Vegetable Science (2018) 45 (1) : 86-91

Genotype-by-harvesting studies in elephant foot yam (*Amorphophallus paeoniifolius* Dennst- Nicolson)

Amit Kumar Singh[*1], Arvind Kumar Chaurasiya[2] and Surajit Mitra

Received: April 2018 / Accepted: May 2018

Abstract

Studies were carried out to assess the genetic divergence and estimate substantial variation and relationship among eleven cultivar of elephant foot yam of six quantitative traits, for best suitability in eastern parts of India.Analysis of variation for such quantitative traits in different cultivars showed considerable and dissimilar level of variability. The largest variation was found for months to maturity, polar diameter, equatorial diameter, plant height, plant width, pseudo-stem girth diameter and average fresh weight of corm. Average fresh weight, pseudo-stem girth diameter and pant height was highly significant correlated with cultivar and year, however plant height, equatorial and polar diameter was significantly correlated with cultivar and year. The ranges of morphological traits *viz.,* Polar diameter 11.2-68.0 cm, Equatorial diameter 8.9-64.0 cm, pseudo-stem girth diameter 14.5-19.2, plant height 39.3-98.7 cm, plant width 96.4-126.0 cm and average fresh weight of corm 190.0-3462.5 g vary at different stages of harvesting. This information will provide researchers with the feasibility to develop desirable cultivars having high yield and better nutritional profile to uplift socio-economic status of vulnerable commodities of eastern parts of India.

Key words: *Amorphophallus paeoniifolius,* Corm, Cultivar, Morphological Changes

Introduction

Elephant foot yam [*Amorphophallus paeoniifolius* Dennst- Nicolson synonym *A. campanulatus* (Roxb.) Blume] is a perennial herbaceous diploid (2n = 2x = 26, 28) of Araceae family, that is found across Australasian and African countries (Jansen et al. 1996). The plant is distributed from close to the coastal line to an altitude up to 900 m above sea level and adapts to low light intensities (Santosaet al. 2006, Sugiyama and Santosa 2008). The crop exhibits wide agro-ecological adaptation to dry and moist lands (Jansen et al.1996, Santosa and Sugiyama 2016) and is abundant under trees shading home gardens, mixed gardens, secondary forests and agroforestry, as well as open fields (Sugiyama and Santosa 2008, Ravi et al. 2008). With ever-increasing population pressure and fast depletion of natural resources, it has become extremely important to diversify the present day agriculture in order to meet various human needs (Janardhanan et al. 2003).

It's a very popular vegetable due to high productivity, nonirritant taste, and maximum monetary return within a short period of time (Duttaet al. 2003). Mature underground corm and young shoots are used locally as important cuisine, medicineand disinfectants in many Asian countries (Sugiyama and Santosa, 2008; Ravi et al. 2009; Singh et al.2016). The starchy corms are harvested at the dormant stage in the dry or winter season (Sugiyama and Santosa, 2008), with productivity reaching 50-80 tonnes per ha annually (Ravi et al. 2009). They have played major role in the history of human diet, since they could be collected from the wild and consumed by many of the world's poorest and most foods insecure households (Harris, 1996). It contains moisture 74.8%, ash 0.73 %, fat 0.38%, protein 5.1%, carbohydrates 18.4%, crude fiber 0.6% and alkaloid (Quisumbing 1978, Jayaweera 1981, Singh et al. 2018).Along with vegetative growth in the rainy season, the plant releases some side-corms (cormels) (Sugiyama and Santosa, 2008); thus, mature elephant foot yams are commonly surrounded by their smallerramets. It is difficult to ascertain whether the tubers can be relied upon as good sources of minerals because of the presence of anti-nutrition substances (oxalate), which render the minerals, in them unavailable to the consumers. These corms are consumed by many people as a food

Department of Horticulture, BCKV, Mohanpur, Nadia, West Bengal- 741252

[1]Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh- 284003

[2]North Eastern Hills University Tura, Meghalaya- 794002

*Corresponding Author, Email: amitsinghbckv@gmail.com

and widely used in many ayurvedic preparations (Singh et al. 2017) because it contains different bioactive components like alkaloids, flavonoids, phenols, vitamins, minerals etc. (Chowdhury and Hussain, 1979; Parkinson, 1984; Sakai, 1983). The tubers of elephant foot yam are anodyne, anti-inflammatory, anti-haemorrhoidal, haemostatic, expectorant, carminative, digestive, appetizer, stomachic, anthelmintic, liver tonic, aphrodisiac, emmenagogue, rejuvenating and tonic (De et al. 2010).Systemic morphological, horticultural, and nutritional characterization for cultivars of elephant foot yam is lacking (Saikia and Borah, 1994, Singh et al. 1999). The results of qualitative evaluation of elephant foot yam by Chowdhury and Hussain (1979); and Sakai (1983) were based mainly on analyses of very few cultivars. For this study cultivars were evaluated for horticultural and nutritional parameters to provide information for breeders to develop desirable types cultivars having high yield and better nutritional profile.

