Original Research Article

Studies on Evaluation of Sweet Potato (*Ipomoea batatas* Lam.) Genotypes for High Tuber Yield and Quality

ABSTRACT

The present investigation was undertaken at the College Orchard, Department of Vegetable Science, Horticultural College & Research Institute, TNAU, Coimbatore during the year 2021-2022 in a randomized block design with four replications. Six sweet potato accessions *viz.*, Sree Arun, Sree Kanaka, Bhu Krishna, CO 5, Ib 73 and Ib 74 were evaluated to study the growth, yield and quality parameters. All the accessions used in this study were morphologically different in leaf lobing, vine pigmentation, tuber skin and flesh colour. Statistical analysis also confirmed that each accession showed a significant difference among them for growth, yield and quality parameters. The results revealed that, maximum number of tubers per vine of 5.25 was observed in Ib 73, however the accession Ib 74 recorded the highest single tuber weight (205.65 g), tuber yield per plant (1.10 kg), tuber yield per plot (32.62 kg) and tuber yield per ha (22.72 t ha^{-1}) followed by Ib 73 with tuber yield per plant (1.09 kg), tuber yield per plot (32.19 kg) and tuber yield per ha (22.35 t ha^{-1}). The quality parameters *viz*., Dry matter (%), TSS, Total sugar and Total protein contents mainly decide the quality and nutritive value of sweet potato. There is a significant variation in the quality parameters i.e, TSS, Dry matter, Total sugar and Total protein contents. Higher values were recorded for dry matter content in Ib 73 (33.50 %). The highest total sugar content and protein content were observed in Ib 74 with 37.2 g/100g and 2.4 g/100g. Overall Ib 74 recorded the highest values for single tuber weight, tuber yield per plant, tuber yield per plot and tuber yield per ha.

Keywords: Performance, Morphological, Agronomic, Yield, Quality traits

1. INTRODUCTION

Sweet potato (*Ipomoea batatas* Lam.) is a high starchy tuberous vegetable belonging to the family Convolvulaceae. It is a dicotyledonous perennial crop of hexaploid in nature with a chromosome number of 2n (6x) = 90. In India, it is popularly called “SakarKand”. Tropical regions of America is considered as a native of sweet potato. It is a highly cross pollinated crop because it is having strong sporophytic self-incompatibility so that self-pollination usually occurs at low frequency. The plant is herbaceous in nature with prostrate growth with a vine length up to 400 centimeters. Some of the cultivars are erect in nature. The crop is widely differentiated through various morphological characteristics like leaf lobing, vine pigmentation, tuber skin and flesh colour. It is cultivated as an annual crop highly for its nutritious tubers rich in starch and protein used for human consumption and also used in industries for various purposes like production of flour, ethanol etc. The tubers are eaten as a vegetable in many forms like boiled tubers, baked products, fried, curries etc. The vines are used as a fodder crop for cattle and they can be grown as ground cover in coconut plantations to reduce weed population [1].The tender leaves and stems are used as a vegetable in many countries.

Sweet potato is an important source of vitamin C, carbohydrate, β-carotene, a precursor of vitamin A [2]. They are a good source of energy with abundance of proteins, lipids, fiber, vitamins, and minerals like potassium [3]. It contains vitamin A (709 µg), sugar (4.2 g), protein (1.6 g), and starch (12.7 g) per 100 g of edible part [4]. Sweet potato could have a significant impact on vitamin A intake in sub-Saharan Africa regions [5]. It plays a great role in saving the lives of millions of children and also helps to create a better future [6]. In many developing countries sweet potato is a secondary staple food and may play an important role in controlling vitamin A deficiency. It can be used for viable

long-term food based strategy for controlling vitamin A deficiency in children. Sweet potato with low glycemic index which is ideal for diabetic patients. Yellow-fleshed sweet potatoes offer considerable potential for processing and canning for export purposes.

In India, sweet potato is cultivated in an area of 0.118 million hectares with production and productivity of 1.219 million tonnes and 10.30 t ha^{-1} respectively [7]. It is highly grown in Assam, Orissa, West Bengal, Tamil Nadu, Uttar Pradesh, Andhra Pradesh and Bihar. In Tamil Nadu, it is cultivated in an area of 586 hectares with a production and productivity of 14402 tonnes and 24.58 tonnes per ha respectively [8]. In Tamil Nadu it is cultivated as a rainfed crop in *kharif* season and irrigated crop in *rabi* season. Cultivation of local, inferior sweet potato varieties is one of the major reasons for lower tuber yield. To maximize the yield with better quality, it is important to evaluate the sweet potato accessions [9] [10].

