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Genetic variability and path coefficient studies on elephant foot yam (*Amorphophallus paeoniifolius* L.)

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Abstract

An experiment conducted at Main Experiment Station of Department of Vegetable Science at Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P). The experimental material consisted of 35 Amorphophallus germplasm and two standard checks first was NDA-9 (Local check) and Gajendra (National check) was conducted in a Randomized Block Design with three replication. The character studied were Days to sprouting, Length of leaves (cm), Width of leaves (cm), Girth of pseudo stem (cm), Plant height (cm), Length of pseudo stem (cm), Polar diameter of corm (cm), Equatorial diameter of corm (cm), Weight of corm per plant (kg), Number of cormel per plant, Weight of cormel per plant (kg), Number of corm per plant and yield (t/ha.). High magnitude of phenotypic and genotypic coefficient of variation was observed for number of cormel per plant followed by weight of cormel per plant, number of corm per plant, yield (t/ha.). High heritability coupled with high genetic advance in percent of mean were recorded for number of cormel per plant, yield tone per hectare, weight of corm per plant and of cormel per plant.

Keywords: Elephant foot yam, variability, heritability and genetic advance phenotypic and genotypic coefficient of variation

Introduction

Elephant foot yam (*Amorphophallus paeoniifolius* L.) 2n=28 belongs to family Areaceae and basically a crop of south East Asia. 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. 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-spring depends upon the heritability of the particular character. The heritability value doses not have much significance 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. Selection and hybridization approaches are followed to bring about the improvement in quantitative parameters.

Materials and Methods

The experimental material comprised of 35germplasm and two check Gjendra and NDA-9 at student's instructional farms of N.D University of Agriculture and Technology Kumarganj Faizabad. The experiment was laid out in a Randomized Block Design with three replications at Main Experiment Station of Department of Vegetable Science at Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P). The inter and intra-row spacing was 90 cm and 90 cm, respectively. Nitrogen, Phosphorus and Potash were applied @ 120 kg, 60 kg. 80kg per hectare, respectively. Nitrogen was applied in two split doses; half at the time of planting and remaining half at the time of first earthing up.

Observations were recorded for thirteen quantitative traits, Days to sprouting, Length of leaves (cm), Width of leaves (cm), Girth of pseudo stem (cm), Plant height (cm), Length of pseudo stem (cm), Polar diameter of corm (cm), Equatorial diameter of corm (cm), Weight of corm per plant (kg), Number of cormel per plant, Weight of cormel per plant (kg), Number of corm per plant and yield (t/ha.). Phenotypic coefficient of variances were estimated based on the formula given by Burton (1952) and heritability and genetic advance were calculated according to Lush (1949).

Results and discussion

The genotypic and phenotypic coefficients of variation for 13 characters are presented in the Table-1. In elephant foot yam, the highest estimate of phenotypic (PCV) and genotypic (GCV) coefficient of variation were observed in case of No. of cormel per plant (PCV=82.97), and (GCV=79.12) followed by weight of cormel per plant (PCV=79.94) and (GCV=65.89), number of corm per plant (PCV=42.62), and (GCV=35.38), yield t/ha (PCV=39.32) and (GCV=37.64), and days to sprouting (PCV=34.92) and (GCV=34.01).

Table 1: Estimate of phenotypic correlation coefficient of 13 characters in elephant foot yam