Material and Methods

The field experiment was conducted as Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The station was located at 23.5 ^{O}N latitude and 89 ^{O}E longitudes with an altitude of 9.75 m above mean sea level from 2011 to 2013. The soil was a slightly acidic (pH 6.5) with sandy loam. The climate of the region is tropical humid with rainfall of 0.00 to 264.00 mm, temperature maximum 37.59 ^{O}C and minimum 9.62 ^{O}C along with RH (%) 96.87 to 36.74 (Annual average). Eleven genotypes/varieties were tested in six harvesting periods for various agro-morphological traits. The observations were recorded on growth attributes like Plant height (cm), plant width (cm), average fresh weight (g), polar diameter (cm), equatorial diameter and pseudo-stem girth diameter at monthly intervals. All the laboratory data were subjected to Complete Randomized Design (CRD) as suggested by Raghuramula (1983). The critical difference (CD) value at 5% level of probability was used for comparing the treatments and to find out the significant difference in between them. Each treatment was replicated for three times. The data analyzed with the help of statistical software from AGRES version 3.01 (Data Entry Module for Ag Res Statistical Software <c> 1994 Pascal Intl software solution).

Results and Discussion

Polar diameter: The results showed changes of the polar diameter according to the cultivar and year during growth and development. Significantly higher value in polar diameter was recorded in BCA-6, NDA-9, IGAM-1, BCA-1, Gajendra and BCA-4 (16.00, 15.30, 15.00, 14.30, 13.70 and 13.60 cm, respectively) at 100 DAP while, lowest value (11.2 cm) was shown by NDA-4, by NDA-5 and AC-28 similar. Conversely, the cultivars BCA-4, BCA-1, NDA-9, BCA-5 and NDA-4 recorded significantly higher polar diameter at 250 DAP (68.00, 64.4, 64.30, 63.10 and 62.70 cm, respectively) while lowest in IGAM-1 (53.10 cm), fallowed by AC-28, Gajendra, BCA-6 and BCA-2 (54.50, 55.30, 62.10 and 62.10 cm, respectively). The variation in polar diameter depends upon cultivars, cultural practices and climatic conditions. The polar diameter has been affected significantly with cultivar and year ($P < 0.05$). The results are in line with that of Panja and Adhikary (2016), and Chattopadhyay et al. (2009) in elephant foot yam.

Table 1 Changes in polar diameter/periphery (cm) in elephant foot yam corm during growth and development period

