Research Article

Estimation of Genetic Variability, Correlation and Path Analysis in Groundnut (*Arachis hypogaea* L.) Germplasm

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Abstract

The present study was conducted on variability, correlation and path coefficient analysis for yield and its contributing traits in groundnut germplasm. The highest genotypic coefficient of variation was observed for plant height at 20 DAS (32.72%) and high heritability coupled with high genetic advance was observed for plant height at 60 DAS (99.50 and 27.48) and kernel uniformity (98.96 and 19.24). The results of phenotypic and genotypic correlation analysis revealed that plant height at 40 DAS (0.9215 and 0.8915), was significantly and positively correlated with pod yield q/ha (0.2897 and 0.2637) and hundred kernel weight (0.8981 and 0.4804) was positively correlated with pod yield/plant. Path analysis indicated that highest positive direct effect on pod yield per plant followed by kernel yield q/ha and kernel uniformity (0.0128).

Keywords: Groundnut, Heritability, Genetic advance, correlation and path coefficient analysis

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Introduction

Groundnut (*Arachis hypogaea* L.) has been the main oilseed crop in India and other developing countries. Globally, groundnut production and area during 2011–2012 averaged 6.93 million tonnes and 141.1 million hectare [1] and production of oil seeds in India 30012.2 thousand tonnes. The oil content in seed of groundnut cultivars for commercial production is generally around 50%, while some germplasm accessions have been found to contain more than 55% oil [2].There is an increasing need for high protein and low oil groundnut as these traits add to the confectionary quality of groundnuts. High oleate to linoleate (O/L) ratio has been associated with prolonged groundnut shelf-life and decreased tendency toward rancidity [3]. The success in any breeding programme depends on the population and its efficient management and utilization. Further, the association analysis, which generates information on the relationship between the character and possibility of indirect selection, is also necessary. Path coefficient analysis may be carried out to obtain the information on the direct and indirect effect of particular character on other characters and finally on yield. Therefore, keeping in view the above outlined necessities the present investigation was carried out to determine relationship between different morphological characters in groundnut germplasm.

Materials and Methods

The experimental material for the present investigation consisted of 40 genotypes of groundnut obtained from the International Crop Research Institute of Semi Arid Tropic, Patancheru, Hyderabad, A. P. The present experiment was conducted in randomized block design at Field Experimentation Centre, Department of Genetics and Plant Breeding, Allahabad during 2012. In each replication consisted of two rows of each genotype with a 1.5 meter row length. Row to row and plant to plant distance 40 x 10 cm. All the recommended agronomic cultural practices and plant protection measure were followed as and when required. Eleven quantitative data were recorded on five randomly selected plants from each genotype in each replication for different characters. Except days to 50% flowering & days to maturity recorded on the plot basis. Replication wise data for each character were subjected for analysis of variance [4]. The statistical and biometrical analysis of GCV and PCV were calculated by formula given by Burton [5], heritability in broad sense (h^2) by Burton and de Vane (1953) and genetic advance i.e., the expected genetic gain was calculated using the procedure given by Johnson *et al*., [6]. The correlation coefficient and path coefficient were worked out as for the method recommended by Al-Jibouri *et al*., [7] and Deway and Lu [8] respectively, the estimated

values were compared with table values of the correlation coefficient to test the significance of the correlation coefficient prescribed by Fisher and Yates [9].

Results and Discussion

The treatment i.e. mean sum of square due to genotypes show highly significant differences for all 11 characters under studies at 1 % level of significant Janki *et al.*, [10] (**Table 1**). This indicated that there is ample scope for selection of promising lines from the present gene pool for yield and its components. Phenotypic coefficient of variation (PCV) was slightly higher magnitude than the genotypic coefficient of variation (GCV) for all the characters, indicating the influence of environmental factors on these traits Patil *et al.*, [11] (**Table 2**). High heritability values were exhibited for plant height at 40 DAS, plant height at 20 DAS, hundred kernel weight, pod yield per plant and sound mature kernel (Table 2). Maximum expected genetic advance as percent of mean was observed high (>20%) for plant height at 20 DAS (66.29%), kernel yield q/ha (60.09%), and plant height at 40 DAS (58.58%). Moderate genetic advance (10-20%) was observed for sound mature kernel (14.65%), primary branches per plant at 60 DAS (14.14%) and primary branches per plant at 20 DAS (10.45%) indicating the presence of additive gene effects; while the some was minimum genetic advance as per cent of mean for primary branches per plant at 40 DAS (9.54%), days to 50 % flowering (8.58%) and days to maturity (2.54%).