Character	Days to sprouting	Length of leaves (cm)	Width of leaves (cm)	Girth of pseudostem (cm)	Plant height (cm)	Length of pseudostem (cm)	Polar diameter of corm (cm)	Equatorial diameter of corm(cm)	Weight of corm per plant (kg)	Number of cormel per plant	Weight of cormel per plant (kg.)	Number of corms per plant	Yield (t/ha.)
Days to sprouting	1.0000	-0.0716	-0.2018*	-0.3529**	-0.2509**	-0.3315**	-0.2833**	-0.1843	-0.0636	0.1156	0.2598**	-0.0799	-0.0629
Length of leaves (cm)		1.0000	0.3976**	-0.0249	-0.1287	0.0243	-0.1749	-0.2256*	-0.2984**	0.3876**	0.1580	0.2674**	-0.3040**
Width of leaves (cm)			1.0000	0.1639	0.1001	0.2030*	-0.0082	-0.1165	-0.0582	-0.1127	-0.2083*	0.0748	-0.0644
Girth of pseudostem (cm)				1.0000	0.3432**	0.5109**	0.5032**	0.4899**	0.3597**	-0.2267*	-0.1494	-0.2315*	0.3546**
Plant height (cm)					1.0000	0.4766**	0.3078**	0.2629**	0.1474	-0.4009**	-0.2309*	-0.0989	0.1459
Length of pseudostem (cm)						1.0000	0.5718**	0.4624**	0.5190**	-0.2280*	-0.2169*	0.0481	0.5132**
Polar diameter of corm (cm)							1.0000	0.8926**	0.7867**	-0.1516	-0.0481	-0.0935	0.7848**
Equatorial diameter of corm (cm)								1.0000	0.8229**	-0.0785	-0.0179	-0.0837	0.8248**
Weight of corm per plant (kg									1.0000	-0.1593	-0.0529	0.0376	0.9993**
Number of cormel per plant										1.0000	0.5646**	0.2354*	-0.1615
Weight of cormel per plant (kg.)											1.0000	0.0377	-0.0543
Number of corms per plant												1.0000	0.0375
Yield (t/ha.)													1.0000

Table 2: Estimate of Genotypic correlation coefficient of 13 characters in elephant foot yam

Characters	Days to sprouting	Length of leaves (cm)	Width of leaves (cm)	Girth of pseudostem (cm)	Plant height (cm)	Length of pseudostem (cm)	Polar diameter of corm (cm)	Equatorial diameter of corm (cm)	Weight of corm per plant (kg)	Number of cormel per plant	Weight of cormel per plant (kg.)	Number of corms per plant	Yield (t/ha.)
Days to sprouting	1.0000	-0.0980	-0.2294	-0.3727	-0.2760	-0.3473	-0.2983	-0.2005	-0.0707	0.1325	0.3128	-0.0914	-0.0713
Length of leaves (cm)		1.0000	0.4525	-0.0677	-0.1674	0.0273	-0.2082	-0.2629	-0.3808	0.4620	0.1422	0.3393	-0.3862
Width of leaves (cm)			1.0000	0.2032	0.1110	0.2309	0.0110	-0.1387	-0.0812	-0.1284	-0.2604	0.0553	-0.0867
Girth of pseudostem (cm)				1.0000	0.3707	0.5448	0.5312	0.5152	0.3850	-0.2583	-0.2071	-0.3157	0.3817
Plant height (cm)					1.0000	0.4949	0.3192	0.2666	0.1482	-0.4001	-0.2711	-0.1309	0.1460
Length of pseudostem (cm)						1.0000	0.5891	0.4747	0.5471	-0.2404	-0.2662	0.0569	0.5416
Polar diameter of corm (cm)							1.0000	0.9134	0.8445	-0.1449	-0.0487	-0.1172	0.8411
Equatorial diameter of corm (cm)								1.0000	0.8664	-0.0733	-0.0237	-0.0896	0.8685
Weight of corm per plant (kg)									1.0000	-0.1757	-0.0682	0.0165	1.0000
Number of cormel per plant										1.0000	0.6623	0.3058	-0.1794
Weight of cormel per											1.0000	0.0895	-0.0688

plant (kg.)													
Number of corms per plant												1.0000	0.0161
Yield (t/ha.)													1.0000

Table 3: Direct and indirect effect of 13 characters of yield (t/ha.) at phenotypic level

