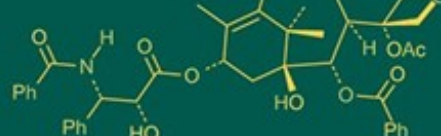
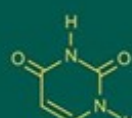


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
Indexing: Embase
IJABR 2026; SP-10(10): 646-650
www.biochemjournal.com
Received: 25-08-2026
Accepted: 28-09-2026
Published: 08-10-2026

Dokka Vara Vinod

Ph.D Scholar, Department of
Vegetable Science, College of
Horticulture, Dr. YSR
Horticultural University,
Andhra Pradesh, India

Sheriful Alam

Principal Scientist, AICRP on
Tuber Crops, Department of
Horticulture, College of
Agriculture, Assam
Agricultural University, India

Sanjib Sharma

Associate Professor,
Department of Floriculture,
College of Horticulture and
Farming Research System,
Assam Agricultural
University, India

Nagendra Sarma Barua

Professor, Department of
Plant Breeding and Genetics,
College of Agriculture, Assam
Agricultural University, India

Samindra Baishya

Professor & Head, Department
of Biochemistry and
Agricultural Chemistry,
College of Agriculture, Assam
Agricultural University, India

Corresponding Author:**Dokka Vara Vinod**

Ph.D Scholar, Department
of Vegetable Science,
College of Horticulture, Dr.
YSR Horticultural
University, Andhra
Pradesh, India

Evaluation of orange-fleshed sweet potato genotypes for growth, yield and under Jorhat conditions of Assam

Dokka Vara Vinod¹, Sheriful Alam², Sanjib Sharma³, Nagendra Sarma Barua⁴, Samindra Baishya⁵

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i10Sh.10356>

ABSTRACT

Orange-fleshed sweet potato (*Ipomoea batatas* L.) is an important biofortified tuber crop recognized for its high β -carotene content, nutritional value, and adaptability to diverse agro-climatic conditions. The present study was undertaken to evaluate the agronomic performance of fourteen orange-fleshed sweet potato genotypes under Jorhat conditions and to identify superior genotypes for yield and quality improvement. The experiment was conducted during the rabi season of 2022–23 at the Department of Horticulture, Assam Agricultural University, Jorhat, using Randomized Block Design with three replications. Twenty-one morphological, yield, and biochemical traits were recorded and subjected to analysis of variance. Significant differences among genotypes for all studied traits indicated the existence of substantial variability, providing ample scope for selection and crop improvement. Among the evaluated genotypes, Bhu Kanti recorded the highest total tuber yield (63.50 t ha^{-1}) and marketable yield (58.44 t ha^{-1}), followed by CIPSWA-2 (59.25 and 51.96 t ha^{-1} , respectively), whereas Gouri produced the lowest yield (17.76 t ha^{-1}). Considerable variation was also observed for tuber size, number of tubers, total soluble solids, starch content, and dry matter. The results demonstrate the presence of valuable genetic diversity among orange-fleshed sweet potato genotypes and identify Bhu Kanti and CIPSWA-2 as promising genotypes for cultivation and future breeding programmes aimed at improving productivity and nutritional quality.

Keywords: Biofortification, Orange-Fleshed Sweet Potato (OFSP), B-carotene, yield, variability

