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Study on character association and path analysis in summer groundnut (*Arachis hypogaea* L.)

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Abstract
The thirty elite genotypes of groundnut were evaluated in randomized block design for variability, heritability and genetic advance during summer, 2011. The Observations were recorded on fifteen characters. The results of analysis of variance revealed, that the differences among genotypes were highly significant (P<1) for all studied traits. The PCV and GCV estimates were higher for number of mature pods per plant, dry pod yield per plant, fresh pod yield per plant and fresh fodder yield per plant. High heritability coupled with high genetic advance was observed for fresh biomass per pant, fresh fodder yield per plant fresh pod yield per plant and dry biomass yield per plant. The association between dry pod yield per plant and other quantitative characters showed significant and positive correlation with number of mature pods per plant, dry biomass, number of pegs per plant, fresh pod yield per plant, fresh biomass, fresh fodder yield per plant and immature pods per plant. Path coefficient analysis revealed that traits *viz*. dry biomass, fresh fodder yield, number of mature pods and fresh pod yield per plant exhibited high direct effect as well as strong association with dry pod yield per plant indicating true and perfect relationship between them. On the basis of relative contribution the fresh biomass, plant height dry pod yield, fresh pod yield, fresh pod yield, plant spread were the main characteristic contributing to the genetic divergence. However, ten elite genotypes were identified as the best performance and potent parent for further hybridization programme as listed below. JL-501, JALW-30, SB-XI, TAG-24, JAL-42, KDG-123, KDG-128, KDG-142, KDG-156, KDG-160 and KDG-171.

Keywords: groundnut, genetic variability, heritability, correlation, direct and indirect effect

Introduction

Groundnut is originated in the area of South America and commonly known as Peanut, monkey nut and goober nut. Groundnut is self-pollinated crop, autotetraploid with chromosome number 2n=4x= 40. The genus *Arachis* is a member of family *Fabaceae* (synonym: *Leguminosae*), subfamily *Papillionoidae*, tribe *Aeschynomeneae* and subtribe stylosanthes. It belongs to the section *Arachis* and series amphiploidies and the family *Fabaceae* (Gregory *et al.*, 1980) [4]. Groundnut kernels contain about 50.00% edible oil and 25.00% protein. The haulms are used as valuable nutritious fodder. Groundnut oil cake is an important cattle feed and a good soil amendment. Groundnut is C_3 plant and can be grown successfully in tropical and subtropical area. It needs good sunshine and high temperature to produce more pods. Therefore, summer is the ideal season for groundnut cultivation. Higher yield is the main objectives of any breeding programme and governed by large number of genes which influence association among different characters. Genetic variability is the basic requirement for crop improvement as this provides wider scope for crop improvement and selection. Thus effectiveness of selection depends upon the nature, extent and magnitude of genetic variability present in material and the extent to which it is heritable. While, selection of suitable diverse parents for hybridization is an important step for getting desired recombination in the segregating generations. So, it is necessary to split the phenotypic variability into heritable and non-heritable components such as genotypic and phenotypic coefficients, heritability and genetic advance.

Materials and Methods

The experimental material consists of thirty diverse genotypes of groundnut derived from different origins. The genotypes were obtained from germplasm collection available at the Agricultural Research Station, Kasbe, Digraj, Dist-Sangali, Maharashtra. These genotypes of groundnut were evaluated in randomized block design with three replications at Botany Research Farm, College of Agriculture Pune, during summer, 2011.

Each genotype was accommodated in a single row plot of 3m length with a spacing of 30 cm between rows and 10 cm between plants within the row. Observations on fifteen characters were recorded on randomly selected five plants from each genotypes and average value was used for the statistical analysis. Analysis of variance was performed to test the significance of difference among the genotypes for the characters studied. Genetic variability parameters were worked out as proposed by (Johnson *et al*. 1955) and correlation coefficient as per Dewey and Lu (1959).

