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Original Research Article

Genetic Evaluation of Genotypes for Variability in Elephant Phoot Yam

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A B S T R A C T

The present study was conducted with the objective o know the extent of variability among the genotypes of elephant phoot yam. The experimental material comprising thirty genotypes which, were evaluated during four environments (2 open field and 2 shade condition) in 2013-2014. The evaluations were conducted in randomized block design with three replications and observations were recorded on yield and quality attributes. The analysis of variance revealed that wide range of variation found among the genotypes for all the traits. The estimates of phenotypic coefficient of variation were higher than the corresponding genotypic coefficient of variation for all the traits. The estimates of phenotypic as well as genotypic coefficients of variation were observed for calcium oxalate, weight of cormels per plant. While high PCV observed for number of cormels per plant. Highest heritability estimates were observed for days required to maturity followed by starch content, days taken for sprouting and weight of corm per plant. High heritability accompanied with high genetic advance was estimated for days taken for sprouting, weight of cormels per plant. However, high heritability and moderate genetic advance was analysed for starch.

Keywords

PCV, GCV, heritability and elephant phoot yam

Introduction

Elephant foot yam [*Amorphophallus paeoniifolius* (Dennst) Nicolson] belongs to family araceae basically a crop of South East Asian origin. It is commonly known as sooran, zimikand, ole, suwarngatty, kundudumpa, balookan, olakachu, etc. in various parts of country. It is a tropical tuber crop that offers excellent scope for adaptation in the tropical climate as a cash crop because of high production potential and popularity for various delicious cuisines.

Botanically, elephant foot yam is an underground stem tuber, grown as a summer vegetable and harvested at the time when there is a scarcity of vegetables in the market (Rashid, 1983). Its cultivation is more or less limited to India, Philippines, Indonesia, Srilanka, Malaysia and South East Asian nations. It is, in general, considered as famine food in Pacific Island (Thaman, 1984).

In India, this crop is traditionally cultivated in Andhra Pradesh, Gujarat, Kerala, Karnataka, Maharashtra, Tamilnadu and North Eastern states (Nedunchazhiyan, 2002). Local cultivars are mostly grown in kitchen garden in North Eastern states. Considering the gains from this crop, farmers of this region have started taking interest in cultivation.

The variability available in a population could be partitioned into heritable and non-heritable components with the aids of genetic parameters such as genotypic coefficient of variation, heritability and genetic advance which also serve as basis for selection. The magnitude of genetic variability forms the basis for crop improvement. The success of any breeding programme depends on the nature and amount of genetic variability available in the breeding materials. The extent of transmission of quantitative characters from parents to the off-springs depends upon the heritability of the particular character. The heritability value dose not have much significant as it fails to account for the magnitude of absolute variability. It is, therefore, necessary to utilize heritability along with genetic advance while advocating for selection. Genetic advance provides information on expected genetic gain resulting from selection of superior genotypes.

Materials and Methods

The present investigation was carried out during 2013 and 2014 at two locations. These locations were Main Experiment Station, Department of Vegetable Science, and MES Horticulture under Aonla shade, Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad (U.P.) which is situated at 26.47 ^{0}N latitude and 82.12 ^{0}E longitude having an elevation of 113 m above the mean sea level. The soil type of Kumarganj is saline having pH value of 8.2 and soil type of Sultanpur is sandy loam with pH value of 7.9.

Treatment of planting materials

Corms were treated with DM-45 and monocrotophos solution of 2.0 and 2.5 % for 30 minute to avoid incidence of soil borne fungal diseases and dried in shade before planting.

The observation was recorded on traits *viz.*, days taken for sprouting, emergence (%), shoot height (cm), stem girth (cm days required to maturity, number of cormels per plant, weight of cormels per plant (g), weight of corm per plant (kg), size of corm (cm^2), yield (t/ ha)), moisture (%), dry matter (%), starch (%) and calcium oxalate (%) on ten selected plants of each treatment in each replication. Average of the data from the sampled plant of each treatment was used for statistical analyses in order to draw valid conclusions. The following observations were recorded during the course of experimentation in different environments i.e. E_1, E_2, E_3 and E_4.

The data were analysed for coefficient of variation (Burton and De Vane, 1953), heritability (Hanson *et al.*, 1956), genetic advance (Johanson *et al.*, 1955).

