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Research Note

Character associations and path analysis in ground nut (*Arachis hypogaea* L.)

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Abstract

Fifty diverse groundnut genotypes were assessed for associations among various agronomic characters and also path analysis for pod yield per plant. The magnitudes of genotypic correlation coefficients were generally higher compared to the corresponding phenotypic correlation coefficients for most of the traits. The pod yield per plant showed highly significant and positive correlations at both genotypic and phenotypic level with kernel yield per plant, number of mature pods per plant, harvest index, biological yield per plant, 100-kernel weight, days to 50% flowering, and shelling out-turn. Path analysis revealed high and positive direct effects of kernel yield per plant, while moderate and positive direct effects of number of mature pods per plant and harvest index on pod yield per plant. Days to 50% flowering and shelling out-turn contributed moderate and negative direct effects, but significant indirect effects along with 100-kernel weight for pod yield per plant. These results suggest kernel yield per plant, number of mature pods per plant, harvest index, 100-kernel weight, days to 50% flowering and shelling out-turn as useful traits for developing high yielding groundnut varieties.

Key words :Groundnut, correlation, selection indices, kernel yield. Character association, path analysis, ground nut, *Arachis hypogaea* L.

Groundnut is an important oilseed crop. The knowledge of association among the yield and yield contributing characters would be of great help in developing a suitable plant type and in planning breeding programme. However, the correlation coefficient does not give any indication about magnitude of contribution made by various component characters. Therefore, genotypic path coefficient analysis was done to find out the direct and indirect effects of yield components and their correlation with pod yield per plant. Pod yield, a polygenic trait, is influenced by its various components directly as well as indirectly *via* other traits, which create a complex situation before a breeder for making selection. Therefore, path coefficient analysis could provide a more realistic picture of the interrelationship, as it considers direct as well as indirect effects of the variables by partitioning the correlation coefficient.

Fifty genotypes of groundnut were tested in a Randomized block design with three replications during summer season of 2014 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. Each genotype was sown as a single row of 3.0 m length with a spacing of 45 x 15 cm between and within rows, respectively. The experiment was surrounded by two guard rows to avoid damage and border effects. Recommended dose of fertilizers for summer groundnut cultivation like 25 kg N_2 ha^{-1} and 50 kg P_2O_5 ha^{-1} were applied. Other recommended agronomic practices were followed to raise a good crop. Data were recorded for 15 agronomic characters *viz*., days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of mature pods per plant, sound mature kernels (%), pod yield per plant (g), 100-pod weight (g), kernel yield per plant (g), 100- kernel weight (g), biological yield per plant (g), shelling out-turn (%), harvest index (%), oil content (%), and protein content (%) in seed. Except days to 50% flowering and days to maturity where data recorded on plot basis, data on rest of the morphological traits were recorded on randomly selected five competitive plants from each accession and average value was used for the statistical analysis. The data was subjected to estimation of phenotypic and genotypic correlation coefficients among all the characters as per Al-Jibouri *et al*. (1958) and path coefficient analysis as per the method suggested by Dewey and Lu (1959). Significant differences were observed among the 50 genotypes for all the 15 characters studied. Analysis of variance revealed highly significant differences among the genotypes for all the traits studied indicating enough genetic variability in the material studied. The genotypic correlations (r_g) were higher than the corresponding phenotypic correlations (r_p) for most of the characters studied indicating least environmental effects on the expression of the traits (Table 1). In the present study, pod yield per plant was found to be significantly and positively correlated with days to 50% flowering, number of mature pods per plant, kernel yield per plant, 100-kernel weight, biological yield per plant, shelling out-turn and harvest index at both genotypic and phenotypic

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levels. Such, positive interrelationship between pod yield per plant and these attributes has also been reported in groundnut by several researchers. The positive genotypic association has been reported for pod yield per plant with number of mature pods per plant (Khanpara *et al*., 2010; Meta and Monpara, 2010; Babariya and Dobariya, 2012; *Choudhary et al*., 2013), kernel yield per plant (Meta and Monpara, 2010), 100-kernel weight (Khanpara *et al*., 2010), biological yield per plant (Khanpara *et al*., 2010; Babariya and Dobariya, 2012; *Choudhary et al*., 2013), shelling out-turn (Vekariya *et al*., 2010), and harvest index (Babariya and Dobariya, 2012; *Choudhary et al*., 2013).