Results and Discussion

The results depicted from data pertaining to the various parameters are presented in Table 1 to 3. Analysis of variance revealed that the variation among the genotypes was significant for all the characters studied and indicated the presence of sufficient genetic variability for the characters. The estimates of phenotypic coefficient of variation (PCV) were magnitudinally higher than the genotypic coefficient of variation (GCV) for all the characters studied indicating influence of environment on these traits (Table 1). The estimates of GCV and PCV were of high magnitude for number of mature pods per plant, dry pod yield per plant and fresh pod yield per plant, indicating good amount of variation for these characters and there is ample scope for their improvement through selection (Table 1). These results confirmed the earlier findings of Reddy *et al.* (1995) [12], Jayalakshmi *et al.* (1998) [7], Islam and Rasul (1998) [6], Yadav *et al.* (1998) [19], Rameshkumar *et al.* (1998) [11] and John *et al.* (2009) [8]. The characters days to 50% flowering, shelling percentage, oil content had very low GCV and PCV estimates, which suggested the narrow range of variation for these characters (Table 1). These results were in accordance with the findings of Ganeshan and Sudhakar (1995) [3], for days to 50% flowering, Prakash *et al.* (2000) [10] for oil content. Vidhiyavaraman and Raveendran (1996) [18] for both oil content and shelling percentage. The heritability estimates were very high for all the characters (Table 1). The heritability estimates along with genetic advance as a per cent of mean are more useful in predicting yield under phenotypic selection than heritability estimates alone (Johnson *et al.* 1955). Number of matured pods per plant and fresh and dry pod yield per plant recorded high genetic advance as a per cent of mean accompanied with high heritability, suggesting that these traits are controlled by additive gene action and phenotypic selection for improvement of these traits will be effective. The results were in accordance with Dashora*et al.* (2002) [2].

Correlation studies

The correlation studies (Table 2) revealed that, the characters *viz.*, number of mature pods per plant, dry biomass per plant, number of pegs per plant, fresh pod yield per plant, fresh biomass per plant, fresh fodder yield per plant and immature pods per plant showed highly significant positive correlation with dry pod yield per plant, indicating dependency of these characters on each other. Similar findings were reported by Sumathi and Ramanatham (1995) [15] and Rosemaryfrancis and Sethupathi (1997) [13] for number of pegs per plant and number of pods per plant. Vasanthi *et al* (1998) [16] for sound mature pods per plant; Antony *et al*. (2000) [1] for dry biomas; Sah *et al.* (2000) [14] for number of mature pods per plant.

Table 1: Parameters of Genetic variability for yield and yield contributing characters in groundnut.

Sr. No	Character	Range	General Mean	GCV	PCV	h^2(b.s)	GA	GAM (%)
1	Days to 50% flowering (No.)	37.33-43.33	40.86	3.200	3.732	73.53	2.31	5.65
2	Plant height (cm)	38.08-55.77	42.98	12.52	12.546	99.65	11.07	27.75
3	Plant spread (cm)	57.42-77.84	66.78	9.068	9.138	98.47	12.38	18.53
4	Fresh biomass (g)	238.81-543.73	371.55	18.35	18.363	99.86	140.35	37.77
5	Dry biomass (g)	79.10-157.60	119.17	16.22	16.294	99.12	36.64	33.27
6	Fresh fodder yield (g)	156.99-390.34	265.62	20.97	21.008	99.72	114.63	43.15
7	Dry fodder yield (g)	50.65-101.77	76.93	17.88	18.085	97.84	28.04	36.45
8	Pegs per plant (No.)	54.53-102.73	74.24	17.89	18.051	98.66	27.18	36.61
9	Mature pods /plant (No.)	27.74-78.85	51.54	25.09	25.277	98.54	26.44	51.30
10	Immature pods/plant(No.)	9.31-20.49	13.28	17.12	18.947	81.67	4.23	31.87
11	Shelling (%)	45.52-66.78	60.58	8.32	8.515	95.58	10.15	16.76
12	HKW(g)	37.22-62.61	50.98	16.20	16.361	98.09	16.85	33.06
13	Oil content (%)	38.85-48.55	42.60	10.57	10.917	93.84	8.87	21.10
14	Fresh pod yield /plant (g)	72.03-156.52	106.38	22.61	22.755	98.73	49.23	46.28
15	Dry pod yield per plant (g)	26.49-68.93	41.98	22.74	23.0686	97.25	19.40	46.21

