical conditions of India.

ACKNOWLEDGEMENT

Authors are thankful to Director, ICAR-Indian Institute of Sugarcane Research, Lucknow for conducting the study in main institute and providing the raw material from IISR Research Outpost, Mukteshwar.

REFERENCES

1. Pathak A D, Kapur Raman, Solomon S, Kumar Rajesh, Srivastava Sangeeta and Singh P R. (2014). Sugar Beet: A Historical Perspective in Indian Context. *Sugar Tech*, **16**(2):125-132
2. Anonymous (1989). Report of All India Coordinated Research project on sugarbeet, Pp 67.
3. Anonymous (2008). AP CESS Network Research Project report on developing agro techniques for tropicalized sugarbeet in India. Pp 69.
4. Iqbal MA and Saleem AM (2015). Sugar beet potential to beat sugarcane as a sugar crop in Pakistan. American Eurasian Journal of Agriculture & Environmental Sciences, **15** (1): 36-44
5. Sandhu SK, Sarao NK, Goyal M, Uppal SK, Singh Pritpal, Kaur Satveer and Kaur Jaspreet (2015). Profiling of sugar beet genotypes for agronomical, sugar quality and forage traits and their genetic diversity analysis using SSR markers. Electronic Journal of Plant Breeding, 7 (2): 253-266.
6. Campbell LG (2002). Sugar beet quality improvement. In: Basra AS, Randhawa LS (eds.) Quality Improvement in Field Crops. Food Products Press, Binghamton, NY, pp. 395–413.
7. Powers L, Schmehl WR, Federer WT, Payne, MG (1963). Chemical, genetic and soils studies involving thirteen characters in sugar beet. *J ASSBT,* **12**: 393–448.
8. Sanghera GS, Singh RP, Kashyap L, Tyagi V and Sharma B (2016). Evaluation of sugarbeet genotypes (*Beta Vulgaris* L.) for root yield and quality traits under subtropical conditions. Journal of Krishi Vigyan, **5** (1): 67-73.
9. Campbell LG (2010). Sugarbeet Germplasm Selected From the USDA Collection, 32-34.

Table 1: Population percentage of sugar beet germplasm and per cent mortality

Germplasm	After 1 month of growth	At the time of harvest	Rate of Germplasm died	Per cent mortality
LKC 2000	114.67	53.67	61.00	53.20
LKC 2006	121.67	67.67	54.00	44.38
LKC 2007	126.33	70.67	55.67	44.06
LK 4	120.33	72.33	48.00	39.89
LKS 10	134.33	70.00	64.33	47.89
L 33	139.00	86.67	52.33	37.65
SHUBRA	140.00	97.67	42.33	30.24
LKC HB	138.67	96.33	42.33	30.53
LKC LB	133.67	85.33	48.33	36.16
LK 7	135.00	82.67	52.33	61.00
R06	138.26	98.25	40.01	40.72
SZ 35	135.63	95.62	40.01	41.84
PAC 6008	128.48	95.23	33.25	34.91
LS 6	133.33	65.33	68.00	51.00
IISR Comp 1	133.00	76	57.00	42.86

Table 2: Mean Performance of sugar beet germplasm on quantitative and qualitative traits

Germplasm	Single root weight (Kg)	Root length (cm)	Root diameter (cm^2)	Brix	Sucrose Content (%)	Purity (%)	Yield (t/ha)
LKC 2000	0.88	33.27	30.22	18.67	13.61	74.90	87.67
LKC 2006	0.79	29.87	26.72	15.43	12.07	76.68	79.00
LKC 2007	0.85	31.40	29.44	16.77	13.03	78.45	85.33
LK 4	0.57	29.73	27.45	15.87	12.65	70.43	57.00
LKS 10	0.44	26.00	23.44	15.73	12.25	73.83	44.33

L 33	0.87	32.27	27.61	15.40	12.00	71.02	86.67
SHUBRA	0.88	31.67	27.44	14.07	17.43	72.68	88.00
LKC HB	0.70	31.70	28.90	16.20	12.90	69.80	71.70
LKC LB	0.65	22.33	21.44	15.57	11.25	75.57	64.67
LK 7	0.68	29.93	26.56	17.20	13.22	76.26	67.7
R06	0.60	31.07	29.00	17.7	13.34	70.43	60.33
SZ 35	0.54	25.27	22.78	17.80	14.06	76.02	54.00
PAC 6008	0.84	27.07	25.39	17.73	14.03	75.36	84.00
LS 6	0.96	30.67	26.67	16.77	16.11	75.43	95.67
IISR Comp 1	0.63	28.67	25.50	17.30	13.49	77.74	63.00
Mean	0.73	29.39	26.57	16.50	13.42	74.31	72.60
Range	0.44-0.95	25.26-33.26	22.78-30.22	14.06-18.66	11.24-17.42	69.80-78.44	44.33-95.66
S.E.	0.02	0.83	0.84	0.34	0.38	1.33	2.14
CV	5.10	4.86	5.45	3.62	4.84	3.10	5.10
CD at 5 per cent	0.06	2.38	2.42	0.99	1.08	3.84	6.19