Introduction

Sweet potato, scientifically known as *Ipomoea batatas* L., is a widely cultivated and consumed tuber vegetable crop with exceptional nutritional value, adaptable to diverse environmental conditions. In Assam, it holds a significant position as a prominent tuber crop, cultivated during both summer and rainy seasons, known locally as "Shakarkand" or "Mitha-Alu" and "Ronga aloo." While cherished for its high caloric content and potential for substantial yield, it plays a pivotal role in India and globally. Its utilization spans human consumption, animal feed, and limited industrial applications like starch and alcohol production. The tubers are prepared in various culinary forms, including boiling, frying, and baking. Moreover, the young leaves and shoots are occasionally consumed as greens. Sweet potato root tubers offer essential minerals, including calcium (30 mg), magnesium (24 mg), potassium (373 mg), sodium (13 mg), phosphorus (49 mg), chlorine (85 mg), sulphur (26 mg), and iron (0.8 mg) per 100 grams. These tubers also contain sugars, primarily sucrose, glucose, fructose, and maltose, accounting for 6-14% of their composition. In addition, sweet potatoes are rich in starch (20-28%), carbohydrates (28.2%), and various vitamins (Dhaliwal, 2017). Particularly, orange-fleshed sweet potatoes, abundant in β -carotene—a precursor of vitamin A, hold tremendous promise as a cost-effective source of antioxidants with a range of health benefits, including anti-oxidative properties, anti-cancer potential, and liver protection. They are increasingly recognized as an ideal bio-fortified crop to combat malnutrition, especially within small-marginal farming communities. Within India, sweet potato ranks third among major tuber crops in terms of both cultivation area and production, following potato and cassava. It is cultivated across an area of 1.16 lakh hectares in India, yielding 11.86 lakh metric tons with a productivity rate of 10.22 tons per hectare (Anonymous, 2020a). Odisha takes the lead in both the area and production of sweet potato, while the highest productivity is observed in Andhra Pradesh. However, sweet potato yield in Assam lags behind compared to other regions in India where it is extensively cultivated, such as Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Tamil Nadu, Kerala, Karnataka, and Andhra Pradesh (Hazra, 2015). A more comprehensive understanding of genetic parameters is essential as it provides valuable insights into the expected response of various traits to selection and aids in the development of optimal breeding strategies. Thus, this study was designed to evaluate genetic variability parameters among sweet potato genotypes, with a particular focus on tuber yield and yield-contributing characteristics.

Materials and Methods

Experimental setup and site description

A meticulously planned field experiment was conducted during the rabi season of 2022-2023 at the prestigious experimental farm of the Department of Horticulture, Assam Agricultural University (AAU), located in Jorhat, Assam. The experimental site, characterized by geographical coordinates of 26°47' N latitude and 94°12' E longitude, stood at an elevation of 86.80 meters above sea level.

Plant materials and genotypes

Fourteen distinct and carefully selected genotypes of orange-fleshed sweet potato (*Ipomoea batatas* L.) were chosen for this study, including Bhu Ja, Dergaon Red, Gouri, TSP16-3, CIPSAW-2, Kamala Sundari, PSP-1, TSP 16-7, S1156, Bhukanti, BhuSona, Co-1, Kiran, and TSP 16-9. These genotypes were chosen to represent a diverse range of sweet potato characteristics.

Experimental design and layout

The experiment was meticulously designed following a randomized block design methodology with the utmost precision. Each genotype was replicated two times, resulting in robust statistical reliability. The planting layout maintained a row spacing of 70 cm and a plant-to-plant spacing of 20 cm, ensuring consistent and controlled growing conditions. The resulting net plot size for each genotype was 3.5 x 2.1 meters.

Cultural practices and data collection

The cultivation of sweet potato involved the strict adherence to recommended cultural practices. These practices were consistently and uniformly applied to each experimental plot, eliminating potential sources of bias. Data were collected for a total of twenty-one traits, including key morphological parameters such as vine length, vine internode length, vine weight per plant, and tuber dimensions. Furthermore, comprehensive data were recorded on whole plant fresh and dry weights, as well as various attributes related to the tubers. Biochemical parameters, which are of paramount importance, including Total Soluble Solids (TSS) content, total carotenoids content, starch content, and the composition of sugars, were meticulously quantified.

Statistical analysis

The data collected was subjected to rigorous statistical analysis. A randomized block design model was employed for the analysis of variance to ensure the highest standards of statistical robustness.

Software and tools

The statistical analysis was conducted using RStudio version 1.4.1717 © 2009-2021, a globally recognized and state-of-the-art statistical analysis platform. This comprehensive and meticulously executed methodology aimed to provide critical insights into the genetic diversity and performance of various sweet potato genotypes, with significant implications for breeding and the advancement of sweet potato cultivation. It adhered to the highest standards of experimental design,

data collection, and statistical analysis, ensuring the utmost scientific rigor and precision.

