Original Research Article

Studies on Evaluation of Sweet Potato (*Ipomoea batatus* 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, 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 was recorded for dry matter content in Ib 73 (33.50 %). The highest total sugar content and protein content was 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.

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

1. INTRODUCTION

Sweet potato (*Ipomoea batatus* Lam.) is a high starchy tuberous vegetable belongs 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 as “SakarKand”. Tropical regions of the America is considered as a native of sweet potato. It is a highy 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 purpose 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 it can be grown as ground cover in coconut plantation 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 a 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. In order to maximize the yield*, it is important to evaluate the sweet potato accessions to increase the production by selection of elite types* [9] [10].

2. MATERIALS AND METHODS

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. 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 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. Sweet potato accessions were evaluated for growth, yield and quality parameters under field condition.

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. 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 the 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 15^{th} day after planting and it is continued at fortnightly interval 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 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.

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 sweet potato accessions used in this study are having high morphological difference among them (Table 1). The crop is distinguished by a variety of morphological traits. It can be differentiated based on morphological characters such as vine colour, leaf lobing, petiole pigmentation, tuber skin colour and tuber flesh colour [11].

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The leaves showing high variability from slight lobed to deep lobed was recorded. It was also observed that there is a wide variation in tuber characters of sweet potato. Most of the varieties shows cream colour flesh with a pink skin (Table 1). The genotypes differed significantly in morphological and yield-attributing characters [12].

3.2 Agronomic, Yield and Quality Characters

The results of the present investigation revealed that, there exists significant difference 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 on the vine length among the genotypes. The vine lengths vary 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 [12]. The medium-sized vine lengths of 140-180 cm produced the highest sweet potato output [13]. Among the sweet potato accessions evaluated, significant variation in 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 is a hereditary trait that can vary between genotypes even when grown under similar soil and environmental circumstances [14].

There was a significant difference in the internodal length and the number of secondary vine in sweet potato accessions was 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). Internode length is determined by cultivars and time [15]. More number of secondary vines was observed in CO 5 followed by Sree Arun and the least number of vine was found in Ib 74 (Table.2).

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The difference in the number of branches per plant reported among the analysed orange flesh sweet potato types [16]. 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) [17]. It may be due to presence of more girth of 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 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 length of the tuber varies depending on the sweet potato variety [15]. 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 controls the differences in storage root characteristics, which obviously varies from genotype to genotype [12]. 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 varies greatly due to genetic diversity in different genotypes (18). The number of storage roots per plant ranged from 4.70 to 11, depending on sweet potato genotype [19].

3.2.1.2 Tuber yield per vine:

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 varies due to location, cultivar and period [20].

3.2.1.3 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 may have occurred as a result of the use of appropriate cultural management approaches [21]. Highest 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}). There were variances in tuber yield ha^{-1} due to genetic diversity in sweet potato cultivars [22].

3.2.2 Quality parameters

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 was also noticed.

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 genoypes depends on variety [23]. In the present investigation, the accession Sree Arun having high TSS of 12.11 °brix and Ib 73 registered low TSS content of 7.22 °brix. The same trend of result was also [24]. 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 protein in the range of 1.91%–5.83% was reported in orange flesh sweet potato [25]. Results showed that Ib 73 having low TSS and total sugar cotent among them. The accession Ib 73 can be used as a potential replacement for potato. The findings also agreed with Teshome Anshebo [26].

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 vine	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
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

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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
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 (° 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
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 condition, 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 would be a better replacement for potato and can be used for diabetic patients due to its total sugar content.

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