Table 1 Analysis of variance for 11 quantitative characters in groundnut germplasm

S.No.	Characters	Mean sum of squares		
		Replications	**Treatments**	**Error**
		d.f. = 2	**d.f.=39**	**d.f.=78**
1.	Days to 50% flowering	3.71	283.16**	98.28
2.	Plant height 20 days (cm)	0.27	3094.37**	69.65
3.	Plant height 40 days (cm)	0.39	7101.08**	67.77
4.	Plant height 60 days (cm)	3.88	20972.96**	69.67
5.	Primary branches / plant 20 days	0.01	18.18**	15.77
6.	Primary branches / plant 40 days	0.51	21.81**	15.06
7.	Primary branches / plant 60 days	1.02	49.13**	23.22
8.	Days to maturity	2.31	457.86**	75.68
9.	Pod yield per plant (g)	3.12	2646.48**	100.05
10.	Pod yield q/ha	0.52	1082.77**	105.98
11.	Shelling %	37.76	5526.59**	3934.17
12.	Hundred kernel weight (g)	2.18	3754.37**	87.42
13.	Sound matured kernel	9.80	3227.86**	211.53
14.	Kernel yield q/ha	1.67	572.62**	125.91
15.	Kernel uniformity	2.11	10355.12**	72.55

*Significant at 5% level
** Significant at 1 % level

Correlation and path analysis

Phenotypic and genotypic correlation coefficient of pod yield per plant with other characters is presented in Kumara *et al.*, (2015) (**Table 3**). The pod yield per plant exhibited highly significant and positive correlation with pod yield q/ha, hundred kernel weight and primary branches per plant at 60 DAS significant and positive correlation with kernel yield q/ha. Path coefficient analysis was carried out by using simple correlation among 11 characters to resolve the direct and indirect effect of different characters on pod yield per plant. The results of path analysis are presented in (**Tables 4** and **5**). The highest positive direct effect on pod yield per plant was exerted by kernel yield q/ha and kernel uniformity (0.0128). In contrast days to 50% flowering (-0.0113) and sound mature kernel (-0.0144) contributed considerable negative direct effect on pod yield per plant. The very low value of direct effect recorded in case of remaining characters indicated that their direct contribution to pod yield was low to the considered of any consequence. In the present investigation plant height at 60 DAS, kernel yield q/ha and kernel uniformity, Residual effect was R = 0.4117 showing the variability in the pod yield in groundnut was contributed by the characters studied in path analysis. Path coefficient analysis suggested that the highest positive direct effect on pod yield per plant was

followed by kernel yield q/ha, plant height at 60 DAS and shelling %. In contrast, primary branches per plant at 60 DAS and days to maturity contribute considerable negative direct effect on pod yield per plant.

Table 2 Estimates of different genetic parameters for different characters in 40 genotypes of groundnut germplasm

