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Genetic Divergence in Elephant Foot Yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson]

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A B S T R A C T

An investigation was carried out using 21 germplasm of Elephant foot yam including one national check to find out genetic divergence among the studied germplasm. The experiment was carried out at T.C.A., Dholi Research Farm of Dr. R.P.C.A.U., Pusa, Samastipur, Bihar, in a completely Randomized Block Design with two replications during 2018. Data were collected for ten characters *viz*., days to sprouting, pseudostem length (cm), pseudostem girth (cm), leaf canopy diameter (cm), chlorophyll content (SPAD), calcium oxalate (mg/100gm), dry matter (%), days to maturity, no. of cormels per plant and corm weight per plant (kg.). All the twenty one germplasm were grouped into five clusters. Highest inter cluster distance was observed between cluster IV and V (238.93) followed by cluster I and IV (229.41) and cluster III and V (172.38) on the basis of their genetic distances. Cluster IV showed maximum cluster mean values for corm weight per plant along with pseudostem girth, leaf canopy diameter, chlorophyll content, calcium oxalate, dry matter and days to maturity. Calcium oxalate followed by corm weight per plant, days taken for sprouting and number of cormels per plant showed maximum contribution towards total genetic divergence in Elephant foot yam germplasm.

Introduction

Elephant foot yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson] is an important tuber crop of the tropical and sub-tropical countries, Because of its higher yield potential, culinary properties, medicinal utility and therapeutic values, it is referred to as "King of tuber crops" (Sengupta *et al.*, 2008) and also known as "Money spinning tuber crop" due to high mean profit associated with cultivation of this crop (Singh *et al.*, 2008).

In India, it is commonly known as Suran or Zimmikand and is traditionally cultivated on commercial scales in the states of Bihar, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, West Bengal and Kerala. Among tropical aroid tuber crops, it's become popular due to high productivity in a short growing season and

high net returns. Besides being used as a vegetable, the tubers can also be used for making pickles, dry and fry cubes, chips, flour, thickening agents and starch for industrial uses (Singh *et al.*, 2016).

Studies of diverse germplasm are expected to identify promising clones for the release of new varieties. The information on genetic divergence of various traits particularly of those that contribute to yield and quality would be of most useful in planning the breeding programme. Grouping of genotypes will be useful in choosing suitable parental lines for hybridization breeding programs, which in turn can help the farmers by making available the elite varieties.

Materials and Methods

The present investigation was carried-out to assess the genetic diversity in 21 germplasm of elephant foot yam, obtained from germplasm collections maintained at Tirhut College of Agriculture, Dholi, including Gajendra variety as National check. The experiment was conducted in Randomized Block Design in two replications at T.C.A., Dholi Research Farm of Dr. R.P.C.A.U., Pusa, Samastipur, Bihar. The observations were recorded on five randomly selected plants in each entry and replication and their mean values were used for statistical analysis. Data were collected for ten characters described in the list. Standard cultural practices were applied during the crop period. Genetic divergence analysis was performed as per Mahalanobis (1936) and clustering of germplasm was done by using Tocher's method (Rao, 1952).

Results and Discussion

Genetic variability is the basic requirement for crop improvement as it provides wider scope for selection. Thus, effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability present in the planting material. Success of clonal crop breeding programme depends largely on the choice of appropriate clones. It is expected that the utilization of divergent clones in hybridization results in promising recombinants.

Genetic improvement mainly depends upon the amount of genetic diversity present in the population. On the basis of D^2 statistics calculated as Mahalanobis Euclidean distance and clustering of germplasm done as suggested by Tocher's method, all the Elephant foot yam germplasms have been classified into five clusters (Table 1; Fig. 1).

Among the clusters, Cluster I (TCA EFY-6, TCA EFY-8, TCA EFY-1, TCA EFY-5, TCA EFY-3, TCA EFY-9, TCA EFY-4 and TCA EFY-2) had eight germplasm. While, cluster II (TCA EFY-14, TCA EFY-15, TCA EFY-18, TCA EFY-11, Gajendra, TCA EFY-17, TCA EFY-20, TCA EFY-12, TCA EFY-19 and TCA EFY-13) had maximum numbers of ten germplasm. Cluster III (TCA EFY-7), cluster IV (TCA EFY-16) and cluster V (TCA EFY-10) had single germplasm in each cluster.

Similar finding was also observed by earlier workers Mandal *et al.,* (2013) and Yadav *et al.,* (2018) in taro. Although, in elephant foot yam such work was not reported earlier.

Based on inter-cluster distances, the maximum divergence was observed between cluster IV and cluster V (D^2 = 238.93), followed by cluster I and cluster IV (D^2 = 229.41), cluster III and V (D^2= 172.38), cluster III and IV (D^2 = 152.41), cluster I and II (D^2 = 118.24), cluster II and V (D^2 = 111.85), cluster I and V (D^2 = 90.46), cluster II and III (D^2 = 89.05), cluster I and III (D^2 = 72.53) and minimum distance was observed between cluster II and IV (D^2= 69.77).