Results and Discussion

The analysis of variance was carried out for the fourteen quantitative traits *viz.*, days taken for sprouting, emergence (%), shoot height (cm), stem girth (cm days required to maturity, number of cormels per plant, weight of cormels per plant (g), weight of corm per plant (kg), size of corm (cm^2), yield (t/ ha), moisture (%), dry matter (%), starch (%) and calcium oxalate (%). The analysis of varance revealed that highly significant mean squares due to genotypes were observed for all the traits during all the four environments (E_1, E_2, E_3, E_4) and over environments (pooled) (Table-1, Table-2, Table-3, Table-4 and Table-5). Further the pooled analysis of variance revealed that mean squares due to environments were found significant for all the traits.

Table.1 Analysis of variance (ANOVA) for various traits among twenty five genotypes of Elephant foot yam in open field during 2013 (E_1)

Source of variation	d.f.	Days taken for sprouting	Emergence %	Shoot height(cm)	Shoot girth(cm)	Days required to maturity	NO. Of cormels per plant	Weight of cormels per plant	Weight of corms per plant(kg)	Size of corm(cm)	Yield(t/ha)	Moisture(%)	Dry matter(%)	Starch(%)	Calcium oxalate(%)
Replication	2	6.65	5.75	4.56	0.04	6.35	0.09	20.69	0.01	1963.36	4.10	0.07	0.07	0.06	0.000
Genotypes	24	183.30**	85.29**	47.69**	21.04**	690.73**	9.71**	9887.25**	0.13**	54426.33**	63.04**	6.08**	6.08**	10.42**	0.003**
Error	48	4.65	2.21	6.15	1.26	2.63	0.22	169.53	0.01	2769.74	3.32	0.14	0.14	0.04	0.000

*, ** = significant at 5% and 1% levels, respectively

Table.2 Analysis of variance (ANOVA) for various traits among twenty five genotypes of Elephant foot yam in open field during 2014 (E_2)

Source of variation	d.f.	Days taken for sprouting	Emergence %	Shoot height(cm)	Shoot girth(cm)	Days required to maturity	No. of cormels per plant	Weight of cormels per plant	Weight of corms per plant(kg)	Size of corm(cm)	Yield (t/ha)	Moisture(%)	Dry matter(%)	Starch(%)	Calcium oxalate Late (%)
Replication	2	1.63	0.06	27.28	0.09	1.55	0.17	54.88	0.01	1605.01	3.87	0.00	0.00	0.09	0.000
Genotypes	24	96.60**	85.29**	171.23**	15.91**	734.37**	8.15**	8270.84**	0.12**	40897.23**	61.49**	5.99**	5.99**	7.76**	0.003**
Error	48	1.56	2.45	20.31	0.44	7.91	0.30	90.23	0.00	3720.09	2.04	0.01	0.01	0.22	0.000

*, ** = significant at 5% and 1% levels, respectively

Table.3 Analysis of variance (ANOVA) for various traits among twenty five genotypes of Elephant foot yam under shade during 2013 (E_3)

Source of variation	d.f.	Days taken for sprouting	Emergence %	Shoot height(cm)	Shoot girth(cm)	Days required to maturity	NO. Of cormels per plant	Weight of cormels per plant	Weight of corms per plant(kg)	Size of corm(cm)	Yield(t/ha)	Moisture(%)	Dry matter(%)	Starch(%)	Calcium oxalate(%)
Replication	2	0.20	3.15	0.68	0.04	1.02	0.00	137.45	0.00	1418.79	1.10	0.23	0.23	0.00	0.000
Genotypes	24	91.47**	87.69**	214.29**	5.53**	794.38**	3.19**	5222.94**	0.19**	47001.82**	96.05**	12.20**	12.20**	8.43**	0.003**
Error	48	1.05	1.54	8.29	0.27	1.66	0.21	67.62	0.00	3212.24	3.15	0.21	0.21	0.02	0.000

*, ** = significant at 5% and 1% levels, respectively

Table.4 Analysis of variance (ANOVA) for various traits among twenty five genotypes of Elephant foot yam under shade during 2014 (E_4)

Source of variation	d.f.	**Days taken for sprouting**	**Emergence %**	**Shoot height(cm)**	**Shoot girth(cm)**	**Days required to maturity**	**NO. Of cormels per plant**	**Weight of cormels per plant**	**Weight of corms per plant(kg)**	**Size of corm(cm)**	**Yield(t/ha)**	**Moisture(%)**	**Dry matter(%)**	**Starch(%)**	**Calcium oxalate(%)**
Replication	2	2.25	0.23	8.90	1.13	1.44	0.01	87.25	0.01	2169.86	2.71	0.00	0.00	0.10	0.000
Genotypes	24	168.72**	87.69**	83.76**	4.40**	889.05**	4.04**	5302.69**	0.21**	27765.14**	103.23**	11.81**	11.81**	7.70**	0.003**
Error	48	1.96	1.00	5.37	0.47	3.63	0.23	74.16	0.02	2653.90	8.91	0.00	0.00	0.05	0.000