Abbreviations:
GCV = Genotypic coefficient of variation, **b. s** = Broad sense,
PCV = Phenotypic coefficient of variation, **G.A** = Genetic advance

and Venkataravana *et al*. (2000) [17] for number of mature pods per plant and fresh fodder yield per plant and John *et al*. (2009) [8] for number of mature pods per plant and fresh pod yield per plant. However, days to 50% flowering, dry fodder yield per plant, shelling percentage, plant spread, hundred kernel weight and plant height recorded positive but non-significant correlation with dry pod yield per plant (Table 2). The oil content showed non-significant and negative correlation with dry pod yield per plant. The character plant height recorded significant and positive correlation with plant spread whereas significant and negative correlation was found with shelling percentage (Table 2). Number of pegs per plant showed significant and positive correlation with number of mature pods per plant and fresh pod yield per plant. This implies that simultaneous selection of these characters may help to increase the yield of groundnut. The results of Sumathi and Ramanathan (1995) [15] for number of mature pods per plant were similar to the results in the present findings.

Path coefficient analysis

The direct and indirect contributions of each character as revealed by path coefficient analysis are presented in (Table 3). The present investigation revealed that dry biomass per plant, fresh fodder yield per plant, number of mature pods per plant and fresh pod yield per plant recorded high magnitude of direct effect accompanied by highly significant correlation with dry pod yield per plant indicating true and perfect relationship between them. Thus suggesting that direct selection of these characters would help in genotypes in groundnut. These results were in agreement with the earlier findings of Patel and Shelke (1992) [9] for both dry biomass and number of mature pods per plant; Sumathi and Ramanathan (1995) [15] and Hoque and Chowdhury (1997) [5] for number of mature pods per plant. The trait fresh biomass had significant positive correlation with dry pod yield per plant, which contributed mainly through its indirect effect *viz.*, dry biomass per plant and number of mature pods per plant, dry fodder yield per plant and while with number of pegs per plant negatively. The significant positive correlation was observed between dry biomass and dry pod yield per plant. Dry biomass have high direct effect and showed its indirect effect *viz.*, fresh biomass, dry fodder yield per plant negatively, while with number of pegs per plant, fresh fodder yield per plant, number of mature pods per plant, and fresh pod yield positively (Table 3). Fresh fodder yield and fresh pod yield per plant showed positive and significant correlation with dry pod yield per plant and contributed indirectly *via.*, dry biomass per plant, number of mature pods per plant and number of immature pods per plant positively, while with dry fodder yield per plant and number of pegs per plant negatively (Table 3). Number of pegs per plant which had significant and positive correlation with dry pod yield per plant and contributed indirectly *via.*, Number of mature pods per plant, number of immature pods per plant and fresh pod yield per plant positively (Table 3). Number of mature pods per plant and number of immature pods per plant showed significantly positive correlation with dry pod yield per plant and contributed indirectly *via.*, Fresh pod yield per plant and immature pods per plant and positively, while number of pegs per plant negatively (Table 3). From above results it is implicated that increase in the performance of these traits which are contributing positively, ultimately leads to increase in the dry pod yield per plant.

Table 2: Genotypic correlation coefficient for different characters in 30 genotypes of groundnut