Thus, on the basis of correlations, days to 50% flowering, number of mature pods per plant, kernel yield per plant, 100-kernel weight, biological yield per plant, shelling out-turn and harvest index were proved to be the important characters influencing pod yield in groundnut and they can serve as marker indicator characters for improvement in pod yield and need to be given importance in selection to achieve higher pod yield. The interrelationship among yield components would help in increasing the yield levels and therefore, more emphasis should be given to these components while selecting better types in groundnut.

The days to 50% flowering, which had highly significant and positive association with number of mature pods per plant, kernel yield per plant and harvest index at both genotypic and phenotypic levels, is an important component in identifying and deciding the duration of the crop. This relationship indicated that the improvement in one character would bring about the improvement in another, which in turn can lead to increase in pod yield. Similar, positive association between days to 50% flowering and kernel yield per plant was observed earlier by Zaman *et al.* (2011).

The path coefficient analysis indicated that the kernel yield per plant exhibited high and positive direct effect on pod yield per plant (Table 2). Number of mature pods per plant and harvest index exhibited moderate and positive direct effects towards pod yield. Thus, these characters turned-out to be the major components of pod yield. However, shelling out-turn exhibited moderate and negative direct effects towards pod yield, but it contributed indirectly by exerting negative indirect effects *via* kernel yield per plant.

Similarly, high and positive direct effects of kernel yield per plant (Kumar *et al.*, 2012; Rao *et al.*, 2014), while moderate and positive direct effects of number of mature pods per plant towards pod yield (Shobha *et al.*, 2012) have been reported earlier. The characters like days to maturity, plant height, and 100-pod weight, biological yield per plant, oil content and protein content exhibited low and positive direct effects on pod yield per plant. However, days to 50% flowering, number of primary branches per plant, sound mature kernels and 100-kernel weight exerted low and negative direct effects on pod yield per plant.

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Table 1. Genotypic (r_g) and phenotypic (r_p) correlation coefficients among 15 characters in groundnut

Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches / plant	No. of mature pods/ plant	Sound mature kernels (%)	100-pod weight (g)	Kernel yield/ plant (g)	100-kernel weight (g)	Biological yield/ plant (g)	Shelling out-turn (%)	Harvest index (%)	Oil content (%)	Protein content (%)
Pod yield/plant (g)	r_g	0.433**	-0.262	-0.061	-0.097	0.906**	0.171	0.192	0.993**	0.442**	0.473**	0.378**	0.700**	0.030	0.064
	r_p	0.408**	-0.240	-0.058	-0.092	0.900**	0.115	0.197	0.985**	0.430**	0.481**	0.285*	0.699**	0.015	0.044
Days to 50% flowering	r_g		-0.056	0.003	-0.038	0.447**	0.051	-0.062	0.443**	0.204	0.076	0.103	0.408**	0.028	0.156
	r_p		-0.059	-0.001	-0.032	0.419**	0.023	-0.061	0.410**	0.195	0.077	0.067	0.386**	0.041	0.118
Days to maturity	r_g			0.162	-0.417**	-0.283*	0.092	0.079	-0.280*	0.079	-0.075	-0.214	-0.234	0.438**	-0.231
	r_p			0.155	-0.401**	-0.263	0.052	0.077	-0.256	0.083	-0.068	-0.161	-0.220	0.399**	-0.193
Plant height (cm)	r_g				0.012	-0.068	0.028	0.031	-0.080	0.030	0.050	-0.100	-0.175	-0.358*	0.594**
	r_p				0.008	-0.069	0.038	0.043	-0.079	0.038	0.052	-0.081	-0.170	-0.312*	0.448**
No. of primary branches/ plant	r_g					-0.115	-0.123	-0.018	-0.070	-0.003	-0.076	0.029	-0.071	-0.131	-0.111
	r_p					-0.108	-0.085	-0.016	-0.064	-0.005	-0.077	0.041	-0.067	-0.128	-0.079
No. of mature pods/ plant	r_g						0.077	-0.218	0.885**	0.113	0.564**	0.388**	0.538**	-0.070	0.223
	r_p						0.042	-0.205	0.878**	0.105	0.561**	0.308*	0.542**	-0.070	0.158
Sound mature kernels (%)	r_g							0.110	0.177	0.129	-0.410**	-0.026	0.513**	-0.141	-0.118
	r_p							0.097	0.121	0.083	-0.203	-0.011	0.289*	-0.092	-0.111
100-pod weight (g)	r_g								0.203	0.740**	-0.186	-0.132	0.332*	0.156	-0.272
	r_p								0.210	0.731**	-0.164	-0.121	0.322*	0.134	-0.220
Kernel yield/ plant (g)	r_g									0.483**	0.457**	0.469**	0.704**	0.012	0.053
	r_p									0.465**	0.458**	0.401**	0.700**	0.002	0.028
100-kernel weight (g)	r_g										0.032	0.210	0.474**	0.221	-0.200
	r_p										0.039	0.160	0.458**	0.201	-0.172
Biological yield/ plant (g)	r_g											0.118	-0.271	0.058	0.345*
	r_p											0.117	-0.261	0.058	0.257
Shelling out-turn (%)	r_g												0.279*	-0.126	0.036
	r_p												0.240	-0.086	0.027
Harvest index (%)	r_g													0.010	-0.227
	r_p													-0.001	-0.179
Oil content (%)	r_g														-0.723**
	r_p														-0.558**

