A STUDY OF CORRELATION AND PATH ANALYSIS IN GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

Sixty genotypes of groundnut were grown in a randomized block design with three replications at the Krishi Gadh Farm, Junagadh Agricultural University, Junagadh during Kharif 2015. Pod yield per plant was significantly and positively correlated with days to 50 per cent flowering, plant height, number of pods per plant, number of mature pods per plant, 100-kernel weight, kernal yield per plant, biological yield per plant and harvest index. Path analysis revealed that the maximum direct effects as well as appreciable indirect influences were exerted by number of mature pods per plant and appreciable indirect influences were exerted by kernel yield per plant, plant height, number of mature pods per plant, biological yield per plant, days to 50 per cent flowering, 100 kernal weight and number of pods per plant. These characters also exhibited significant and positive associations with pod yield per plant. These characters would be considered as the most important yield contributing characters and due emphasis would be placed on these components.

KEY WORDS: Correlation, groundnut, path analysis

INTRODUCTION

The production of oilseeds is of great importance in both developing and developed countries, because of an increasing gap in demand and supply of edible oils. Groundnut has been recognized around the world by an assortment of colorful names like peanut in America and several other names such as African nut, Chinese nut, Manila nut, Kipper nut, Hawks nut, Jar nut, Earth chestnut, Monkey nut, Goober pea, Ground pea and Ground bean (Johnson,1964), while in India it is well known as Mungphali. Groundnut is the also known as "**The King of Oilseeds**". The origin of this crop dates back to 350 B.C. and in India it has been introduced in around 1650. It was introduced into India during the first half of the sixteenth century from one of the Pacific islands of China, where it was introduced earlier from either Central America or South America. The genus *Arachis* is native to South America, with all the species having originated in Brazil, Bolivia, Argentina, Uruguay and Paraguay. Groundnut is commercially cultivated over 100 countries between latitude 40º N and 40º S latitudes (Ramanathan, 2001).

Botanically, cultivated groundnut can be classified into two sub-species, which mainly differed in their branching pattern (sub-species *hypogaea* with alternate branching habit and sub-species *fastigiata* with sequential branching habit). Each sub-species is again divided into two botanical varieties, sub-species *hypogaea* into *var. hypogaea* (*Virginia*) and *var. hirsuta* (Peruvian runner), whereas sub-species *fastigiata* into *var. fastigiata* (*Valencia*) and *var. vulgaris* (*Spanish*). In trade, bold seeded types are referred to as Virginia, the small seeded as Spanish and third type runner is also recognized (Ramanathan, 2001).

Out of major food legumes, only groundnut would be option to provide the current worldwide shortage of vegetable protein and oil. Groundnut is relatively day length insensitive crop. Therefore, most of the varieties developed anywhere in the world can be evaluated at any latitude, where favourable temperature exists. In addition to this, groundnut is relatively well adapted to semi-arid region, as it has inherent drought tolerance capacity. Major groundnut producers in the world are China, India, Nigeria, USA, Indonesia and Sudan. India ranks the first in area and second largest producer next to China. In India, about 91 per cent of total groundnut area is confined to the states of Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Rajasthan. The rest of the area and production is scattered mainly in the states of Odisha, Uttar Pradesh, Madhya Pradesh and Punjab (Chopra, 2001).

Yield, being a complex character, is the result of action and interaction of many yield contributing characters. Yield and yield contributing characters are controlled by polygene and highly influenced by environment. A clear picture of contribution of each component is the final expression of character would be emerge through the study of correlation and causation of path concept revealing different ways in which component attributes influence the complex traits. Correlation studies provide better understanding of yield components, which helps the plant breeder during selection. A positive correlation between desirable characters is favourable to the plant breeder because it helps in simultaneous improvement of both the characters. A negative correlation, on the other hand, will hinder the simultaneous expression of both the characters with high values. Path analysis has been widely applied to several crop species. The information obtained by path analysis helps in direct and indirect selection for genetic improvement of yield (Dewey and Lu, 1959). In order to achieve the goal of increased production by increasing the yield potential of crop, knowledge of direction and magnitude of association between various traits is essential for plant breeders. Accordingly, the present investigation was aimed to study the association of pod yield and its component traits in elite groundnut genotypes.