Cv.\DAP	100			130			160			190			220			250		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	12.6	16.0	14.3	30.5	32.0	31.3	37.0	39.0	38.0	59.7	59.0	59.4	63.5	64.0	63.8	64.2	64.5	64.4
BCA-2	13.3	12.5	12.9	33.0	31.0	32.0	41.2	39.3	40.3	53.9	57.7	55.8	61.9	61.3	61.6	62.0	62.1	62.1
BCA-4	11.0	16.2	13.6	39.4	38.4	38.9	43.8	45.0	44.4	55.5	61.5	58.5	68.1	67.3	67.7	67.8	68.1	68.0
BCA-5	12.7	11.5	12.1	30.4	31.0	30.7	34.3	36.0	35.2	52.3	54.0	53.1	65.0	62.4	63.7	62.8	63.4	63.1
BCA-6	13.7	18.3	16.0	33.5	32.4	33.0	36.5	38.8	37.7	54.6	56.3	55.5	60.6	62.0	61.3	61.7	62.4	62.1
NDA-4	8.7	13.7	11.2	30.1	31.2	30.7	38.7	37.5	38.1	53.2	55.0	54.1	60.0	61.8	60.9	62.9	62.5	62.7
NDA-5	11.4	10.9	11.2	36.1	38.8	37.5	41.3	43.0	42.2	58.1	56.7	57.4	61.1	62.1	61.6	62.0	62.9	62.5
NDA-9	13.6	16.9	15.3	41.5	42.7	42.1	44.1	48.5	46.3	58.3	57.0	57.7	61.5	63.8	62.7	64.0	64.5	64.3
AC-28	11.6	10.7	11.2	31.1	32.8	32.0	36.2	37.3	36.8	46.2	46.6	46.4	52.3	54.5	53.4	54.0	55	54.5
IGAM-1	12.6	17.4	15.0	34.5	33.5	34.0	40.4	39.2	39.8	47.1	45.6	46.4	51.8	52.7	52.3	52.7	53.5	53.1
Gajendra	11.2	16.2	13.7	29.5	31.0	30.3	41.3	39.0	40.2	50.3	50.2	50.2	52.2	53.9	53.1	56.0	54.6	55.3
Mean	12.0	11.1	13.3	35.0	34.1	33.8	39.5	40.2	39.9	55.2	54.5	54.9	59.8	61.9	60.9	60.9	62.4	61.7
	CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed	
	0.05			0.05			0.05			0.05			0.05			0.05		
C	0.573	0.284	**	0.640	0.317	**	2.722	1.349	**	2.438	1.208	**	2.806	1.390	**	2.043	1.012	**
Y	0.244	0.121	**	0.273	0.135	**	1.161	0.575	NS	1.039	0.515	NS	1.196	0.592	NS	0.871	0.432	NS
CY	0.811	0.402	**	0.906	0.448	**	3.851	1.907	NS	3.448	1.708	NS	3.968	1.966	NS	2.890	1.432	NS

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

Table 2 Changes in equatorial diameter (cm) in elephant foot yam corm during growth and development period

Cv.\ DAP	100			130			160			190			220			250		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	13.4	15.2	14.3	17.8	19.3	18.6	34.7	36.2	35.5	54.9	53.7	54.3	59.5	60.2	59.9	60.5	61.5	61.0
BCA-2	12.5	13.4	13.0	16.5	16.8	16.7	33.5	34.5	34.0	36.3	35.8	36.1	37.0	36.8	36.9	37.3	38.7	38.0
BCA-4	9.5	11.2	10.4	13.9	15.1	14.5	26.7	28.9	27.8	42.8	43.5	43.2	55.2	56.1	55.7	55.6	56.4	56.0
BCA-5	12.4	14.4	13.4	16.1	18.2	17.2	28.7	27.9	28.3	54.0	58.6	56.3	63.5	63.0	63.3	63.7	64.0	63.9
BCA-6	13.6	15.1	14.4	16.8	19.3	18.1	29.5	31.5	30.5	40.5	44.3	42.4	45.2	45.0	45.1	45.9	46.0	46.0
NDA-4	7.4	10.3	8.9	12.6	14.4	13.5	25.8	25.2	25.5	39.2	43.0	41.1	44.0	42.6	43.3	44.4	44.0	44.2
NDA-5	9.2	10.8	10.0	13.7	15.3	14.5	26.9	28.4	27.7	41.2	39.0	40.1	50.0	47.8	48.9	50.2	49.0	49.6
NDA-9	12.5	14.6	13.6	15.9	18.8	17.4	28.5	27.7	28.1	51.4	50.5	51.0	55.0	55.3	55.2	55.6	56.0	55.8
AC-28	12.0	12.9	12.5	16.2	17.2	16.7	28.9	32.1	30.5	45.7	46.4	46.1	54.1	53.0	53.6	54.5	53.4	54.0
IGAM-1	12.8	15.1	14.0	17.0	19.1	18.1	28.0	27.9	28.0	53.2	52.8	53.0	58.1	58.4	58.3	58.4	59.0	58.7
Gajendra	9.0	10.2	9.6	14.5	14.6	14.6	27.3	32.4	29.9	43.5	46.9	45.2	54.0	54.7	54.4	54.8	55.2	55.0
Mean	11.3	13.02	12.2	15.5	17.1	16.3	29.0	30.2	29.6	45.7	46.8	46.2	52.3	52.1	52.2	52.8	53.0	52.9
	CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed	
C	3.170	1.570	**	2.759	1.367	**	0.887	0.439	**	3.706	1.836	**	1.052	0.521	**	1.362	0.675	**
Y	1.352	0.699	**	1.177	0.583	**	0.378	0.187	**	1.580	0.783	NS	0.448	0.222	NS	0.581	0.288	NS
CY	4.483	2.221	NS	3.902	1.933	NS	1.255	0.622	**	5.241	2.596	NS	1.489	0.737	NS	1.926	0.954	NS