Table 1. Genotypes of orange-fleshed sweet potato

Genotype	Name of the genotype	Source
1	Bhu Ja	AICRP TC
2	Dergaon Red	AICRP TC
3	Gouri	AICRP TC
4	TSP 16-3	AICRP TC
5	CIPSAW-2	AICRP TC
6	Kamala Sundari	AICRP TC
7	PSP-1	AICRP TC
8	TSP 16-7	AICRP TC
9	S1156	AICRP TC
10	Bhukanti	AICRP TC
11	Bhu Sona	CTCRI
12	Kiran	AICRP TC
13	Co-1	AICRP TC
14	TSP 16-9	AICRP TC

Results and Discussion

The analysis of variance (ANOVA) conducted in this study has unveiled a wealth of significant differences among the examined sweet potato genotypes for all the studied characteristics, underscoring the presence of substantial variability and inherent genetic diversity within the genotypes under investigation. A comprehensive presentation of the ANOVA results for all the examined traits is available in Table 2.

Moreover, the ANOVA focused on tuber yield and its associated traits has elucidated that the mean sum of squares attributed to genotypes was highly significant for all the examined characteristics. Notably, while the replication mean sum of squares did not exhibit significance for any of the traits, the treatment sum of squares displayed high significance across all parameters. The remarkable significance of the mean sum of squares concerning tuber yield and its associated attributes underlines the substantial variability present within the studied genotypes, offering valuable insights for the enhancement of diverse traits.

These findings align with prior research findings, echoing the works of Sahu (2003), Anshebo *et al.* (2004), Teshome *et al.* (2004), Turkey (2006), Chaurasia (2012), Mohanty (2013), Dash *et al.* (2014), and Bhadauriya *et al.* (2018) in the context of sweet potato. Similarly, the results parallel those of Sharavati *et al.* (2018) [1], Narayanmurthy *et al.* (2018) [2], Gehan (2019) [3], Seid *et al.* (2020) [4], Wani *et al.* (2023) and Vinod *et al.* (2024) [5] concerning orange-fleshed sweet potato. Collectively, these findings underscore the critical importance of genetic diversity and variability in these crop species, providing a solid foundation for further research and breeding efforts.

Table 2. Analysis of variance for tubers yield and its component characters in sweet potato

S. No.	Character	Mean sum of squares		
		Replication Df:1	Treatment DF:13	Error DF:13
1	Vine length (cm)	180.035	3955.603**	47.331
2	Internodal length (cm)	0.021	9.985**	0.003
3	Vine weight per plant (g)	5460.035	36329.336**	1374.651
4	Fresh weight of whole plant (g)	1251.570	208215.000*	1391.330
5	Dry weight of whole plant (g)	12.622	10035.600**	15.050
6	Plant dry matter content (%)	1.120	43.930**	0.990

(continued on next page)

S. No.	Character	Mean sum of squares		
		Replication Df:1	Treatment DF:13	Error DF:13
7	Fresh weight of tuber (g)	1457.285	90852.261**	1866.491
8	Dry weight of tuber (g)	10.080	4738.113**	15.036
9	Tuber dry matter content (%)	2.690	56.750**	2.320
10	Moisture content	2.686	56.748**	2.321
11	Length of the tuber (cm)	0.284	17.940*	0.424
12	Diameter of tuber (cm)	0.056	1.927**	0.017
13	Number of tubers per plant	0.012	8.494**	0.102
14	Marketable tuber yield per plant (g)	243.670	60679.571**	1830.146
15	Marketable tuber yield per hectare	1.220	303.720**	9.160
16	Total Soluble Solids (°Brix)	0.060	4.539**	0.027
17	Total carotenoids (mg/100g)	0.001	28.449**	0.005
18	Starch content (%)	0.024	36.351**	0.023
19	Total sugars (%)	0.003	5.102**	0.002
20	Reducing sugars (%)	0.007	4.537**	0.002
21	Non-reducing sugar (%)	1.728	0.051**	0.001
22	Shelf life	5.140	50.530*	0.990