Traits	DF	PH	PS	FB	DB	FFY	DFY	MP	IP	PP	SP	OC	HKW	FPY	DPY
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	-0.079	0.110	0.381*	0.312	0.313	0.323	0.466**	0.393*	0.148	0.002	-0.097	0.335	0.225	0.190
2		1	0.651**	0.202	0.034	0.171	0.032	-0.096	-0.020	-0.135	-0.363*	0.113	-0.333	0.175	0.009
3			1	0.266	0.193	0.257	0.192	0.288	0.289	0.171	-0.186	0.159	-0.241	0.140	0.103
4				1	0.834**	0.946**	0.772**	0.369	0.400*	0.208	-0.283	0.005	0.090	0.621**	0.573**
5					1	0.824**	0.866**	0.510**	0.521**	0.361	-0.126	-0.108	0.107	0.478**	0.742**
6						1	0.822**	0.280	0.286	0.181	-0.294	-0.074	0.025	0.348	0.479**
7							1	0.212	0.205	0.219	-0.329	-0.156	0.174	0.244	0.321
8								1	0.966**	0.330	0.358	-0.158	0.064	0.401*	0.684**
9									1	0.247	0.281	-0.123	0.037	0.493**	0.746**
10										1	0.177	0.198	-0.180	0.267	0.426**
11											1	0.213	0.212	-0.056	0.188
12												1	-0.012	0.213	0.045
13													1	0.212	-0.012
14														1	0.622**
15															1

Table 3: Direct and Indirect effects of different characters on pod yield in groundnut.

Sr. No.	DF	PH	PS	FB	DB	FFY	DFY	PP	MP	IP	SP	HKW	OC	FPY	CPDY
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	0.1510	0.005	-0.001	-0.616	0.477	0.429	-0.342	-0.296	0.275	0.005	-0.004	0.000	-0.019	0.126	0.191
2	-0.012	-0.061	-0.006	-0.326	0.052	0.235	-0.035	0.061	-0.015	-0.005	0.004	-0.001	0.019	0.098	0.008
3	0.017	-0.040	-0.010	-0.431	0.294	0.352	-0.203	-0.183	0.203	0.006	0.006	-0.001	0.014	0.078	0.102
4	0.058	-0.012	-0.003	-1.614	1.272	1.295	-0.818	-0.234	0.280	0.007	0.000	-0.001	-0.005	0.348	0.573**
5	0.047	-0.002	-0.002	-1.346	1.525	1.128	-0.917	-0.324	0.365	0.013	-0.004	0.000	-0.006	0.268	0.745**
6	0.047	-0.010	-0.003	-1.529	1.257	1.368	-0.870	-0.178	0.201	0.006	-0.003	-0.001	-0.002	0.195	0.478**
7	0.049	-0.002	-0.002	-1.247	1.321	1.124	1.059	-0.135	0.144	0.008	-0.006	-0.001	-0.010	0.137	0.321
8	0..070	0.006	-0.003	-0.596	0.779	0.384	-0.225	-0.635	0.677	0.012	-0.006	0.001	-0.004	0.225	0.684**
9	0.059	0.001	-0.003	-0.646	0.795	0.392	-0.218	-0.613	0.700	0.009	-0.005	0.001	-0.002	0.277	0.747**
10	0.022	0.008	-0.002	-0.336	0.551	0.248	-0.233	-0.210	0.173	0.035	0.008	0.001	0.010	0.150	0.425*
11	0.000	0.022	0.002	0.458	-0.192	-0.403	0.348	-0.228	0.197	0.006	0.014	0.004	-0.007	-0.032	0.189
12	-0.015	-0.007	-0.002	-0.001	-0.165	-0.102	0.165	0.100	-0.086	0.007	0.038	0.001	-0.009	0.120	0.044
13	0.051	0.020	0.002	-0.146	0.164	0.035	-0.185	-0.041	0.026	-0.006	0.006	0.000	-0.058	0.119	-0.013
14	0.034	-0.011	-0.001	-1.002	0.729	0.476	-0.259	-0.255	0.346	0.010	0.008	0.000	-0.012	0.560	0.623**

Residual effect = 0.0048

Abbreviations: DF-Days to 50% flowering, **PH-** Plant height (cm), **PS-**Plant spread (cm), **FB-**Fresh biomass (g), **DB-** Dry biomass (g), **FFY-**Fresh fodder yield (g), **DFY-**Dry fodder yield (g), **PP-**Pegs per plant(No.), **MP-** Mature pods per plant (No), **IP-** Immature pods per plant (No.), **SP-**Shelling (%), **HKW-**Hundred kernel weight(g), **OC-** Oil content (%), **FPY-**Fresh pod yield per plant (g), **CPDY-**Correlation with Dry pod yield per plant (g).

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