MATERIALS AND METHODS

The experiment material consisted of 60 genotypes of groundnut. The study was conducted during *kharif* 2015 at the Krishi Gadh Farm, Junagadh Agricultural University, Junagadh. The soil of experimental site was medium black, alluvial in origin and medium in organic matter. The climate of the area represents tropical and semi-arid. Sixty genotypes of groundnut were sown in a Randomized Block Design (RBD) with three replications Each genotype was accommodated in a single row of 3.0 meter length with a spacing of 45 cm between rows and 10 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 12.50 kg/ha N_2 and 25.0 kg/ha P_2O_5, 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. The observations were recorded on five randomly selected plants in each entry and replications, their mean values were used for statistical analysis. The characters studied were days to 50 per cent flowering, days to maturity, plant height (cm), number of secondary branches per plant, number of pods per plant, number of mature pods per plant, sound mature kernels (%), 100-kernel weight (g), kernel yield per plant (g), pod yield per plant (g), shelling out-turn (%), oil content (%), biological yield per plant (g) and harvest index (%). The mean values of selected plants were averaged and expressed as mean of the respective characters per replication. Data were subjected for analysis of variance (Panse and Sukhatme, 1985). The phenotypic and genotypic correlation coefficients of all the characters were worked-out as per Al-Jibouri *et al.* (1958) and the path coefficient analysis was carried-out as per the method suggested by Dewey and Lu (1959).

RESULTS AND DISSCUSSION

Through correlation and path analysis, the nature and extent of association between different characters influencing yield and cause of association can be better understood which helps in formulation of selection criteria for improvement of yield. The results pertaining to correlation studies are presented in Table 1, whereas the direct and indirect contributions of yield components on pod yield per plant are presented in Table 2.

In general, the genotypic correlation co-efficients were higher than the corresponding phenotypic correlation co-efficients showing the inherent association between the traits. In the present study, pod yield per plant had strong positively correlated at both genotypic and phenotypic level with characters *viz*., days to 50 per cent flowering, number of pods per plant, number of mature pods per plant, 100-kernel weight, kernel yield per plant and biological yield per plant. So these characters should be given more weightage in selection process. These results indicated the importance of the characters towards contribution of pod yield per plant.

In the present findings, days to 50 per cent flowering had strongly high significant and positive association with kernel yield per plant at both genotypic as well as phenotypic levels, while positive significant correlation only at phenotypic level with number of mature pods per plant. The characters *viz*., days to maturity, plant height, 100 kernel weight and shelling out-turn reported to have negative correlation with days to 50 per cent flowering. Suneetha *et al.* (2004) had revealed similar results as per present study for days to 50 per cent flowering and plant height.

Days to maturity had significant and positive association with number of secondary branches per plant at both genotypic and phenotypic level. Kumar *et al*. (2014) reported similar result for correlation between days to maturity and number of secondary branches per plant. The character like 100 kernel weight and harvest index were significantly associated with days to maturity only at phenotypic level while, sound mature kernels and biological yield per plant showed negative significant correlation for days to maturity.

The association of plant height to biological yield per plant was strongly positive and significant at both genotypic as well as phenotypic level, while only at genotypic level with number of mature pods per plant, 100 kernel weight and kernel yield per plant. Dolma *et al.* (2010) found similar correlation for kernel yield per plant and pod yield per plant, while shelling out-turn and harvest index were strongly negatively associated with plant height.

In the present study, number of secondary branches per plant registered strong positive and significant correlation with number of pods per plant at genotypic as well as phenotypic level and only at phenotypic level significant correlation with shelling out-turn and harvest index. There was strong negative correlation of number of secondary branch per plant with kernel yield per plant and biological yield per plant.

