Electronic Journal of Plant Breeding, 6(1): 248-252 (Mar 2015)
ISSN 0975-928X

Research Note

Correlation and path analysis in Virginia groundnut (*Arachis hypogaea* L.)

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(Received:26 Aug 2014; Accepted:29 Dec 2014)

Abstract
Sixty diverse genotypes of Virginia groundnut were evaluated during *kharif* 2013 for genetic parameters *viz*., correlation and path analysis. The magnitudes of genotypic correlation coefficients were higher as compared to the corresponding phenotypic correlation coefficients. The pod yield per plant had highly significant and positive correlations at phenotypic levels with number of mature pods per plant, 100-pod weight, shelling out-turn, kernel yield per plant, biological yield per plant and harvest index. Path analysis revealed that the biological yield per plant and harvest index had high and positive direct effects on pod yield per plant.

Keywords
Groundnut, correlation, path analysis

Groundnut is an important oil seed crop. The knowledge of association among the yield and yield contributing characters would be of great help in constructing a suitable plant type and in planning breeding programme. However, the correlation coefficient does not give any indication about comparative magnitude of contribution made by various component characters. Therefore, genotypic path coefficient analysis was carried out to find 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.

Sixty genotypes of groundnut were sown in a Randomized Block Design (RBD) with three replications during *kharif* 2013. Each genotype was accommodated in a single row of 3.0 m length with a spacing of 60 cm between rows and 15 cm between plants within the row. The experiment was surrounded by two guard rows to avoid damage and border effects. The fertilizers in the experimental area was applied at the rate of 12.5 kg N_2 ha^{-1} and 25.0 kg P_2O_5 ha^{-1} as it is a recommended dose for *kharif* cultivation of groundnut in the region. Other recommended agronomical practices in vogue were followed for reaping good crop. Data were recorded on randomly selected five plants from each genotype and average value was used for the statistical analysis for 15 characters *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of mature pods per plant, 100-pod weight, 100- kernel weight, sound mature kernel (%), shelling out-turn, biological yield per plant harvest index, kernel yield per plant, pod yield per plant, oil content and protein content. The data subjected to different statistical analysis *viz*., Phenotypic and genotypic correlation coefficients of all the characters were worked-out as per Al-Jibouri *et al*. (1958) and path coefficient analysis was carried-out as per the method suggested by Dewey and Lu (1959).

Analysis of variance revealed that highly significant differences among the genotypes were observed for all the traits. Which indicating the presence of good amount of genetic variability among the material studied. The genotypic correlations were higher than the phenotypic correlation for most of the character studied that 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 number of mature pods per plant, 100-pod weight, 100-kernel weight, sound mature kernels, shelling out-turn, biological yield per plant, harvest index, kernel yield per plant, and protein content at genotypic and phenotypic 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 between pod yield per plant and number of mature pods per plant by Choudhary *et al*.,(2013); for 100-pod weight by John *et al*., (2005); for 100-kernel weight by John *et al*.,(2009), for biological yield per plant by Babariya *et al*.,(2012) and Choudhary *et al*.,(2013); for harvest index by Suneetha *et al*., (2004) and Babariya *et al*.,(2012); for shelling out-turn by Vekariya *et al*.,(2010); for kernel yield per plant and sound mature kernels by Meta and Monpara,(2010).

Thus, on the basis of correlations, number of mature pods per plant, 100-pod weight, 100-kernel weight, sound mature kernels, shelling out-turn, biological yield per plant, harvest index kernel yield per plant and protein content were proved to be the outstanding 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.

Pod yield per plant exhibited negative correlation with 50% flowering, at phenotypic levels. The negative association between these traits has been reported by John *et al*. 2005. The days to 50% flowering, which had highly significant and positive association with days to maturity and number of primary branches per plant at genotypic level, is an important component in identifying and deciding the duration of the crop. These traits *i.e*., days to 50% flowering and days to maturity had positive interrelationship with number of primary branches per plant at genotypic level for both and phenotypic level for days to maturity.

This relationship indicated that the improvement in one character would bring about the improvement in another, which in turn, automatically led to increase in pod yield. Similar the positive associations were also observed earlier scientist between days to 50 % flowering and days to maturity by John *et al*., (2005); John *et al*., (2009) and Choudhary *et al*., (2013); for days to 50% flowering and primary branches per plant by John *et al*., (2009). Channayya *et al*., (2011) reported positive interrelationship of days to 50 % flowering and days to maturity with Number of primary branches per plant.