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

Equatorial diameter: The analysis of variance showed that equatorial diameter was highly significant ($P < 0.05$) to all treatments (Table 2). At the early stage of corm development at 100 DAP, the cultivar BCA-6, BCA-1, IGAM-1, NDA-9 and BCA-5 recorded significantly higher equatorial diameter (14.4, 14.3, 14.0, 13.6 and 13.4 cm, respectively). Whereas, significantly lower equatorial diameter was recorded in the cultivars NDA-4, Gajendra, NDA-5 and BCA-4 with values 8.9, 9.6, 10.0 and 10.4 cm, respectively at 100 DAP. At 250 days after planting maximum value 63.9 cm was recorded in cv., BCA-5, which was *at par* with BCA-1, IGAM-1, BCA-4, NDA-9 and Gajendra (61.1, 58.7, 56.0, 44.2 and 55.0 cm, respectively). Minimum equatorial diameter was recorded in cv.,BCA-2 (38.0 cm) and NDA-4 (44.2 cm) at 250 DAP. Taking into consideration during growth and development period it was observed that there was significant variation in mean equatorial diameter with the value ranging from 8.9 to 63.9 cm. The results corroborate the findings of Chattopadhyayet al. (2009) and Panja and Adhikary (2016) in elephant foot yam.

Plant height: The result presented in Table 3 showed that a steady growth was found in elephant foot yam height during growth and development, and cultivar Gajendra showed highest height among the all cultivar

Table 3 Changes in plant height (cm) in elephant foot yam corm during growth and development period

Cv.\DAP	100			130			160			190		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	61.1	57.4	59.2	78.0	74.3	76.1	84.7	87.5	86.1	88.5	88.0	88.2
BCA-2	57.3	59.7	58.5	67.8	72.9	70.3	81.8	85.5	83.6	88.2	87.3	87.8
BCA-4	54.5	58.6	56.5	73.3	74.6	73.9	82.5	84.6	83.5	86.2	86.0	86.1
BCA-5	51.3	55.7	53.5	71.8	77.8	74.8	91.9	94.5	93.2	95.5	96.2	95.8
BCA-6	35.5	44.4	39.9	59.6	69.0	64.3	74.3	78.9	76.6	79.9	80.1	80.0
NDA-4	38.5	47.8	43.1	60.6	61.6	61.1	74.3	74.9	74.6	77.2	76.9	77.0
NDA-5	44.0	58.6	51.3	65.4	69.3	67.3	72.0	77.3	74.6	78.2	79.3	78.7
NDA-9	55.7	51.3	53.5	64.7	59.5	62.1	71.2	65.7	68.4	73.5	71.0	72.3
AC-28	39.0	44.5	41.7	52.5	59.9	56.2	62.1	63.3	62.7	63.2	65.2	64.2
IGAM-1	36.1	42.4	39.3	56.5	54.5	55.5	62.7	60.8	61.7	62.1	63.8	62.9
Gajendra	57.8	62.6	60.2	69.8	75.8	72.8	87.6	88.3	87.9	98.9	98.5	98.7
Mean	48.2	53.0	50.6	65.4	68.1	66.7	76.8	78.3	77.5	81.0	81.1	81.1
	CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed	
C	1.481	0.734	**	7.015	3.475	**	7.060	3.497	**	2.291	1.135	**
Y	0.631	0.313	**	2.991	1.481	NS	3.010	1.491	NS	0.977	0.484	NS
CY	2.095	1.038	**	9.921	4.915	NS	9.984	4.946	NS	3.240	1.605	NS

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

from 100 to 190 DAP (60.20 and 98.68 cm, respectively). Data pertaining at 100 DAP was lowest (39.25 cm) in cultivar IGAM-1 fallowed by BCA-6, AC-28 and NDA-4 (39.94, 41.70 and 43.13 cm, respectively) and at 190 DAP cultivar IGAM-1 attained the least (62.90 cm) height among all cultivars fallowed by AC-28, NDA-9, NDA-4, NDA-5 and BCA-4 (64.15, 72.25, 77.00, 78.77 and 86.08 cm, respectively). It also showed that the cultivar IGAM-1 recorded the lowest height at all stage of growth and development. Such variation in plant height might be related to their genetic origin, geographical sources, and the level of soil fertility, where they are grown.