**Significance at 1% level

Table 3a and 3b presents a comprehensive summary of the performance of various sweet potato genotypes across a range of essential traits. Notably, vine length displayed considerable variation, spanning from a minimum of 61.30 cm observed in the Bhu Ja genotype to a maximum of 225.20 cm in Gouri, with an average of 123.17 cm. Similarly, vine internode length exhibited a spectrum ranging from 3.71 cm in Gouri to 11.91 cm in TSP-16-3, with an average of 5.54 cm. Vine weight also demonstrated a broad diversity, with Gouri at the lower end with 146.00 g and CIPSWA-2 at the upper end with 270.00 g, yielding an average of 300.89 g. Dry matter content and tuber moisture content showed variation with averages of 27.44 and 72.56, respectively.

Moving on to tuber characteristics, tuber length varied from 15.95 cm in PSP-1 to 26.66 cm in Kamala, with a mean of 19.21 cm. The diameter of tubers spanned from 3.13 cm in TSP-16-7 to 6.18 cm in CIPSWA-2, resulting in an average of 4.35 cm. The average number of tubers per plant was 5.30, ranging from 2.50 in Gouri to 9.20 in Bhu Kanti. Furthermore, tuber weight per plant displayed notable variation, ranging from 110.10 g in Gouri to a peak of 272.80 g in CIPSWA-2, with an average of 205.58 g.

Tuber yield showcased substantial diversity, with values ranging from 17.76 to 63.50 t/ha and an overall mean of 38.48 t/ha. Bhu Kanti secured the highest tuber yield at 63.50 t/ha, closely followed by CIPSWA-2 at 59.25 t/ha, Bhu Sona at 52.74 t/ha, and S1156 at 49.31 t/ha. In contrast, the lowest tuber yield was recorded in the Gouri genotype at 17.76 t/ha.

The dry matter content of tubers ranged from the lowest in Bhu Kanti at 15.58% to the highest in PSP-1 at 34.46%, with an average of 24.90%.