Table.1 List of ten quantitative characters studied and their abbreviations

Sl. No.	Observation	Aberration	Sl. No	Observation	Aberration
1	Days to sprouting	DS	6	Calcium oxalate (mg/100gm)	CO
2	Pseudostem length (cm)	PsL	7	Dry matter (%)	DM
3	Pseudostem girth (cm)	PsG	8	Days to maturity	DsM
4	Leaf canopy diameter (cm)	LCD	9	No. of cormels per plant	NCPP
5	Chlorophyll content (SPAD)	CC	10	Corm weight per plant(kg)	CWPP

Table.2 Clustering pattern of 21 germplasm in elephant foot yam

Sl. No.	No. of germplasm within cluster	Germplasm in cluster
I	**8**	**TCA EFY-6, TCA EFY-8, TCA EFY-1, TCA EFY-5, TCA EFY-3, TCA EFY-9, TCA EFY-4, TCA EFY-2**
II	**10**	**TCA EFY-14, TCA EFY-15, TCA EFY-18, TCA EFY-11, TCA EFY-17, TCA EFY-20, TCA EFY-12, TCA EFY-19, TCA EFY-13, Gajendra**
III	**1**	**TCA EFY-7**
IV	**1**	**TCA EFY-16**
V	**1**	**TCA EFY-10**

Table.3 Mean intra and inter cluster distance (D^2) among five clusters of elephant foot yam

Clusters	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
Cluster I	**42.17**	118.24	72.53	229.41	90.46
Cluster II		**39.78**	89.05	69.77	111.85
Cluster III			**0.00**	152.41	172.38
Cluster IV				**0.00**	238.93
Cluster V					**0.00**

NB: Bold values are for Intra Cluster distances

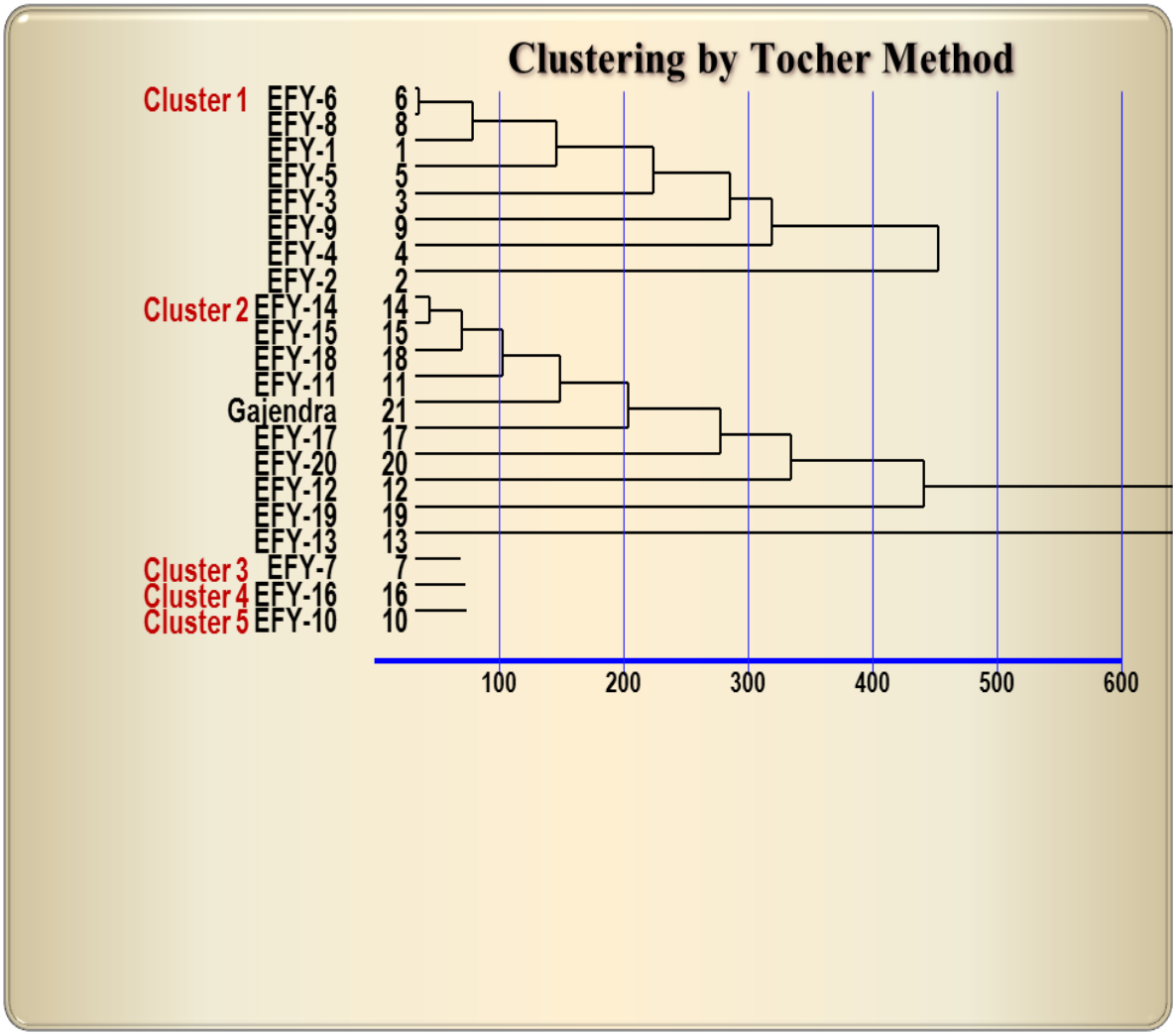
Table.4 Cluster mean values for ten quantitative characters in elephant foot yam