S. No.	Characters	Genotypic variance	Phenotypic variance	Coefficients of Variation		Heritability (bs) (%)	Genetic Advance	Genetic Advance as per cent of mean
				GCV	PCV			
1.	Days to 50 % flowering	2.00	3.26	5.32	6.79	61.4	2.28	8.58
2.	Plant height at 20 days (cm)	26.15	27.04	32.72	33.28	96.70	10.35	66.29
3.	Plant height at 40 days (cm)	60.42	61.27	28.62	28.81	98.69	15.90	58.58
4.	Plant height at 60 days (cm)	178.95	179.851	26.49	26.56	99.50	27.48	54.45
5.	Primary branches / plant at 20 days	0.08	0.29	9.21	16.72	30.33	0.33	10.45
6.	Primary branches / plant at 40 days	0.12	0.31	7.44	11.95	38.73	0.44	9.54
7.	Primary branches / plant at 60 days	0.32	0.61	9.53	13.23	51.85	0.84	14.14
8.	Days to maturity	3.59	4.56	1.59	1.79	78.72	3.46	2.90
9.	Pod yield per plant (g)	22.19	23.47	27.09	27.80	94.54	9.43	54.26
10.	Pod yield q/ha	8.80	10.16	26.14	28.09	86.63	5.68	50.13
11.	Shelling %	30.42	80.86	8.30	13.54	37.62	6.96	10.49
12.	Hundred kernel weight (g)	31.71	32.83	17.04	17.34	96.59	11.40	34.50
13.	Sound matured kernel	26.68	29.39	7.46	7.80	90.77	10.13	14.65
14.	Kernel yield q/ha	4.35	5.97	31.18	33.33	87.52	5.38	60.09
15.	Kernel uniformity	88.19	89.12	13.90	13.97	98.96	19.24	28.49

Table 3 Genotypic and phenotypic correlation among 11 characters in groundnut germplasm

S. No.	Characters	Correlation	Days to 50% flowering	Plant height 20 DAS (cm)	Plant height 40 DAS (cm)	Plant height 60 DAS (cm)	Primary branches per plant at 20 DAS	Primary branches per plant at 40 DAS	Primary branches per plant at 60 DAS	Days to maturity	Pod yield per plant (g)	Pod yield q/ha	Shelling percentage	100 kernel weight	Sound mature kernal	Kernal yield	Kernal uniformity
1	Days to 50% flowering	G	**1.0000**	0.3067	0.3155	0.2515	-0.0058	-0.0019	-0.0355	-0.1803	0.0176	-0.0296	0.2790	0.1176	0.1697	0.0369	-0.0170
		P	**1.0000**	0.2329*	0.8734	0.9069	0.1370	-0.4955	-0.5630	-0.4015	0.1919	-0.1282	-0.2177	0.1111	-0.2071	-0.1640	-0.2337
2	Plant height 20	G		**1.0000**	0.2559**	0.9297	-0.0181	-0.4392	-0.4360	-0.2323	0.2874	0.0065	-0.1337	0.1261	-0.1135	-0.0234	-0.0398