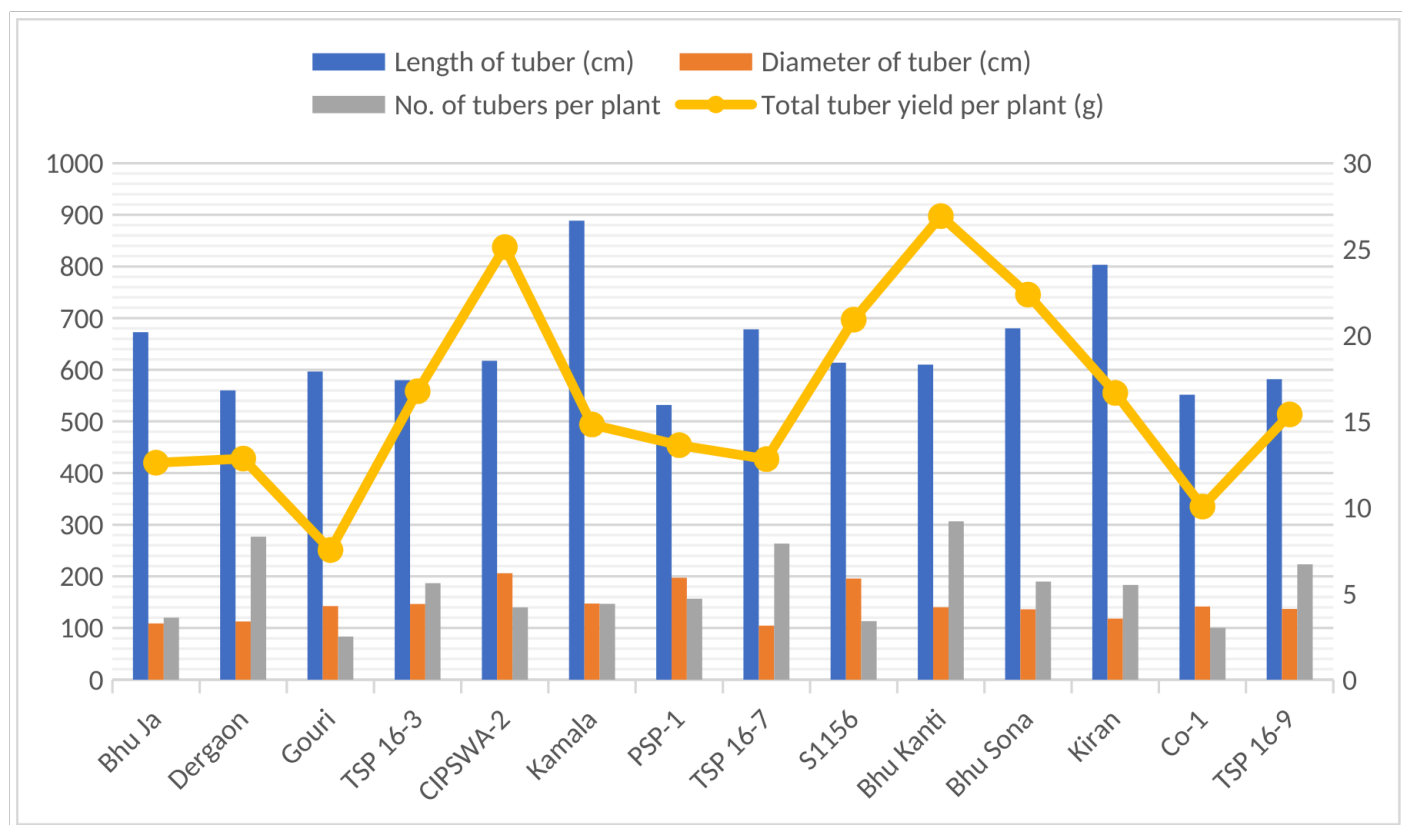
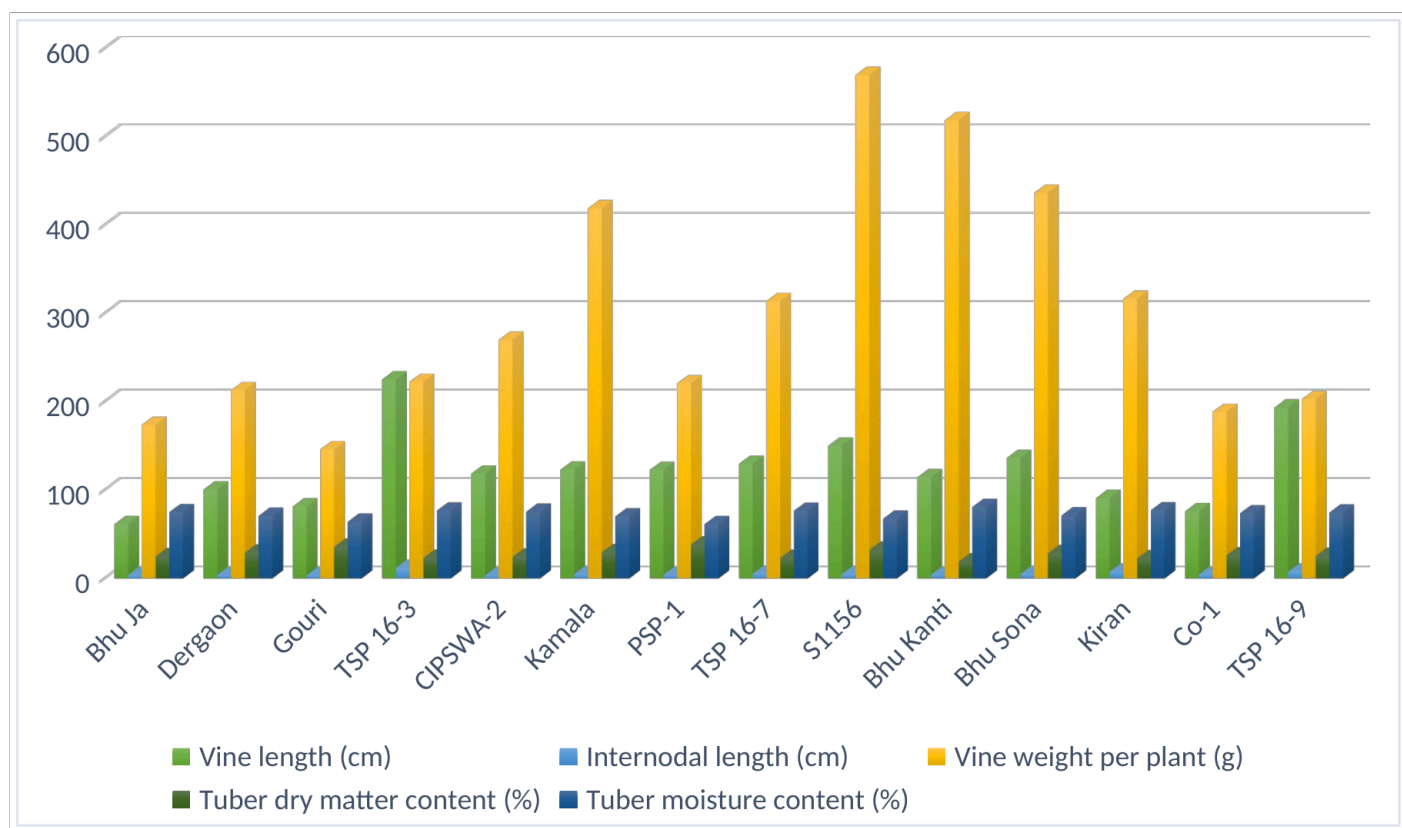
These findings underscore the significant variability in vine and tuber-related traits, TSS and starch content, and further confirm the potential for genetic diversity within these sweet potato genotypes. This variability holds great promise for crop improvement and targeted breeding programs, aligning with previous studies by Gajanayake *et al.* (2014) [6], Tiwari *et al.* (2021) [7], Mello *et al.* (2021) [8], and Pavithra *et al.* (2023) [9] in sweet potato. It emphasizes the wealth of opportunities for enhancing sweet potato performance, which is of considerable importance for both agricultural productivity and crop development initiatives.