2. MATERIALS AND METHODS

A field experiment was conducted at the College Orchard, Department of Vegetable Science, Horticultural College and Research Institute, TNAU, Coimbatore during 2021-2022 in November - December season. The soil type is sandy loam with a pH of 7.6. Six sweet potato accessions *viz.*, Sree Arun, Sree Kanaka, Bhu Krishna, CO 5, Ib 73 and Ib 74 were selected for this study. Sree Arun and Sree Kanaka are the ruling varieties in Kerala with the flesh colour of cream and orange respectively. Bhu Krishna is a purple fleshed sweet potato variety rich in anthocyanin, predominantly cultivated in Odisha. CO 5 is an orange fleshed variety rich in β-carotene cultivated in Tamil Nadu. Whereas Ib 73 and Ib 74 are pre-released cultures from TNAU, Coimbatore and they are compared with the ruling varieties for tuber yield and quality traits. These accessions were planted in a standard Randomized block design with four replications. Vine cuttings of Sree Arun, Sree Kanaka and Bhu Krishna were collected from CTCRI, Thiruvanandhapuram, CO 5 was obtained from HC & RI, TNAU and Ib 73 and Ib 74 were collected from the germplasm maintained at the Department of Vegetable Science, HC & RI, TNAU, Coimbatore. Sweet potato accessions were evaluated for growth, yield and quality parameters under field conditions.

2.1 Methodology

Individual plots with a size of 14.4 square meter was prepared and vermicompost @ 5 t ha^{-1} was applied before planting of cuttings. The basal dose of 20:40:60 kg of N_2:P_2O_5:K_2O ha^{-1} was applied with @ 200 kg neem cake ha^{-1}. The sweet potato vine cuttings of 15 cm length with 3-4 nodes were planted at a spacing of 60 x 20 cm, in double row system in a bed size of 90 cm breadth and 6 m length. Top dressing of fertilizer at a rate of 20:40:60 kg N_2:P_2O_5:K_2O ha^{-1} was applied 45 days after planting. Etheral at a concentration of 250 ppm was sprayed on the 15^{th} day after planting and it is continued at fortnightly intervals for four times to increase the tuber yield. Weeding was done two times at 30 and 45 days after planting. Vine turning was done at 60 days after planting to avoid adventitious root formation in nodes and to encourage main roots to form good size tubers. Earthing up was given two times during the 45^{th} and 60^{th} day after planting. Harvesting of the tubers starts from 90 days after planting depending upon the nature of the accession. The growth and yield parameters were recorded from five random plants in each replication. Quality parameters were biochemically analysed from the harvested tubers. The dry matter content was recorded by the ratio of dry weight and fresh weight of the tuber and it was expressed in percentage (%). The TSS (Total soluble solids) was observed by using hand refractometer. The total sugar content of the fresh tuber was estimated by using anthrone method [11]. The protein content of the fresh tuber was obtained by Lowry's method [12].

2.2 Statistical analysis

The recorded data was used for statistical analysis using the AGRES software version 7.01 and the analysis was done at 0.05 level of significance.

3. RESULTS AND DISCUSSION:

3.1 Morphological characters

The results showed that sweet potato accessions used in this study had high morphological differences (Table 1). The crop was distinguished by a variety of morphological traits. The leaves showing high variability from slight lobed to deep lobed were recorded. Among the sweet potato accessions except CO 5, all were lobed. It was also observed that there was a wide variation in tuber characters of sweet potato. Most of the accessions had light green to dark green coloured vine except Bhu Krishna which had purple coloured vine (Table 1). The similar results were supported by [13] [14].

3.2 Agronomic, Yield and Quality Characters

The results of the present investigation revealed that, there were significant differences for growth, yield and quality parameters among the different accessions.