The present results on correlation coefficients revealed that days to 50% flowering, primary branches per plant, number of mature pods per plant, 100-pod weight, 100-kernel weight, kernel yield per plant, biological yield per plant and harvest index were the most important attributes and may contribute considerably towards 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 path coefficient analysis indicated that the biological yield per plant and harvest index exhibited high and positive direct effects on pod yield per plant (Table 2). Days to maturity and shelling out-turn exhibited moderate and positive direct effects towards pod yield. Thus, these characters turned-out to be the major components of pod yield. The character like kernel yield per plant exhibited moderate-high and negative direct effects towards pod yield. The maximum and positive direct effects of biological yield per plant and harvest index have also been reported by Suneetha *et al*., (2004); Choudhary *et al*. (2013), for harvest index. For biological yield per plant similar result has been reported by Choudhary *et al*. (2013). Shelling out-turn exhibited moderate and positive direct effects towards pod yield similar result has been reported by Suneetha *et al*. (2004).

The character like days to maturity, number of mature pods per plant, 100-pod weight, 100-kernel weight, sound mature kernels, shelling out-turns and protein content exhibited low and positive direct effects with pod yield per plant. While, the days to 50% flowering, plant height, number of primary branches per plant and oil content exerted low and negative direct effect towards pod yield per plant. The biological yield per plant and harvest index exhibited high and positive direct effects on pod yield resulting in its significant and positive association with pod yield. Similarly, kernel yield per plant had low and negative effect on pod yield but, it contributed indirectly by exerting negative indirect effects via biological yield per plant and harvest index.

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Electronic Journal of Plant Breeding, 6(1): 248-252 (Mar 2015)
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Table 1 Genotypic (r_g) and phenotypic (r_p) correlation coefficients among 15 characters in Virginia groundnut

Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches /plant	No. of mature pods/plant	100-pod weight (g)	100-kernel weight (g)	Sound mature kernel (%)	Shelling out-turn (%)	Biological yield/plant (g)	Harvest index (%)	Kernel yield /plant (g)	Oil content (%)	Protein content (%)
Pod yield/plant (g)	r_g	0.001	0.071	0.143	0.022	0.132	0.294**	0.229**	0.241**	0.382**	0.375**	0.604**	0.914**	0.090	0.254**
	r_p	-0.008	0.055	0.09	0.024	0.271**	0.245**	0.189*	0.177*	0.233**	0.292**	0.696**	0.914**	0.062	0.178*
Days to 50% flowering	r_g		0.313**	-0.756**	0.246**	0.080	-0.02	-0.314**	-0.086	-0.404**	0.124	-0.122	-0.181*	0.104	0.102
	r_p		0.207**	-0.515**	0.106	-0.002	-0.020	-0.264**	-0.072	-0.230**	0.066	-0.057	-0.132	0.086	0.078
Days to maturity	r_g			-0.106	0.319**	-0.004	-0.131	-0.29	-0.183*	-0.022	-0.032	0.048	0.053	-0.053	0.019
	r_p			-0.056	0.184*	0.004	-0.099	-0.187*	-0.126	0.013	-0.041	0.058	0.044	-0.019	0.001
Plant height (cm)	r_g				-0.153*	0.565**	0.020	0.118	-0.088	0.240**	0.323**	-0.144	0.226**	-0.229**	0.135
	r_p				-0.039	0.153*	0.006	0.083	-0.070	0.213**	0.183*	-0.044	0.147*	-0.147*	0.105
No. of primary branches /plant	r_g					0.520**	-0.002	-0.352**	-0.317**	0.212**	0.304**	-0.247**	0.082	-0.24	-0.012
	r_p					0.134	-0.004	-0.207**	-0.185*	0.152*	0.128	-0.067	0.085	-0.172*	-0.016
No. of mature pods/plant	r_g						0.158*	-0.411**	-0.260**	0.031	0.511**	-0.299**	0.121	-0.107	0.047
	r_p						0.114	-0.225**	-0.102	0.054	0.252**	0.075	0.221**	-0.044	0.013
100-pod weight (g)	r_g							0.134	0.254**	0.121	0.101	0.187*	0.257**	0.286**	0.116
	r_p							0.134	0.219**	0.088	0.085	0.162*	0.231**	0.274**	0.109
100-kernel weight (g)	r_g								0.315**	0.146*	-0.153*	0.346**	0.234**	0.022	0.078
	r_p								0.278**	0.099	-0.136	0.271**	0.204**	0.025	0.065
Sound mature kernel (%)	r_g									-0.042	-0.090	0.291**	0.166*	0.414**	0.002
	r_p									-0.040	-0.090	0.215**	0.134	0.370**	0.021
Shelling out-turn (%)	r_g										-0.084	0.449**	0.754**	-0.315**	0.253**
	r_p										-0.086	0.29	0.551**	-0.239**	0.184*
Biological yield/plant (g)	r_g											-0.507**	0.255**	-0.084	0.262**
	r_p											-0.469**	0.208**	-0.073	0.221**
Harvest index (%)	r_g												0.636**	0.165*	0.001
	r_p												0.685**	0.117	-0.008
Kernel yield /plant (g)	r_g													-0.062	0.283**
	r_p													-0.055	0.224**
Oil content (%)	r_g														-0.4141**
	r_p														-0.393**