*, ** = significant at 5% and 1% levels, respectively

Table.5 Pooled analysis of variance (ANOVA) for various traits among twenty five genotypes of Elephant foot yam

Source of variation	d.f.	Days taken for sprouting	Emergence %	Shoot height(cm)	Shoot girth(cm)	Days required to maturity	NO. Of cormels per plant	Weight of cormels per plant	Weight of corms per plant(kg)	Size of corm(cm)	Yield(t/ha)	Moisture(%)	Dry matter(%)	Starch(%)	Calcium oxa Late (%)
Replication	2	6.14	3.74	7.12	0.16	0.11	0.03	101.20	0.01	344.24	7.34	0.15	0.15	0.18	0.000
Environments	3	148.73**	106.99**	9960.69**	5.77**	47.48**	11.33**	6488.39**	3.08**	256545.14**	1491.25**	2.22**	2.22**	4.22**	0.001**
Interactions	6	1.53	1.82	11.43	0.38	3.42	0.08	66.36	0.00	2270.92	1.48	0.05	0.05	0.02	0.000
Overall Sum	11	42.51**	30.85	2724.08**	1.81	14.83	3.14*	1824.16**	0.84**	71268.13**	408.85**	0.66	0.66	1.20**	0.000
Treatments	24	467.22**	171.51**	288.01**	21.02**	3047.70**	8.92**	24234.94**	0.51**	104617.54**	260.78**	20.03**	20.03**	33.44**	0.008**
Error	264	8.30	17.16	28.11	2.79	8.41	1.64	477.44	0.02	8198.63	8.90	1.53	1.53	0.14	0.001

*, ** = significant at 5% and 1% levels, respectively

Table.6 Estimates of variability parameters for growth, yield and quality traits in amorphophalous during four environments (E_1, E_2, E_3, E_4) and over environments (pooled)

Traits / Components of variation		Days taken for sprouting	Emergence %	Shoot height (cm)	Shoot girth (cm)	Days required to maturity	No. of cormels per plant	Weight of cormels per plant	Weight of corms per plant (kg)	Size of corm (cm)	Yield(t/ha)	Moisture (%)	Dry matter (%)	Starch (%)	Calcium oxa Late (%)
PCV (%)	E_1	22.22	6.11	4.63	18.78	6.39	30.94	25.15	10.88	13.47	10.86	1.78	8.07	13.88	29.02
	E_2	14.84	6.13	9.20	15.65	6.65	28.39	23.59	10.48	12.41	10.51	1.73	7.83	12.44	28.99
	E_3	14.33	6.27	7.81	9.83	6.88	20.70	19.77	15.50	14.24	15.77	2.51	11.20	12.86	27.35
	E_4	19.56	6.27	4.89	9.09	7.31	23.04	20.02	17.43	11.21	17.43	2.43	10.79	12.46	27.35
	pooled	17.88	6.19	6.80	14.03	6.81	26.58	22.43	13.40	12.92	13.47	2.14	9.62	12.94	28.15
GCV (%)	E_1	21.40	5.88	3.85	17.20	6.35	29.91	24.51	10.06	12.50	10.05	1.72	7.79	13.80	28.51
	E_2	14.49	5.87	7.76	15.02	6.54	26.91	23.20	9.98	10.89	10.00	1.72	7.82	11.93	28.59
	E_3	14.09	6.11	7.38	9.14	6.86	18.83	19.39	14.94	12.90	15.03	2.45	10.91	12.83	26.84
	E_4	19.23	6.16	4.45	7.79	7.26	21.18	19.61	15.39	9.77	15.39	2.43	10.79	12.33	26.84
	pooled	16.20	4.05	4.48	8.33	6.70	13.80	20.14	11.12	9.09	11.29	1.52	6.82	12.63	20.53
ECV (%)	E_1	5.98	1.66	2.57	7.53	0.68	7.91	5.61	4.13	5.01	4.11	0.46	2.10	1.49	5.43
	E_2	3.22	1.75	4.93	4.39	1.18	9.06	4.22	3.20	5.97	3.21	0.09	0.43	3.52	4.78
	E_3	2.63	1.41	2.56	3.60	0.54	8.61	3.85	4.14	6.05	4.79	0.56	2.51	0.98	5.23
	E_4	3.61	1.14	2.02	4.68	0.81	9.08	4.05	8.19	5.50	8.19	0.04	0.18	1.80	5.23
	pooled	7.55	4.68	5.11	11.29	1.22	22.72	9.89	7.48	9.18	7.35	1.51	6.78	2.82	19.26
h^2 (broad sense) (%)	E_1	92.75	92.61	69.24	83.94	98.87	93.46	95.03	85.58	86.14	85.70	93.23	93.23	98.85	96.50
	E_2	95.29	91.86	71.24	92.12	96.84	89.83	96.80	90.65	76.91	90.65	99.70	99.70	91.99	97.28
	E_3	96.64	94.92	89.23	86.57	99.38	82.69	96.21	92.87	81.96	90.78	94.98	94.98	99.42	96.34
	E_4	96.59	96.67	82.96	73.53	98.78	84.49	95.92	77.91	75.93	77.91	99.97	99.97	97.91	96.34
	pooled	82.16	42.84	43.52	35.21	96.79	26.95	80.57	68.84	49.50	70.23	50.28	50.28	95.24	53.17
Genetic advance (% of mean)	E_1	42.46	11.66	6.60	32.47	13.02	59.56	49.23	19.18	23.90	19.17	3.41	15.49	28.26	57.69
	E_2	29.14	11.59	13.50	29.70	13.26	52.54	47.03	19.57	19.67	19.62	3.55	16.08	23.57	58.09
	E_3	28.52	12.27	14.36	17.52	14.08	35.26	39.18	29.66	24.05	29.50	4.91	21.91	26.34	54.28
	E_4	38.93	12.48	8.35	13.76	14.87	40.10	39.57	27.98	17.54	27.98	5.01	22.22	25.14	54.28
	pooled	30.26	5.47	6.09	10.18	13.58	14.76	37.23	19.00	13.17	19.48	2.22	9.96	25.39	30.83