Canopy diameter: The cultivars showed significant variation in total canopy diameter of elephant foot yam plant during growth and development (Table 4). Significantly higher value in plant canopy diameter was showed in cultivar NDA-5, NDA-9, BCA-6, BCA-2 and Gajendra (117.20, 115.00, 114.25, 111.90 and 11.15 cm, respectively) at 100 DAP. The lowest value (96.35 cm) was shown by IGAM-1 at 100 DAP. Conversely, the cultivars NDA-9, NDA-5, BCA-6, BCA-5 and Gajendra recorded significantly higher plant canopy diameter at 250 DAP (126.00, 125.70, 125.35, 124.00, and 121.00 cm, respectively) while lowest in NDA-4, IGAM-1, AC-28, BCA-1, BCA-2 and BCA-4 (112.00, 113.00, 114.20, 114.85, 117.50 and 118.50 cm, respectively). The results agree with Chattopadhyay et al., (2009) in elephant foot yam.

Pseudo-stem girth diameter: Pseudo-stem girth diameter was significantly influenced by cultivars during growth and development (Table 5). The maximum equal

Table 4 Changes in canopy diameter (cm) in elephant foot yam corm during growth and development period

Cv.\DAP	100			130			160			190		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	101.2	104.4	102.8	109.3	113.2	111.3	113.3	115.1	114.2	114.2	115.5	114.9
BCA-2	109.6	114.2	111.9	113.6	116.8	115.2	116.4	118.0	117.2	116.0	119.0	117.5
BCA-4	102.8	109.3	106.1	117.9	111.7	114.8	119.9	116.3	118.1	120.3	116.7	118.5
BCA-5	113.2	109.3	111.3	123.0	111.7	117.4	127.0	119.9	123.5	127.6	120.4	124.0
BCA-6	117.9	110.6	114.3	120.2	114.6	117.4	128.0	121.7	124.8	128.4	122.3	125.4
NDA-4	97.3	101.6	99.5	102.5	106.8	104.7	112.3	110.3	111.3	113.0	111.0	112.0
NDA-5	119.0	115.4	117.2	125.8	120.2	123.0	127.9	122.5	125.2	128.3	123.1	125.7
NDA-9	113.0	117.0	115.0	118.9	119.6	119.3	123.7	126.8	125.3	124.5	127.5	126.0
AC-28	96.0	101.8	98.9	113.9	100.0	107.0	119.8	107.5	113.7	120.4	108.0	114.2
IGAM-1	95.3	97.4	96.4	99.3	106.2	102.7	109.6	115.0	112.3	110.3	115.7	113.0
Gajendra	113.3	109.0	111.2	98.8	115.8	107.3	107.5	120.8	114.1	121.2	121.5	121.4
Mean	107.2	108.2	107.7	113.0	112.4	112.7	118.7	117.6	118.1	120.4	118.3	119.3
	CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed	
C	6.666	3.302	**	2.022	1.001	**	1.702	0.843	**	2.244	1.113	**
Y	2.842	1.408	NS	0.862	0.427	NS	0.726	0.359	**	0.957	0.474	**
CY	9.427	4.670	NS	2.860	1.417	**	2.408	1.192	**	3.174	1.572	**

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

Table 5 Changes in pseudo-stem girth diameter (cm) in elephant foot yam corm during growth and development period

Cv.\DAP	100			130			160			190		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	15.7	16.0	15.9	16.5	16.4	16.5	16.8	16.0	16.4	16.9	16.4	16.6
BCA-2	17.0	18.5	17.8	17.5	18.8	18.2	18.4	19.2	18.8	18.6	19.4	19.0
BCA-4	16.6	16.4	16.5	17.3	17.8	17.5	17.5	18.2	17.9	18.1	18.4	18.3
BCA-5	16.7	18.8	17.8	17.1	19.2	18.2	17.8	19.5	18.7	18.0	19.6	18.8
BCA-6	11.9	18.5	15.2	14.5	19.0	16.8	15.3	19.3	17.3	16.1	19.5	17.8
NDA-4	13.9	18.0	16.0	15.4	18.4	16.9	16.5	18.8	17.7	17.0	19.0	18.0
NDA-5	12.2	16.7	14.5	13.8	17.2	15.5	16.5	17.5	17.0	17.3	17.7	17.5
NDA-9	17.1	18.4	17.8	18.0	19.0	18.5	18.4	19.7	19.1	18.6	19.8	19.2
AC-28	14.4	18.6	16.5	16.3	19.8	18.0	16.9	20.0	18.5	17.1	20.1	18.6
IGAM-1	14.7	16.2	15.5	15.5	16.6	16.1	16.3	17.0	16.7	16.8	17.2	17.0
Gajendra	14.9	17.7	16.3	16.0	18.2	17.1	16.5	18.7	17.6	16.6	18.9	17.7
Mean	15.0	17.6	16.3	16.2	18.2	17.2	17.0	18.5	17.8	17.4	18.7	18.0
	CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed		CD 0.05	S Ed	
C	2.149	1.064	*	0.722	0.357	**	0.838	0.415	**	2.841	1.407	NS
Y	0.916	0.454	**	0.308	0.152	**	0.357	0.177	**	1.211	0.600	*
CY	3.039	1.505	NS	1.021	0.506	**	1.185	0.587	**	4.017	1.990	NS