Cluster No.	DS	PsL	PsG	LCD	CC	CO	DM	DsM	NCPP	CWPP
Cluster I	48.38	43.98	9.66	101.16	29.71	7.49	21.26	188.81	5.69	0.84
Cluster II	33.80	67.19	13.26	108.99	34.41	7.90	20.84	191.45	3.87	1.30
Cluster III	53.00	44.15	9.15	87.80	27.00	9.84	17.10	188.50	5.45	1.11
Cluster IV	33.50	56.10	14.50	117.40	36.15	10.93	22.60	208.00	4.75	1.61
Cluster V	27.50	38.45	8.90	78.50	34.53	5.82	21.70	184.00	4.40	0.62

Table.5 Contribution percentage of ten quantitative characters towards genetic divergence in elephant foot yam germplasm

Sl. No.	Source	Contribution %	Times Ranked 1st
1	Days to sprouting	18.57 %	39
2	Pseudostem length (cm)	2.38 %	5
3	Pseudostem girth (cm)	0.00 %	0
4	Leaf canopy diameter (cm)	0.48 %	1
5	Chlorophyll content (SPAD)	2.86 %	6
6	Calcium oxalate (mg/100gm)	39.52 %	83
7	Dry matter (%)	3.81 %	8
8	Days to maturity	1.90 %	4
9	No. of cormels per plant	10.00 %	21
10	Corm weight per plant (kg)	20.48 %	43

Fig.1 Dendogram of 21 germplasm of elephant foot yam



Hence, it is advisable to attempt crossing of the germplasm from cluster IV with the germplasm of cluster V as well as between I and IV, also between III and V, which may lead to broad spectrum of favorable genetic variability among their segregates for yield improvement in elephant foot yam.

The higher inter-cluster distance indicated greater genetic divergence between the germplasm of those clusters while, lower inter-cluster values between the clusters suggested that the germplasm of the clusters were not much genetically diverse from each other. Similar approach was adopted by Rahajeng and Rahayuningsih (2017) in sweet potato, Shikha *et al.,* (2018) in yam bean, Fantaw *et al.,* (2014) in tannia and Yadav *et al.,* (2018) in taro.

The average intra and inter cluster distance between all possible pairs of five clusters presented in Table 2, was the indicator of genetic diversity present in the experimental material. The maximum intra cluster distance was found within cluster I (D^2 = 42.17), followed by cluster II (D^2 = 39.78). Whereas, cluster III, cluster IV, cluster V had only one germplasm. Therefore, the intra cluster distance was zero.

Cluster mean in respect of ten quantitative characters of twenty-one germplasm were presented in Table 3. Cluster II was found to have maximum cluster mean value for pseudostem length (67.19), whereas cluster IV had germplasm with highest mean value for psudostem girth (14.50), leaf canopy diameter (117.40), chlorophyll content (36.15), dry matter (22.60) and corm weight per plant (1.61) providing an opportunity for selection of germplasm from these clusters to the respective traits in breeding programmes. Cluster I had the minimum mean value for characters like calcium oxalate, in order to make the low calcium oxalate variety, genotypes should be selected from these cluster. Days to sprouting and days to maturity had minimum mean value in cluster V, therefore, to make early duration variety, germplasm of this cluster may be used in hybridization programme. Similar approach was adopted by Devi *et al.,* (2013) in elephant foot yam.

In the contribution of each character to total genetic divergence presented in Table 4, which showed calcium oxalate (39.52 %) contributed maximum to the genetic divergence, followed by corm weight per plant (20.48 %), days to sprouting (18.57 %), no. of cormels per plant (10.00 %), dry matter (3.81 %), chlorophyll content (2.86 %), pseudostem length (2.38 %), days to maturity (1.90 %) and leaf canopy diameter (0.48 %) (Table 5), however, pseudostem girth exhibited no contribution towards total divergence.

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