3.2.1 Agronomic traits

The vine length was measured at the harvestable stage and the average was computed. The analysis of data showed there was a significant difference in the vine length among the genotypes. The vine length varies from 108.83 cm to 246.95 cm (Table.2). Sweet potato accession Ib 73 showed more vine length of 246.95 cm followed by Bhu Krishna with 212.45 cm and the lowest was found in Ib 74 (108.83 cm). The genetic makeup of the genotypes influences the vine length [14]. The medium-sized vine length might produced the highest sweet potato output. Related findings also observed by [15]. Among the sweet potato accessions evaluated, significant variation in the girth of tuber was noticed. The variety Sree Kanaka showed more vine girth of 2.65 cm followed by CO 5 with 2.45 cm and the lowest was found in Bhu Krishna with 1.35 cm (Table.2). Vine diameter might be a hereditary trait that can vary between genotypes even when grown under similar soil and environmental conditions. Similar findings was observed by [16].

There was a significant difference in the internodal length and the number of secondary vines in sweet potato accessions were observed. The highest internodal length was found in CO 5 with 9.32 cm and the lowest was found in Ib 74 (2.33 cm). Internodal length is determined by cultivars and time [17]. More number of secondary vines were observed in CO 5 followed by Sree Arun and the least number of vines were found in Ib 74 (Table.2). Similar finding was reported by [18]. Foliage weight varied significantly among the sweet potato accessions. Sree Kanaka recorded more foliage weight (1.98 kg) and Ib 74 recorded low foliage weight (0.72 kg). The genotype Kamala Sundari (1301 g) had the highest fresh weight plant^{-1} while the genotype Doulatpuri had the lowest (420 g) [19]. It might be due to the presence of more girth of the vine.

3.2.1.1 Yield trait

Yield is a complex trait influenced by many factors. In sweet potato, the important yield contributing characters are tuber length, tuber girth and number of tubers per vine. In the present investigation, significant variation was noticed in the length of tubers, tuber girth, number of tubers per vine, tuber yield per plot and tuber yield per hectare.

The highest tuber length of 22.08 cm was observed in Ib 74 and the lowest of 8.85 cm was found in Bhu Krishna. The variation in the length of the tuber might be depending on the sweet potato variety or genotype. This finding was similar to [17]. Sweet potato genotypes and environmental conditions have a significant impact on tuber length. The highest mean diameter of tuber (16.68 cm) was recorded in Ib 74 and the lowest (10.93 cm) was observed in Bhu Krishna. Maximum number of tubers per vine was observed in Ib 73 (5.25) and minimum number of tubers per vine was observed in Sree Arun (2.25).The highest tuber weight was found in Ib 74 (205.65 g) and the lowest was found in Ib 73 (203.04 g). The genetic makeup of the genotypes might controls the differences in storage root characteristics, which obviously varies from genotype to genotype. [16] also agreed with the findings of the present study. Ib 73 produced more number of tubers followed by Ib 74 and the least number of tubers was found in Bhu Krishna (Table.3). The quantity of tubers per plant varied due to genetic diversity in different genotypes. The similar result was found in findings of [20] [21].

Tuber yield per vine is an important character in sweet potato which influences the gross return of the crop. The highest tuber yield per vine of 1.10 kg was found in Ib 74 followed by Ib 73 with 1.09 kg and the lowest was found in Bhu Krishna (0.13 kg). The variation in the yield of storage roots per plant might be due to location, cultivar and period. This finding was similar to the research work done by [22].

3.2.1.2 Tuber yield per plot

Tuber yield per plot is an economic trait which boosts the tuber yield per hectare. The highest tuber yield per plot was recorded in Ib 74 with 32.62 kg followed by Ib 73 (32.19 kg) and the lowest

was found in Bhu Krishna with 11.82 kg. Considerable changes across genotypes might have occurred as a result of the use of appropriate cultural management approaches. The above finding was also similar to the finding of the author [23]. The maximum tuber yield per hectare was estimated in Ib 74 (22.72 t ha^{-1}) followed by Ib 73 with 22.35 t ha^{-1} and the lowest was found in Bhu Krishna (8.23 t ha^{-1}). The variation in the tuber yield might be due to genetic diversity in sweet potato cultivars. [24] results are in line with the research findings of the present study.

3.2.2 Quality parameters

The quality parameters *viz*., Dry matter (%), TSS (Total soluble solids), Total sugar and Total protein contents mainly decide the quality and nutritive value of sweet potato. There is a significant variation observed in the tuber quality parameters of sweet potato genotypes.