* and ** indicates significant of values at P=0.05 and P=0.01 levels, respectively .

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

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches /plant	No. of mature pods/ plant	100-pod weight (g)	100-kernel weight (g)	Sound mature kernel (%)	Shelling out-turn (%)	Biological yield/plant (g)	Harvest index (%)	Kernel yield /plant (g)	Oil content (%)	Protein content (%)	Pod yield/ plant
Days to 50% flowering	**-0.0428**	-0.0134	0.0324	-0.0106	-0.0034	0.0009	0.0135	0.0037	0.0173	-0.0053	0.0053	0.0078	-0.0045	-0.0044	0.0001
Days to maturity	0.0271	**0.0863**	-0.0092	0.0275	-0.0003	-0.0113	-0.0250	-0.0158	-0.0019	-0.0028	0.0042	0.0046	-0.0046	0.0017	0.0719
Plant height (cm)	0.0382	0.0054	**-0.0506**	0.0078	-0.0286	-0.0010	-0.0060	0.0045	-0.0122	-0.0163	0.0073	-0.0115	0.0116	-0.0068	0.1436
No. of primary branches/plant	-0.0079	-0.0103	0.0049	**-0.0322**	-0.0167	0.0001	0.0113	0.0102	-0.0068	-0.0098	0.0080	-0.0026	0.0077	0.0004	0.0220
No. of mature pods/plant	0.0026	-0.0001	0.0180	0.0166	**0.0318**	0.0050	-0.0131	-0.0083	0.0010	0.0163	-0.0095	0.0039	-0.0034	0.0015	0.1327
100-pod weight(g)	-0.0002	-0.0011	0.0002	0.0000	0.0013	**0.0082**	0.0011	0.0021	0.0010	0.0008	0.0015	0.0021	0.0024	0.0010	0.2949**
100-kernel weight (g)	-0.0053	-0.0049	0.0020	-0.0060	-0.0070	0.0023	**0.0170**	0.0054	0.0025	-0.0026	0.0059	0.0040	0.0004	0.0013	0.2293**
Sound mature kernel (%)	-0.0027	-0.0057	-0.0027	-0.0098	-0.0081	0.0079	0.0098	**0.0309**	-0.0013	-0.0028	0.0090	0.0052	0.0128	0.0001	0.2416**
Shelling out-turn (%)	-0.0240	-0.0013	0.0143	0.0126	0.0019	0.0072	0.0087	-0.0025	**0.0594**	-0.0050	0.0267	0.0448	-0.0187	0.0150	0.3824**
Biological yield/plant (g)	0.1323	-0.0340	0.3428	0.3229	0.5427	0.1073	-0.1623	-0.0960	-0.0897	**1.0605**	-0.5379	0.2704	-0.0893	0.2784	0.3753**
Harvest index (%)	-0.1484	0.0591	-0.1742	-0.2996	-0.3619	0.2262	0.4190	0.3531	0.5433	-0.6137	**1.2099**	0.7704	0.2006	0.0015	0.6047**
Kernel yield/plant (g)	0.0342	-0.0100	-0.0427	-0.0155	-0.0228	-0.0485	-0.0442	-0.0314	-0.1421	-0.0480	-0.1199	**-0.1883**	0.0117	-0.0534	0.9141**
Oil content (%)	-0.0036	0.0018	0.0079	0.0082	0.0037	-0.0098	-0.0008	-0.0142	0.0108	0.0029	-0.0057	0.0021	**-0.0343**	0.0142	0.0904
Protein content (%)	0.0005	0.0001	0.0006	-0.0001	0.0002	0.0005	0.0004	0.0000	0.0011	0.0012	0.0000	0.0013	-0.0019	**0.0045**	0.2549**

*, ** Significant at 5 % and 1% levels, respectively

Residual effect, R = 0 .074