Correlation analysis revealed that number of pods per plant had positive significantly correlation with number of mature pods per plant, 100-kernal weight, kernel yield per plant and harvest index at both genotypic and phenotypic level, which indicated that the improvement in these characters will be improve results for number of pods per plant while, shelling out-turn had negative correlation with number of pods per plant.

Number of mature pods per plant seemed to have positive significant correlation with 100 kernel weight, kernel yield per plant and harvest index at both genotypic as well as phenotypic level. The results are in conformity with findings of Maunde *et al.* (2015) for harvest index.

The sound mature kernels had negative significant correlation with kernel yield per plant at both genotypic and phenotypic levels. The correlation co-efficient of 100-kernel weight with kernel yield per plant was significant and positive which confirms that the improvement in one character would results in improvement in another character and 100 kernel weight was negatively significant with shelling out-turn. Kernel yield per plant was significant and positively correlated with biological yield per plant and harvest index at both level and negatively significant at genotypic level with shelling out-turn. The results are in conformity with findings of Sumathi and Muralidharan (2008), John *et al.* (2009) and Dolma *et al.* (2010) for biological yield per plant and by Bera and Das (2000), Dolma *et al.* (2010) and Kumar *et al.* (2014) for harvest index.

The character shelling out-turn showed negative significant correlation with biological yield per plant at both level and negative significant corelation with harvest index at genotypic level, which revealed that decrease in both characters will results in improvement in shelling out-turn. Biological yield per plant revealed negative significant correlation with harvest index, while the harvest index was not significantly positively or negatively associated with any characters under present study.

The present results on correlation coefficients revealed that days to 50 per cent flowering, plant height, number of pods per plant, number of mature pods per plant, 100-kernel weight, kernel yield per plant, biological yield per plant and harvest index were the most important attributes and may contributed 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 those components while selecting in groundnut breeding.

Path analysis provides information about the cause and effect situation in understanding the association between two variables. It permits the examination of direct effect of various characters on yield as well as their indirect effects via other genotypes from the diverse breeding population.

In the present study, kernel yield per plant (0.789) revealed the highest significant positive genotypic correlation with pod yield per plant followed by plant height (0.590), number of mature pods per plant (0.479), biological yield per plant (0.472), 100 kernel weight (0.318), days to 50 per cent flowering (0.342) and number of pods per plant (0.264). It revealed that true relationship between them and direct selection for these traits, it will be rewarding for yield improvement.

In present study, positive direct effect towards pod yield observed for number of mature pods per plant (1.656), 100 kernel weight (0.803), days to 50 per cent flowering (0.675), oil content (0.289), shelling out-turn (0.189) and biological yield per plant (0.010). Therefore, it was suggested that these characters may be considered as the most important yield contributing character for selection. The result of present study are in agreement with findings of Nagda *et al.* (2001), Raut *et al.* (2010) and Zaman *et al.* (2011) for number of mature pods per plant; Nandini and Savithramma (2012) for biological yield per plant; and Awatade *et al.* (2009) and Nandini and Savithramma (2012) for days to maturity.

High negative direct effect was noticed in number of pods per plant (-1.696), harvest index(-1.035), kernel yield per plant (-0.908), sound mature kernels (-0.475), number of secondary branches per plant (-0.379), days to maturity (-0.035) and biological yield per plant (0.010). The results are in conformity with findings of Rao *et al.* (2014 and 2015) and John and Reddy (2015) for number of pods per plant; Babariya *et al.* (2012), Kumar *et al.* (2012) and Choudhary *et al.* (2013) for harvest index (-1.035); Awatade *et al.* (2009), Khanpara *et al.* (2010) and Nandini and Savithramma (2012) for days to maturity; and Khanpara *et al.* (2010) and Nandini and Savithramma (2012) for plant height towards pod yield per plant.