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

Table 6 Changes in Average fresh weight (g) of corm in elephant foot yam during growth and development period

Cv.\DAP	100			130			160			190			220			250		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
BCA-1	324.9	390.0	357.4	565.0	580.0	572.5	1010.0	1035.0	1022.5	1750.2	1625.0	1687.6	2100.4	1800.0	1950.2	2050.0	2130.0	2090.0
BCA-2	440.1	460.0	450.0	741.8	650.0	695.9	1280.0	1100.0	1190.0	1405.0	1250.0	1327.5	1970.0	2040.0	2005.0	2030.0	2105.0	2067.5
BCA-4	570.0	435.0	502.5	1604.0	1250.0	1427.0	1925.0	1450.0	1687.5	2430.0	1840.0	2135.0	2875.0	2545.0	2710.0	2935.0	2650.0	2792.5
BCA-5	530.0	610.0	570.0	1730.0	960.0	1345.0	2490.0	1990.0	2240.0	3260.0	3110.0	3185.0	3450.0	3370.0	3410.0	3500.0	3425.0	3462.5
BCA-6	359.7	560.0	459.8	750.1	850.0	800.0	1100.0	1150.0	1125.0	1985.8	2130.0	2057.9	2595.0	2600.0	2597.5	2630.0	2635.0	2632.5
NDA-4	425.3	530.0	477.7	1075.0	975.0	1025.0	1764.9	1680.0	1722.4	2174.7	2030.0	2102.3	2424.3	2350.0	2387.2	2500.3	2420.0	2460.2
NDA-5	210.0	490.0	350.0	546.0	720.0	633.0	987.0	1390.0	1188.5	1460.0	1610.0	1535.0	1630.0	1805.0	1717.5	1665.0	1850.0	1757.5
NDA-9	450.0	865.0	657.5	1154.3	1100.0	1127.2	1846.4	1850.0	1848.2	2405.8	2560.0	2482.9	2897.3	2700.0	2798.7	2940.0	2775.0	2857.5
AC-28	350.0	260.0	305.0	625.0	550.0	587.5	1200.0	1180.0	1190.0	2110.0	1990.0	2050.0	2310.0	2250.0	2280.0	2370.0	2310.0	2340.0
IGAM-1	280.0	225.0	252.5	542.3	590.0	566.1	989.0	950.0	969.5	1350.0	1135.0	1242.5	1445.0	1460.0	1452.5	1500.0	1530.0	1515.0
Gajendra	170.1	210.0	190.0	680.0	590.0	635.0	1190.3	900.0	1045.2	1685.7	1580.0	1632.8	2035.0	1945.0	1990.0	2110.0	2035.0	2072.5
Mean	373.6	457.7	415.7	910.3	801.4	855.8	1434.8	1334.1	1384.4	2001.6	1896.4	1949.0	2339.3	2260.5	2299.9	2384.6	2351.4	2368.0
	CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed		CD	S Ed	
	0.05			0.05			0.05			0.05			0.05			0.05		
C	19.012	9.419	**	6.849	3.933	**	19.730	9.774	**	6.643	3.291	**	19.347	9.584	**	18.391	9.111	**
Y	8.106	4.016	**	2.921	1.446	**	8.413	4.167	**	2.832	1.403	**	8.249	4.086	**	7.842	3.885	**
CY	26.887	13.320	**	9.687	4.798	**	27.903	13.823	**	9.394	4.654	**	27.361	13.554	**	26.009	12.885	**