The highest dry matter content was observed in Ib 73 (33.49 %) and the lowest dry matter content was observed in CO 5 (21.58 %). The difference in the dry matter content of sweet potato genotypes might be depends on variety. The similar result was found by [25]. In the present investigation, the accession Sree Arun has high TSS of 12.11 °brix and Ib 73 registered low TSS content of 7.22 °brix. The same trend of results was also observed by [26]. The highest total sugar content was observed in Ib 74 (37.22 g/100 g) and the lowest was observed in Ib 73 (29.79 g/100 g). Ib 74 also recorded more protein content of 2.41 g/100 g and Bhu Krishna recorded the lowest with 1.48 g/100 g. The similar range of result was also found [27]. Results showed that Ib 73 has low TSS and total sugar content among them. The accession Ib 73 can be used as a potential replacement for potatoes. The findings are in accordance with the findings of Teshome Anshebo [28].

Accessions	Vine colour	Leaf lobe type	Petiole pigmentation	Tuber skin colour	Tuber flesh colour
SreeArun	green	Slight teeth	green	Yellowish white	Cream
Sree Kanaka	light green	Moderate	green	Yellowish Orange	Orange
Bhu Krishna	purple	Moderate	Green with purple	Purplish red	Purple
CO 5	green	Non-lobed	green	dark Pink	Light Orange
Ib 73	green	Moderate	green	dark Pink	White
Ib 74	green	Deep lobed	green	Light Pink	Cream

Accessions	Vine length (cm)	Vine girth (cm)	Internodal length (cm)	Number of secondary vines	Foliage weight (kg)
SreeArun	121.55	2.05	3.38	13.25	1.31
Sree Kanaka	162.74	2.65	3.93	9.75	1.98
Bhu Krishna	212.45	1.35	3.33	10.25	0.72
CO 5	185.43	2.45	9.32	14.25	1.86
Ib 73	246.95	1.81	4.03	13.50	1.31
Ib 74	108.83	1.85	2.33	9.25	1.01
Mean	172.99	2.03	4.39	11.71	1.37
SEd	8.28	0.09	0.33	0.94	0.12
CD(.05)	17.64	0.20	0.70	2.00	0.25
CV (%)	6.77	6.60	10.64	11.39	12.09

Accessions	Tuber length (cm)	Tuber diameter (cm)	Single tuber weight (g)	Number of tubers per vine	Tuber yield per vine (kg)	Tuber yield per plot (kg)	Tuber yield per hectare (t)
SreeArun	10.12	12.26	49.62	2.25	0.22	13.68	9.23
Sree Kanaka	18.58	13.53	148.81	3.25	0.53	24.63	17.17
Bhu Krishna	8.85	10.93	53.15	2.45	0.13	11.82	8.23
CO 5	17.51	12.13	135.55	2.85	0.44	22.48	15.67
Ib 73	19.26	13.95	203.04	5.25	1.09	32.19	22.35
Ib 74	22.08	16.68	205.65	3.55	1.10	32.62	22.72
Mean	16.07	13.25	132.64	3.27	0.59	22.90	15.90
SEd	1.05	0.83	17.42	0.02	0.007	0.26	0.29
CD(.05)	2.25	1.78	37.13	0.05	0.016	0.57	0.62
CV (%)	9.28	8.92	18.58	1.22	1.83	1.63	2.62

5. CONCLUSION

Accessions	Dry matter (%)	Total soluble solid (^{o} brix)	Total sugar (g/100 g)	Total protein (g/100 g)
SreeArun	30.61	12.11	34.24	1.79
Sree Kanaka	22.29	10.20	30.38	2.12
Bhu Krishna	23.41	9.39	32.41	1.48
CO 5	21.58	8.52	33.46	1.61
Ib 73	33.49	7.23	29.79	2.23
Ib 74	26.91	8.76	37.22	2.41
Mean	26.38	9.37	32.92	1.94
SEd	0.64	0.07	0.52	0.03
CD(.05)	1.36	0.16	1.11	0.06
CV	3.44	1.19	2.24	2.36

4. CONCLUSION

The current study revealed that there were significant differences observed among the sweet potato accessions in terms of morphological, agronomic, yield and quality contributing characters. According to the current findings, it can be concluded that the sweet potato accessions under study may be easily distinguished from one another due to their individual physical traits and their yield and quality traits. Under Coimbatore conditions, the sweet potato accession Ib 74 yielded better followed by Ib 73. Hence it can be recommended as a viable replacement for the low yielding variety under field conditions of Coimbatore region of Tamil Nadu. The accession Ib 73 with low TSS and less total sugar content will be a better replacement for potatoes and can be used for diabetic patients due to its low sugar content.

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