Characters	Days to sprouting	Length of leaves (cm)	Width of leaves (cm)	Girth of pseudostem (cm)	Plant height (cm)	Length of pseudostem (cm)	Polar diameter of corm (cm)	Equatorial diameter of corm (cm)	Weight of corm per plant (kg)	Number of cormel per plant	Weight of cormel per plant (kg.)	Number of corms per plant	Yield (t/ha.)
Days to sprouting	-0.0030	0.0002	0.0005	0.0024	0.0004	0.0009	0.0036	-0.0041	-0.0632	-0.0006	-0.0001	-0.0001	-0.0629
Length of leaves (cm)	0.0002	-0.0025	-0.0011	0.0002	0.0002	-0.0001	0.0023	-0.0050	-0.2964	-0.0021	-0.0001	0.0003	-0.3040
Width of leaves (cm)	0.0006	-0.0010	-0.0027	-0.0011	-0.0002	-0.0005	0.0001	-0.0026	-0.0578	0.0006	0.0001	0.0001	-0.0644
Girth of pseudostem (cm)	0.0010	0.0001	-0.0004	-0.0068	-0.0006	-0.0014	-0.0065	0.0108	0.3573	0.0012	0.0000	-0.0003	0.3546
Plant height (cm)	0.0007	0.0003	-0.0003	-0.0023	-0.0016	-0.0013	-0.0040	0.0058	0.1464	0.0022	0.0001	-0.0001	0.1459
Length of pseudostem (cm)	0.0010	-0.0001	-0.0005	-0.0035	-0.0008	-0.0027	-0.0074	0.0102	0.5155	0.0012	0.0001	0.0001	0.5132
Polar diameter of corm (cm)	0.0008	0.0004	0.0000	-0.0034	-0.0005	-0.0015	-0.0129	0.0197	0.7814	0.0008	0.0000	-0.0001	0.7848
Equatorial diameter of corm (cm)	0.0005	0.0006	0.0003	-0.0033	-0.0004	-0.0012	-0.0115	0.0221	0.8174	0.0004	0.0000	-0.0001	0.8248
Weight of corm per plant (kg)	0.0002	0.0007	0.0002	-0.0024	-0.0002	-0.0014	-0.0101	0.0182	0.9933	0.0009	0.0000	0.0000	0.9993
Number of cormel per plant	-0.0003	-0.0010	0.0003	0.0015	0.0007	0.0006	0.0020	-0.0017	-0.1582	-0.0054	-0.0002	0.0003	-0.1615
Weight of cormel per plant (kg.)	-0.0008	-0.0004	0.0006	0.0010	0.0004	0.0006	0.0006	-0.0004	-0.0526	-0.0030	-0.0003	0.0000	-0.0543
Number of corms per plant	0.0002	-0.0007	-0.0002	0.0016	0.0002	-0.0001	0.0012	-0.0018	0.0373	-0.0013	0.0000	0.0011	0.0375

Table 4: Direct and indirect effect of 13 characters of yield (t/ha.) at genotypic level

Characters	Days to sprouting	Length of leaves (cm)	Width of leaves (cm)	Girth of pseudostem (cm)	Plant height (cm)	Length of pseudostem (cm)	Polar diameter of corm (cm)	Equatorial diameter of corm(cm)	Weight of corm per plant (kg)	Number of cormel per plant	Weight of cormel per plant (kg.)	Number of corms per plant	Yield (t/ha.)
Days to sprouting	-0.0079	0.0001	-0.003	0.0032	0.0014	-0.0008	0.0115	-0.0090	-0.0703	-0.0018	0.0024	0.0001	-0.0713
Length of leaves (cm)	0.0008	-0.0013	0.0006	0.0006	0.0008	0.0001	0.0080	-0.0117	-0.3785	-0.0063	0.0011	-0.0004	-0.3862
Width of leaves (cm)	0.0018	-0.0006	0.0014	-0.0017	-0.0006	0.0006	-0.0004	-0.0062	-0.0807	0.0018	-0.0020	-0.0001	-0.0867
Girth of pseudostem (cm)	0.0029	0.0001	0.0003	-0.0085	-0.0019	0.0013	-0.0205	0.0230	-0.3827	0.0035	-0.0016	0.0004	0.3817
Plant height (cm)	0.0022	0.0002	0.0002	-0.0032	-0.0050	0.0012	-0.0123	0.0119	0.1473	0.0055	-0.0021	0.0002	0.1460
Length of pseudostem (cm)	0.0027	0.0000	0.0003	-0.0047	-0.0025	0.0024	-0.0228	0.0212	0.5437	0.0033	-0.0021	-0.0001	0.5416
Polar diameter of corm (cm)	0.0023	0.0003	0.0000	-0.0045	-0.0016	0.0014	-0.0387	0.0408	0.8393	0.0020	-0.0004	0.0001	0.8411
Equatorial diameter of corm (cm)	0.0016	0.0004	-0.0002	-0.0044	-0.0013	0.0012	-0.0353	0.0447	0.8610	0.0010	-0.0002	0.0001	0.8685
Weight of corm per plant (kg)	0.0006	0.0005	-0.0001	-0.0033	-0.0007	0.0013	-0.0326	0.0387	0.9939	0.0024	-0.0005	0.0000	1.0000
Number of cormel per plant	-0.0010	-0.0006	-0.0002	0.0022	0.0020	-0.0006	0.0056	-0.0033	-0.1746	-0.0137	0.0052	-0.0004	-0.1794
Weight of cormel per plant (kg.)	0.0025	-0.0002	-0.0004	0.0018	0.0014	-0.0006	0.0019	-0.0011	-0.0677	-0.0091	0.0078	-0.0001	-0.0688
Number of corms per plant	0.0007	-0.0005	0.0001	0.0027	0.0007	0.0001	0.0045	-0.0040	0.0164	-0.0042	0.0007	-0.0012	0.0161