C-Cv.- Cultivar; Y- Year; CD- Critical Difference at 5 %; S Ed- Standard Error of Deviation; DAP- Days After Planting; R- Replication (3); NS- Non Significant; **- Highly Significant; *- Significant

diameter was (17.75 cm) recorded in cultivar BCA-2, NDA-9 and BCA-4, similarly in cv., BCA-4 and AC-28(16.5 cm) at 100 DAP but at 190 DAP it was found that the BCA-2 recorded the highest (19.98 cm) pseudo-stem girth diameter fallowed by NDA-9, BCA-5, AC-28 and BCA-4 (19.18, 18.80, 18.60 and 18.25 cm, respectively). At 100 DAP cultivar NDA-5 attained the least diameter (14.45 cm) fallowed by IGAM-1, BCA-1, NDA-4 and Gajendra (15.45, 15.85, 15.95 and 16.30 cm, respectively) and at 190 DAP cultivar BCA-1 recorded the lowest (16.60 cm) diameter fallowed by IGAM-1, NDA-5, Gajendra and BCA-6 (17.00, 17.50, 17.73 and 17.80 cm, respectively).In all four stages of development, maximum (19.98 cm) and minimum (16.6 cm) pseudo-stem girth diameter was recorded in BCA-2 and BCA-1, respectively. Varietal differences in pseudo-stem girth at different development stages were also observed by Goswami (1990) and Kumar et al. (2014).

Average fresh weight of corm: Average weight of the corms also varied significantly among the different cultivars (Table 6). At the early stage of harvesting *i.e.,* at 100 DAP, the cultivar NDA-9, BCA-5, BCA-4 and NDA-4 exhibited significantly higher amount of average fresh weight of corm (657.5, 570.0, 502.5 and 477.6 g, respectively). Whereas, significantly lower fresh weight of corm was obtained from cultivars Gajendra, IGAM-1, AC-28, NDA-5 and BCA-1 with 109.0, 252.5, 305.0, 350.0 and 357.4 g fresh weight, respectively.At 250 DAP maximum value (3462.5 g) was recorded in cv., BCA-5, which was *at par* with cv., NDA-9, BCA-4, and BCA-6 (2857.5, 2792.5 and 2632.5 g, respectively). Minimum fresh weight of corm was found in IGAM-1 (1515.0 g) and NDA-5 (1757.5 g). Taking into consideration all the maturity stages, it was observed that there was significant variation in mean fresh weight of corm with the value ranging from 109.0 to 3462.5 g.

lkjk'k

यह अध्ययन वैज्ञानिको और उत्पादको के लिये काफी उपयुक्त होगी तथा इसका उपयोग अधिक उपज व नई प्रजाति विकसित करने में लाभकर होगी। जिमीकन्द के 11 प्रभेदों के मध्य अनुवांशिक प्रसंस्करण एवं प्रचुर विविधता व उनके सम्बन्ध में 6 गुणों हेतु आपसी मात्रात्मक योगदान को ज्ञात करने के लिए मूल्यांकन किया गया जिनसे भारत के उत्तरी भागों हेतु प्रभेद का चयन किया गया। इनके विश्लेषण विविधता से स्पष्ट हुआ कि असमानुपाती विविधता मौजूद हैं सबसे अधिक विविधता पकने वाले महीनों, ध्रवीय व्यास, मध्य रेखीय पौध, ऊँचाई, पौध का फैलाव, कूट तना व्यास/परिधि एवं प्रजाति व वर्ष हेतु सार्थक सहसम्बन्ध पाया गया जबकि पौध ऊँचाई ध्रुवीय व मध्य रेखीय व्यास भी प्रजाति व वर्ष से सहसम्बंध को स्पश्ट किए। कार्यकीय गुणों का प्रसरण जैसे ध्रुवीय व्यास 11.2–68.0 सेमी., मध्य रेखीय व्यास 8.9–64.0 सेमी., कूट तना व्यास 14.5–19.2 सेमी., पौध ऊँचाई 39.3–98.7 सेमी., पौध फैलाव 96.4–126 सेमी. तथा औसत ताजा कन्द उपज 190–3462.5 ग्राम जननद्रव्यों/प्रजातियों एवं कटाई की विभिन्न अवस्था में पाया गया।

References

Chattopadhyay A, Saha B, Pal S, Bhattacharya A and Sen H (2009) Quantitative and qualitative aspects of elephant foot yam. Int J Veg Sci 16(1): 73-84.