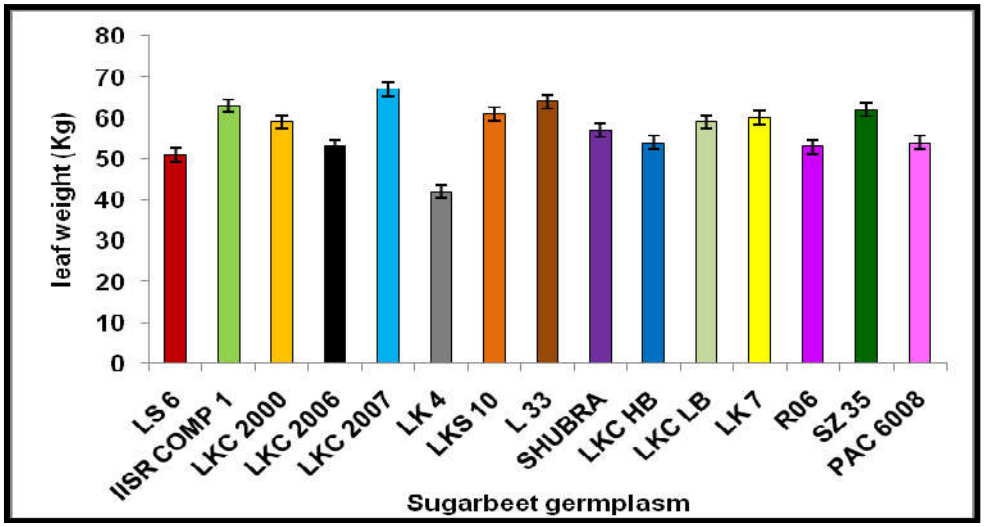

Fig. 1 Leaf weight of different sugarbeet germplasm

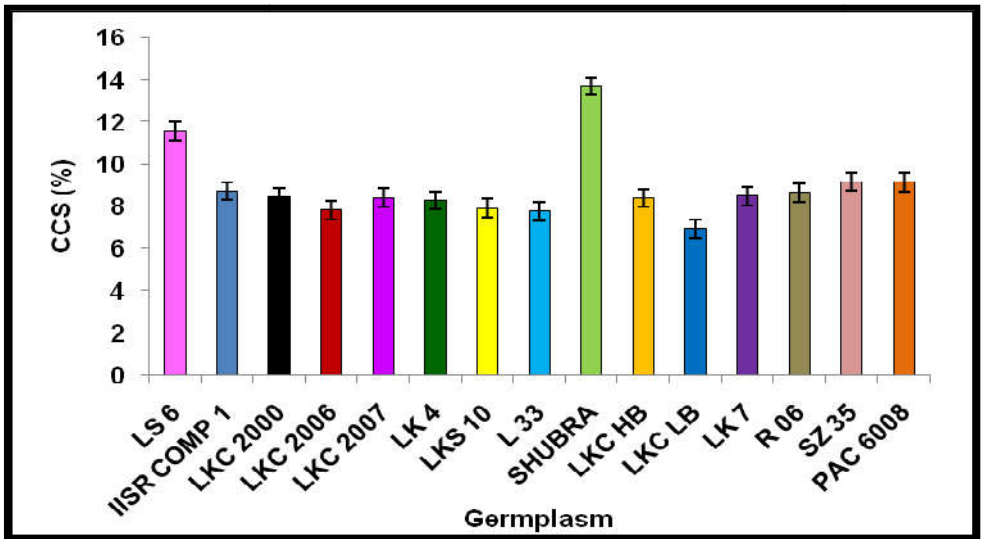

Fig. 2 CCS (%) of sugarbeet germplasm

CITATION OF THIS ARTICLE

Varucha Misra, Upagya Sah, A.K. Mall*, Ram Kishor and A.D. Pathak. Identification And Evaluation Of Different Sugar Beet Germplasm For High Yield And Sucrose Content Under Indian Agro-Climatic Conditions. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 2, 2017: 292-295