Table 3. (a) Mean performance of orange fleshed sweet potato genotypes for various quantitative parameters

S.No.	Name of the genotype	Vine length (cm)	Internodal length (cm)	Vine weight per plant (g)	Tuber dry matter content (%)	Tuber moisture con- tent (%)
1	Bhu Ja	61.30	4.12	173.80	25.07	74.93
2	Dergaon Red	100.60	4.18	213.00	29.23	70.78
3	Gouri	81.50	3.71	146.00	35.86	64.14
4	TSP 16-3	225.20	11.91	222.60	23.18	76.82
5	CIPSWA-2	118.60	3.66	270.00	24.50	75.50
6	Kamala	123.20	5.24	418.90	29.72	70.29
7	PSP-1	122.80	4.24	221.00	38.49	61.51
8	TSP 16-7	129.70	5.56	314.00	23.42	76.59
9	S1156	150.20	5.22	570.00	32.41	67.59
10	Bhu Kanti	114.70	4.60	518.70	19.31	80.89
11	Bhu Sona	136.30	5.19	436.50	28.62	71.39
12	Kiran	90.90	7.75	316.50	22.83	77.17
13	Co-1	76.10	4.53	188.50	26.21	73.80
14	TSP 16-9	193.40	7.73	203.00	25.41	74.59

(continued on next page)