E_1=Open field, 2013, E_2= Open Field, 2014, E_3= under shade, 2013 and E_4= under shade, 2014

PCV= Phenotypic coefficients of variation, GCV= Genotypic coefficients of variation, ECV= environmental coefficients of variation and h^2=heritability

Mean squares due to overall sum were found significant for all most of the traits except shoot girth, days required to maturity, moisture (%) and dry matter content. The genotypic and phenotypic coefficient of variation (GCV and PCV) for fourteen traits revealed that all the traits parameters had significant range of variation (Table-6).

The estimates of phenotypic as well as genotypic coefficient of variation were observed for calcium oxalate, weight of cormels per plant. While high PCV observed for number of cormels per plant during all four environments (E_1, E_2, E_3, E_4) and over environments (pooled). Moderate estimates of PCV as well as GCV were observed for days taken for sprouting, weight of corms per plant and starch (%). While, shoot girth was recorded moderate estimates of PCV during all four environments (E_1, E_2, E_3, E_4) and over environments (pooled). However, rest of the traits showed low estimates of phenotypic coefficient of variation and genotypic coefficient of variation. Similar results were also reported by Laxmi *et al.*, (1980), Kumar (1995), Thankamma and Unnikrishnan (1995), Singh *et al.*, (2000) and Mukherjee *et al.*, (2003).

Highest heritability estimates were observed (Table-6) for days required to maturity followed by starch content, days taken for sprouting, and weight of corm per plant. Whereas, moderate estimates of heritability were observed in case of yield (t/ha), weight of corms per plant, calcium oxalate, moisture and dry matter content. The remaining traits showed low estimates of heritability over environments (pooled). These results are in corroboration with the findings of Rai *et al.*, (2003), Singh *et al.*, (2003) and Singh *et al.*, (2004).

High heritability accompanied with high genetic advance was estimated for days taken for sprouting, weight of cormels per plant. However, high heritability and moderate genetic advance was analysed for starch. While, moderate heritability coupled high genetic advance were observed in case of calcium oxalate during all four environments (E_1, E_2, E_3, E_4) over environments (pooled). These results are supported by the findings of Biradar *et al.*, (1978), Chand *et al.*, (1987), Rai *et al.*, (2003), Singh *et al.*, (2003) and Singh *et al.*, (2004). Moreover, high heritability along with moderate genetic advance for days taken for sprouting, days required to maturity, weight of cormels per plant and starch (%) the presence of additive gene action for these traits selection could be reliable.

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