	DAS (cm)	P	**1.0000**	0.8523**	0.1993**	-0.0161	-0.4312	-0.4594	-0.2737	0.2620	0.0290	-0.1415	0.2266	-0.1936	0.0005	-0.0973
3	Plant height 40	G		**1.0000**	0.8915**	0.0809	0.3219	-0.3908	0.0167	0.0915	0.0105	0.0401	-0.0983	0.1941	0.0444	-0.2543
	DAS (cm)	P		**1.0000**	0.9215**	0.0712	0.0079	0.8968	0.1801	0.1398	0.3953	0.4414	0.0057	0.3862	0.4974	0.0049
4	Plant height 60	G			**1.0000**	0.0067	-0.3106**	-0.0718	0.3002	-0.0212	0.4228	0.3598	-0.1652	0.2266	0.5095	0.0270
	DAS (cm)	P			**1.0000**	-0.0077	-0.2640**	-0.3908**	-0.1706	-0.2110	0.0971	0.1336	-0.0320	0.2206	0.1059	0.0387
5	Primary branches a 20 DAS	G				**1.0000**	-0.2741**	-0.2970**	-0.3509**	0.0073	0.7028	0.1859	0.0850	0.0926	0.7232	0.1290
		P				**1.0000**	0.2303*	-0.3294**	-0.2075*	0.1846*	-0.0406	0.0574	0.3358	-0.0378	0.9599	0.2558
6	Primary branches a 40 DAS	G					**1.0000**	0.2092*	-0.2462**	0.2694**	-0.1204	0.0967	-0.2244	0.2410	0.3307	0.0236
		P					**1.0000**	0.4591**	-0.0629	0.2561**	0.0020	-0.1199	0.0868	-0.2883	0.2417	0.1928
7	Primary branches at 60 DAS	G						**1.0000**	0.0539	0.0551	0.0247	-0.0848	0.1139	0.1204	0.0273	-0.1361
		P						**1.0000**	0.1816*	0.1046	-0.0143	-0.0914	0.1234	-0.1995*	-0.0164	0.2455
8	Days to maturity	G							**1.0000**	-0.0379	0.2354**	0.0631	0.2241*	-0.1056	-0.1338	-0.0119
		P							**1.0000**	-0.1672	0.2326*	0.1667	-0.0666	-0.1852*	-0.0248	-0.2268*
9	Pod yield per plant (g)	G								**1.0000**	0.0842	0.2087*	-0.0272	0.1025	-0.0040	-0.0406
		P								**1.0000**	0.6567**	0.0911	-0.1230	0.2241*	0.0231	-0.0961
10	Pod yield (q/ha)	G									**1.0000**	0.1079	-0.0210	0.1446	0.2637**	-0.1509
		P									**1.0000**	0.0647	0.0791	0.1942*	0.2897**	-0.0130
11	Shelling %	G										**1.0000**	0.3019**	-0.0723	0.1022	0.0058
		P										**1.0000**	-0.1513	-0.0319	0.6207**	0.0458
12	100 kernal weight	G											**1.0000**	0.1161	0.8981**	0.1256
		P											**1.0000**	0.2627**	0.4804**	0.2355**
13	Sound maturity kernel	G												**1.0000**	0.1918*	0.0333
		P												**1.0000**	0.0157	0.1908*
14	Kernel yield	G													**1.0000**	-0.1221
		P													**1.0000**	0.2166*
15	Kernel uniformity	G														**1.0000**
		P														**1.0000**

* Significant at 5% level
** Significant at 1% level

Table 4 Phenotypic path coefficient analysis for 11 characters in groundnut-pod yield/plant is as dependent character

S.No.	Characters	Days to 50% flowering	Plant height (cm) At 60 DAS	Primary branches/ plant At 60 DAS	Days to maturity	Shelling (%)	Hundred kernel weight (g)	Sound matured kernel (%)	Kernel yield (q/ha)	Kernel uniformity (%)	Pod yield/plant (gm.)
1.	Days to 50% flowering	**-0.0113**	-0.0022	0.0008	0.0019	-0.0011	-0.0010	-0.0014	0.0002	0.0001	0.0073
2.	Plant height (cm) At 60 DAS	0.0375	**0.1881**	-0.0620	-0.0463	-0.0172	0.0422	-0.0348	-0.0007	-0.0181	0.2561
3.	Primary branches/ plant At 60 DAS	0.0115	0.0526	**-0.1596**	-0.0290	-0.0333	0.0196	-0.0231	-0.0462	-0.0009	-0.0379
4.	Days to maturity	0.0270	0.0390	-0.0287	**-0.1582**	-0.0144	0.0033	-0.0307	-0.0162	-0.0072	-0.1672
5.	Shelling (%)	-0.0250	0.0236	-0.0539	-0.0235	**-0.2583**	0.0391	-0.0300	-0.1241	-0.0086	0.1079
6.	Hundred kernel weight (g)	-0.0167	-0.0430	0.0236	0.0040	0.0290	**-0.1918**	0.0504	-0.0368	-0.0366	0.0791
7.	Sound matured kernel (%)	-0.0017	0.0027	-0.0021	-0.0028	-0.0017	0.0038	**-0.0144**	-0.0002	0.0018	-0.0723
8.	Kernel yield (q/ha)	-0.0138	-0.0033	0.2439	0.0861	0.4045	0.1615	0.0132	**0.8420**	0.1824	0.6207
9.	Kernel uniformity (%)	-0.0002	-0.0012	0.0001	0.0006	0.0004	0.0024	-0.0016	0.0028	**0.0128**	0.1259

Table 5 Genotypic path coefficient analysis for 11 characters in groundnut-pod yield/plant is as dependent character