S.No.	Name of the genotype	Vine length (cm)	Internodal length (cm)	Vine weight per plant (g)	Tuber dry matter content (%)	Tuber moisture content (%)
	Gm	123.17	5.54	300.89	27.44	72.56
	<i>SEm</i> _±	4.86	0.04	26.21	1.07	1.07
	CD at 5%	14.86	0.13	80.09	3.29	3.29



Conclusion

The extensive analysis of variance conducted in this study highlights the substantial genetic diversity and inherent variability within the evaluated sweet potato genotypes, emphasizing the pivotal role of

genotypes in shaping these observed differences. The significant findings, particularly with regard to tuber yield and its associated traits, underscore the potential for significant improvements in crop productivity and quality. The high phenotypic and genotypic coefficients of

variation, along with heritability and genetic advance estimates, underscore the strong genetic influence on the studied traits, offering promising prospects for focused selection and enhancement. The genetic richness unearthed in this study provides a solid foundation for harnessing genetic diversity in sweet potato breeding programs, with the potential to revolutionize the crop and enhance its role in sustainable agriculture. This research provides a robust foundation for lever-

aging genetic diversity in sweet potato breeding programs, with profound implications for global food security and nutritional enrichment. By harnessing the natural genetic wealth uncovered in this study, researchers and breeders can continue to advance the vital sweet potato crop, addressing the demands of a growing global population with sustainable, nutritious, and abundant harvests.

Table 3. (b) Mean performance of orange fleshed sweet potato genotypes for various quantitative parameters

S.No.	Name of the genotype	Length of tuber (cm)	Diameter of tuber (cm)	No. of tubers per plant	Total tuber yield per plant (g)	Total tuber yield (t/ha)	Unmarketable tuber yield (g/plant)	Unmarketable tuber yield per hectare (t/ha)	Marketable tuber yield (g/plant)	Marketable tuber yield per hectare (t/ha)
1	Bhu Ja	20.18	3.27	3.60	420.10	29.72	33.90	2.40	386.20	27.32
2	Dergaon Red	16.80	3.38	8.30	428.00	30.28	82.00	5.80	346.00	24.48
3	Gouri	17.90	4.27	2.50	251.00	17.76	10.50	0.74	240.50	17.01
4	TSP 16-3	17.40	4.39	5.60	558.50	39.51	48.50	3.43	510.00	36.08
5	CIPSWA-2	18.52	6.18	4.20	837.50	59.25	103.00	7.29	734.50	51.96
6	Kamala	26.66	4.42	4.40	494.00	34.95	38.00	2.69	456.00	32.26
7	PSP-1	15.95	5.92	4.70	454.00	32.12	17.50	1.24	436.50	30.88
8	TSP 16-7	20.35	3.13	7.90	427.00	30.21	77.50	5.48	349.50	24.73
9	S1156	18.41	5.87	3.40	697.00	49.31	32.00	2.26	665.00	47.05
10	Bhu Kanti	18.30	4.21	9.20	897.50	63.50	71.50	5.06	826.00	58.44
11	Bhu Sona	20.40	4.09	5.70	745.50	52.74	59.00	4.17	686.50	48.57
12	Kiran	24.10	3.55	5.50	555.20	39.28	25.20	1.78	530.00	37.50
13	Co-1	16.55	4.25	3.00	335.20	23.71	27.70	1.96	307.50	21.76
14	TSP 16-9	17.45	4.10	6.70	513.50	36.33	39.00	2.76	474.50	33.57
	Gm	19.21	4.35	5.33	543.86	38.48	47.52	3.36	515.22	35.11
	SEM _±	0.46	0.09	0.22	23.18	1.64	NS	NS	31.95	2.13
	CD at 5%	1.40	0.28	0.69	70.80	5.01	NS	NS	97.60	6.54

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How to cite this article: Vinod DV, Alam S, Sharma S, Barua NS, Baishya S. Evaluation of orange-fleshed sweet potato genotypes for growth, yield and under Jorhat conditions of Assam. *International Journal of Advanced Biochemistry Research.* 2026;SP-10(10):646-650. doi: <https://www.doi.org/10.33545/26174693.2026.v10.i10Sh.10356>