High estimate of (PCV=82.97) and moderate estimate of (GCV=79.12) in case of number of cormel per plant followed by weight of cormel per plant (PCV=79.94) and (GCV=65.89), number of corm per plant (PCV=42.62) and (GCV=35.38). Lowest estimate of PCV and GCV were observed in case of Width of leaf (PCV=9.63) and (GCV=8.60), followed by Length of leaf (PCV=9.75) and, (GCV=8.50.

The heritability gives an idea of transmissibility of a character from parent to offspring.

Estimates of heritability and expected genetic advance for different characters are presented in at phenotypic level, the correlation coefficients were highly significant for 29 combinations and significant for 10 combinations.

Days of sprouting showed having highly significant positive correlation with cormel weight per plant and it showed positive non-significant correlation with number of cormel per plant highly significant negative correlation with girth of pseudostem, plant height, length of pseudostem, polar diameter of corm and negatively significant with leaf length. Leaf length showed highly significant and positive correlation with cormel per plant, corm per plant and highly significant negative correlation with weight of corm per plant. Leaf length showed negative significant correlation with equatorial diameter of corm. Positive and non-significant correlation with width of leaf, weight of cormel per plant and girth of pseudostem, plant height, polar diameter showed negative non-significant correlation. Width of leaf was exhibited significant negative correlation with most important character cormel yield per plant and significant positive correlation with length of pseudostem. It was also exhibited positive non-significant correlation with girth of pseudostem, plant height, number of corm per plant. It showed negative non-significant correlation with polar diameter of corm, equatorial diameter of corm, weight of cormel per plant, number of cormel per plant and corm yield tone per hectare. Girth of pseudostem was exhibited highly significant positive correlation with plant high, length of pseudostem, polar diameter of corm, equatorial diameter of corm, weight of corm per plant and yield tone per hector. It showed significant negative correlation with cormel per plan.

Length of pseudostem exhibited highly significant positive correlation with the polar diameter of corm, equatorial diameter, weight of corm and yield tone per hector. Number Cormel per plant and weight of cormel plant showed significant negatively correlation with length of pseudostem and number of corm per plant showed positive non-significant correlation with length of pseudostem. Polar diameter of corm was exhibited highly significant positive correlation with equatorial diameter of corm, weight of corm per plant, and yield tone per hector. It was also showed negative non-significant with number of cormel per plant, weight of cormel per plant and number of corm per plant. Equatorial diameter of corm exhibited highly significant positive correlation with weight of corm per plant and corm yield tone per hector. Number of cormel per plant, weight of cormel per plant, number of corm per plant showed non-significant negative correlation with equatorial diameter of corm. Weight of corm per plant was exhibited highly significant positive correlation noted with important character yield tone per hector and showed positive non-significant correlation number of corm per plant and negative non-significant with number of cormel per plant and weight of cormel per plant. Number of cormel per plant was exhibited highly significant positive correlation with weight of cormel per plant and significant positive correlation with number of corm per plant. Yield tone per hector showed negative non-significant correlation with this character. Weight of cormel per plant was exhibited positive non-significant with number of corm per plant and negatively non-significant correlated with corm yield tone per hector. And this important character showed positive non-significant correlation with number of corm per plant.