Chowdhury B and Hussain M (1979) Chemical composition of the edible parts of aroids grown in Bangladesh. Indian J Agri Sci 49(2): 110–115.

De S, Dey YN and Ghosh AK (2010) Phytochemical investigation and chromatographic evaluation of the different extracts of tuber of *Amorphophallus paeoniifolius* (Araceae). Int J Pharmac Biomed Res 1(5): 150-157.

Dutta D, Chattopadhyay A and Mukherjee A (2003) Response of elephant foot yam to cut and whole seed corm and potassium in acid alluvium. Journal of Interacademicia 7(1): 31-34.

Harris J (1996) Wild yam gathering. Macmillan science library: 67-101.

Janardhanan K, Vadivel V and Pugalenti M (2003) Biodiversity in Indian underexploited/tribal pulses. *In*: Improvement Strategies for Leguminosae Biotechnology. Jaiwal, P.K. and Singh, R.P. (Eds.), Kluwer Academic Publishers, Great Britain, pp: 353-405.

Jansen PCM, Wilk CV and Hetterscheid WLA (1996) *Amorphophallus* Blume ex Decaisne. *In* M. Flach and F. Rumawas (Eds.). PROSEA 9: Plant Yielding Non- seed Carbohydrates. Backhuys Publ. Leiden pp 45—50.

Jayaweera DMA (1981) Medicinal Plants used in Ceylon Part 1. National Science Council of Sri Lanka, Colombo.

Kumar S, Singh PK, Solankey SS and Singh BK (2014) Genotypic × environment interaction and stability analysis for yield and quality components in elephant foot yam [*Amorphophallus paeoniifolius* (Dennst) Nicolson]. African J Agric Res 9 (7): 707-712.

Panja P and Adhikary S (2016) Diversity of physical and bio-chemical properties in some elephant foot yam cultivars at harvest fresh stage. The Bioscan 11(2): 1193-1198.

Parkinson S (1984) The contribution of aroids in the nutrition of people in the South Pacific, In: S. Chandra (ed.). Edible aroids. Oxford: Clarendon Press, 215-224.

Quisumbing E (1978) Eduardo: Medicinal Plants of the Philippines. Katha Publishing Company. JMC PRESS, Quezon City, Philippines.

Raghuramula H, Madhavan NK and Sundaram K (1983)A Manual of Laboratory Technology. National Institute of Nutrition. Indian Council of Medical Research, Jamia-Osmania, Hyderabad.

Ravi V, Ravindran CS and Suja G (2009) Growth and productivity of elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson): An overview. J Root Crops 35: 131-142.

Saikia T and Borah RC (1994) Biochemical composition of acrid and non acrid *Amorphophallus* corms. Agri Res J Kerala 7(1): 90-91.

Sakai WS (1983) Aroid root crops: *Alocasia, Cyrtosperma* and *Amorphophallus*. In: Chan J Jr (Ed) Handbook of tropical foods. Marcel Dekker, New York, pp 29-83.

Santosa E and Sugiyama N (2016) *Amorphophallus* species in East Nusa Tenggara Islands, Indonesia. Tropical Agriculture Development 60(1): 53-57.

Santosa E, Sugiyama N, Nakata M, Lee ON (2006) Growth and corm production of *Amorphophallus* at different shading levels in Indonesia. Japanese J Tropical Agri 50(2): 87-91.

Singh A, Chaurasiya AK and Mitra S (2016) Assessment of nutritional composition in elephant foot yam (*Amorphophallus paeoniifolius*) cultivars. Int J Food Studies 5: 146-157.

Singh AB, Awasthi CP and Singh N (1999) Biochemical composition and nutritive value of promising collections of promising collections of different elephant foot yam (*Amorphophallus campanulatus* Roxb.). Vegetable Science 26(2): 186–187.

Singh AK, Chaurasiya AK and Mitra S (2017) Assessment of anti-nutritional changes in elephant foot yam (*Amorphophallus paeoniifolius*) cultivars. Vegetable Science 44(2): 57-61.

Singh AK, Chaurasiya AK and Mitra S (2018) Consumer acceptance of lactic acid fermented elephant foot yam pickle. Chemical Sci Rev Letters 7(25) 88-93.

Sugiyama N and Santosa E (2008) Edible Amorphophallus in Indonesia: A potential crops in agroforestry. Yogyakarta: GadjahMada University Press 125.