*, ** Significant at P=0.05 and 0.01 levels, respectively.

Table 2. Genotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects (off diagonal) of different characters on pod yield in groundnut

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches /plant	No. of mature pods/ plant	Sound mature kernels (%)	100-pod weight (g)	Kernel yield/ plant (g)	100-kernel weight (g)	Biological yield/ plant (g)	Shelling out-tern (%)	Harvest index (%)	Oil content (%)	Protein content (%)	Pod yield/ plant
Days to 50% flowering	**-0.0400**	0.0022	-0.0001	0.0015	-0.0179	-0.0021	0.0025	-0.0177	-0.0081	-0.0030	-0.0041	-0.0163	-0.0011	-0.0062	0.4327**
Days to maturity	-0.0009	**0.0161**	0.0026	-0.0067	-0.0045	0.0015	0.0013	-0.0045	0.0013	-0.0012	-0.0034	-0.0038	0.0070	-0.0037	-0.2622
Plant height (cm)	0.0001	0.0036	**0.0225**	0.0003	-0.0015	0.0006	0.0007	-0.0018	0.0007	0.0011	-0.0022	-0.0039	-0.0080	0.0133	-0.0610
No. of primary branches/ plant	0.0001	0.0011	0.0000	**-0.0026**	0.0003	0.0003	0.0000	0.0002	0.0000	0.0002	-0.0001	0.0002	0.0003	0.0003	-0.0965
No. of mature pods/plant	0.0377	-0.0239	-0.0058	-0.0097	**0.0845**	0.0065	-0.0184	0.0748	0.0096	0.0476	0.0328	0.0455	-0.0059	0.0188	0.9064**
Sound mature kernels (%)	-0.0015	-0.0026	-0.0008	0.0035	-0.0022	**-0.0285**	-0.0031	-0.0050	-0.0037	0.0117	0.0007	-0.0146	0.0040	0.0034	0.1707
100-pod weight(g)	-0.0007	0.0009	0.0004	-0.0002	-0.0026	0.0013	**0.0118**	0.0024	0.0087	-0.0022	-0.0016	0.0039	0.0018	-0.0032	0.1908
Kernel yield/plant (g)	0.4111	-0.2604	-0.0740	-0.0647	0.8207	0.1638	0.1884	**0.9273**	0.4477	0.4239	0.4353	0.6527	0.0107	0.0489	0.9932**
100-kernel weight(g)	-0.0086	-0.0033	-0.0013	0.0001	-0.0047	-0.0054	-0.0310	-0.0203	**-0.0420**	-0.0014	-0.0088	-0.0199	-0.0093	0.0084	0.4424**
Biological yield/plant (g)	0.0026	-0.0026	0.0017	-0.0026	0.0196	-0.0143	-0.0065	0.0159	0.0011	**0.0348**	0.0066	-0.0094	0.0020	0.0120	0.4733**
Shelling out-turn (%)	-0.0105	0.0218	0.0102	-0.0030	-0.0396	0.0026	0.0135	-0.0479	-0.0215	-0.0192	**-0.1020**	-0.0284	0.0128	-0.0037	0.3776**
Harvest index (%)	0.0398	-0.0228	-0.0170	-0.0069	0.0524	0.0499	0.0323	0.0685	0.0462	-0.0264	0.0272	**0.0973**	0.0010	-0.0221	0.6996**
Oil content (%)	0.0007	0.0116	-0.0095	-0.0035	-0.0018	-0.0037	0.0041	0.0003	0.0059	0.0015	-0.0033	0.0003	**0.0265**	-0.0191	0.0295
Protein content (%)	0.0027	-0.0040	0.0102	-0.0019	0.0038	-0.0020	-0.0047	0.0009	-0.0034	0.0059	0.0006	-0.0039	-0.0124	**0.0172**	0.0642

*, ** Significant at P=0.05 and 0.01, respectively; Residual effect (R) = -0 .0017