Discussion

The corm yield is a complex and highly variable character, which is a result of cumulative effect of many contributing traits. Therefore, direct selection for yield may not always be very effective. Thus, for bringing a rational improvement in desirable direction, the correlation between traits and their contribution to yield must be known. A positive correlation between desirable characters is important to the plant breeder because it helps in simultaneous improvement of both the characters. On the other hand, a negative correlation between desirable traits will hinder the simultaneous expression of both the characters. Hence, simultaneous selections for these traits become difficult. In the present study, the estimates of genotypic correlation coefficients, in general, were higher than the phenotypic correlation coefficient, which indicates the apparent association of two characters is not only due to genes but also due to favourable influence of environment. This result gets support from the findings of Kamlam *et al.* (1977) [7] and Mukharjee *et al.* (2003). In the present study, days to sprouting showed highly significant positive correlation with weight of cormel per plant and highly significant negative correlation with girth of pseudo stem, plant height, length of pseudo stem and polar diameter of corm. It also show significant negative correlation with width of leaf but it also showed non signification positive correlation with number of cormel per plant while, it was non-significant negative correlation with length of leaf, equatorial diameter of corm, weigh of corm per plant, number of corm per plant and yield tone per hectare. Yield tone per hectare showed highly significant positive correlation weight of corm per plant, equatorial diameter of corm, and polar diameter of corm, lengt pseudo stem and girth of pseudo stem. Other character showed negative correlation with each contribution. Weight of cormel per plant showed highly significant positive correlation with number of cormel per plant and days to sprouting. Equatorial diameter of corm showed highly significant positive correlation with polar diameter of corm, length of pseudo stem, and plant height and significant negative correlation with length of leaf. Polar diameter of corm showed highly significant positive correlation with length of pseudo stem plant height, girth of pseudo stem negative correlation with days to sprouting. Plant height was also show highly significant positive correlation with girth of pseudo stem and negatively highly significant with days to sprouting. Thus it may be decaled that selection on these traits eighter in combination alone would be beneficial to identify the genotype having yield potential. Similar finding have been reported by Das (1977), Mehta *et al.* (2003) [9] and Maini *et al*. (1981).

Path coefficient

Correlation studies alone are not sufficient to ascertain a clear association among the characters as more variable is considered in the correlation. Thus the path coefficient has been suggested by Wright (1921) [18] to understand the forces in building up correlation. Dewey and Lu (1959) [3] partitioned the total correlation into direct and indirect effects. In other words, it is measure of the direct and indirect contribution of various independent characters on the dependent character i.e. yields. Path correlation coefficient analysis revealed that weight of corm per plant (0.9933) showed maximum direct effect on equatorial diameter of corm (0.0221) followed by number of corm per plant (0.0011) showed higher value of positive direct effect on yield t/ha. Thus it revealed that weight of corm per plant major positive role yield traits, while negative direct effect was exhibited by polar diameter of corm (-0.0129), girth of pseudo stem (-0.0068), number of cormel per plant (-0.0054), days of sprouting (-0.0030), width of leaf per plant (-0.0027) and weight of cormel per plant (-0.0003) at phenotypic level. Length of pseudo stem showed high indirect effect with all the traits expect days to sprouting, number of cormel per plant and weight of cormel plant.

Path coefficient analysis for various morphological and quality traits was studies by pandey *et al*. (1996) [10], Sarkar *et al.* (1996) [13], Mehta *et al.* (2003) [9] and Cheema *et al*. (2007).

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