S.No.	Characters	Days to 50% flowering	Plant height (cm) At 60 DAS	Primary branches/ plant At 60 DAS	Days to maturity	Shelling (%)	Hundred kernel weight (g)	Sound matured kernel (%)	Kernel yield (q/ha)	Kernel uniformity (%)	Pod yield/plant (g)
1.	Days to 50% flowering	**-0.0381**	-0.0096	0.0014	0.0069	-0.0106	-0.0045	-0.0065	-0.0014	0.0006	0.0176
2.	Plant height (cm) at 60 DAS	0.0028	**0.0110**	-0.0051	-0.0030	-0.0016	0.0025	-0.0021	0.0000	-0.0011	0.2620
3.	Primary branches / plant at 60 DAS	0.0205	0.2659	**-0.5788**	-0.1737	-0.2082	0.0956	-0.1312	-0.2949	-0.0156	-0.0212
4.	Days to maturity	0.0284	0.0431	-0.0473	**-0.1576**	-0.0210	0.0050	-0.0348	-0.0167	-0.0061	-0.2110
5.	Shelling (%)	0.0014	-0.0007	0.0017	0.0006	**0.0048**	-0.0011	0.0012	0.0016	0.0001	0.1859
6.	Hundred kernel weight (g)	-0.0331	-0.0637	0.0464	0.0090	0.0631	**-0.2811**	0.0811	-0.0680	-0.0542	0.0850
7.	Sound matured kernel (%)	-0.0070	0.0080	-0.0094	-0.0091	-0.0099	0.0119	**-0.0413**	-0.0011	0.0056	-0.0926
8.	Kernel yield (q/ha)	0.0414	0.0006	0.5718	0.1189	0.3711	0.2713	0.0307	**1.1223**	0.2755	0.7232
9.	Kernel uniformity (%)	0.0013	0.0074	-0.0020	-0.0029	-0.0018	-0.0146	0.0103	-0.0186	**-0.0759**	0.1290

References

[1] Agriculture Statistics at glance (2011) Directorate of Economic and Statistic, Ministry of Agriculture Government of India, New Delhi.

[2] Lios BS and Holbrook (1980) Groundnut in genetic resources, chromosome engineering and crop improvement. *Oilseed crops*, **7**(2): 115-118.

[3] Braddock JS, Sims CA and O'Keede SK. (1995) Flavor and oxidative stability of roasted high oleic acid peanuts. *Journal of Food Sciences*, 489-493.

[4] Panse VG and Sukhatme PV (1985) Statistical method for Agriculture Worker, Indian Council of Agricultural Research, New Delhi. pp. 381.

[5] Burton GW. (1952) Quantitative inheritance of grasses. Proc. 6th International Grassland Congress. 1: 277-283.

[6] Johnson HW Robinson HF and Comstock RE (1955) Estimates of genetic and environmental variability in soybean. *Agronomy Journal*. **47**: 314-18.

[7] Al Jibouri, HA, Miller, PA and Robinson HF (1958) Genotypic and environmental variation and co-variation in an upland rice crop of inter specific origin. *Agronomy Journal*. **50**: 626-636.

[8] Dewey DR and Lu KH (1959) Genetic variability, correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomic Journal*. **51**: 515-518.

[9] Fisher RA and Yates F. (1967) Statistical Tables for Biological, Agricultural and Medical Research. Longmen Group Limited, London.

[10] Janaki M Naidu LN, Ramana CV and Rao MP (2015) Assessment of genetic variability, heritability and genetic advance for quantitative traits in chilli (*Capsicum annuum* L.). *The Bioscan* **10**(2): 729-733.

[11] Patil AS Punewar AA Nandanwar HR and Shah KP (2014) Estimation of variability parameters for yield and its component traits in groundnut (*Arachis hypogaea* L.). *The Bioscan* **9**(2): 749-754.

[12] Kumara PS Sanjeev BG and Ravana PV (2015) Studies on correlation and path analysis for traits related to water use efficiency and pod yield and its component in groundnut (Arachis hypogaea L.). *The Bioscan* **10**(4): 2155-2158.

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