The character day to 50 per cent flowering had moderate positive direct effect (0.673) with positive indirect effect *via* characters *viz.*, number of mature pod per plant (0.443) and harvest index (0.231), which was cause of positive significant association with pod yield. Plant height had low negative direct effect (-0.012), but its genotypic correlation was positive because of indirect positive contribution of some characters *viz.*, harvest index (1.177) and number of mature pods per plant (0.515). The character number of secondary branches per plant had moderate negative direct effects as well as significant negative genotypic correlation, such negative trend contributed by indirect yield contributing characters like days to 50 per cent flowering, days to maturity and 100 kernel weight. Number of pods per plant (-1.696) exerted high negative direct effect on pod yield per plant but, it contributed by exerting indirect positive effects *via* number of mature pods per plant (1.641) and 100 kernel weight (0.406), which resulted in its positive genotypic correlation with pod yield per plant. Number of mature pods per plant was high positive significant genotypic correlation with pod yield which was resulted from high positive direct effect (1.656) as well as contribution of indirect positive effect through characters *viz.*, oil content (0.492) and 100 kernel weight (0.392). Similarly 100 kernel weight was reported moderate positive direct effect (0.803) as well as genotypic correlation. The character kernel yield per plant (-0.908) had moderate negative direct effect, but it contributed to the pod yield indirectly *via* oil content (0.383) and harvest index (0.369), which results in positive significant genotypic correlation. Biological yield per plant (0.010) exerted low positive direct effect towards pod yield per plant, but its indirect effect *via* number of secondary branches per plant (0.145) and harvest index (1.365) resulted in positive significant genotypic correlation. Harvest index was reported high negative direct effect (-1.035) on pod yield, but it contributed positive indirect effect *via* days to 50 per cent flowering (0.001) and plant height (0.003), which resulted in its positive genotypic correlation with pod yield per plant.

It was cleared from the path analysis that the maximum direct effects as well as appreciable indirect influences were exerted by number of mature pods per plant and appreciable indirect influences were exerted by kernel yield per plant, plant height, number of mature pods per plant, biological yield per plant, days to 50 per cent flowering, 100 kernel weight and number of pods per plant. These characters also exhibited significant and positive associations with pod yield per plant and hence, they may be considered as the most important yield contributing characters and due emphasis should be placed on these components while selecting for high yielding.

CONCLUSION

Considering correlations and path co-efficient, for selection of a high yielding genotype, more emphasis should be given on days to maturity, number of mature pods per plant, sound mature kernals, kernal yield per plant, biological yield per pant and shelling out-turn.

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Table 1: Genotypic (r_g) and phenotypic (r_p) correlation coefficients among 14 characters in groundnut

Characters		Days to 50 Per Cent Flowering	Days to Maturity	Plant Height (cm)	No. of Secondary Branches /Plant	No. of Pods /Plant	No. of Mature Pods /Plant	Sound Mature Kernels (%)	100-Kernel Weight (g)	Kernel Yield /Plant (g)	Shelling Out-Turn (%)	Biologial Yield /Plant (g)	Harvest Index (%)	Oil Content (%)
Pod Yield Per Plant	r_g	0.342**	0.008	0.590**	-0.482**	0.264**	0.479**	-0.112	0.318**	0.789**	-0.638**	0.472**	0.154	0.140
	r_p	0.249 **	0.005	0.162	-0.388**	0.203*	0.374**	-0.122	0.275**	0.733**	-0.376**	0.398**	0.296**	0.097
Days to 50 Per Cent Flowering	r_g		-0.233*	-0.435**	-0.156	0.192*	0.267**	0.064	-0.265**	0.499**	-0.227**	0.169	0.002	0.058
	r_p		-0.180*	-0.054	-0.098	0.104	0.145	-0.033	-0.068	0.265**	-0.050	0.122	0.023	-0.004
Days to Maturity	r_g			-0.062	0.420**	0.176	0.179	-0.247**	0.179*	-0.076	0.007	-0.180*	0.190*	-0.031
	r_p			-0.044	0.293**	0.126	0.103	-0.168	0.083	-0.016	-0.024	-0.128	0.097	-0.039
Plant Height (cm)	r_g				0.056	0.106	0.311**	-0.223*	0.188*	0.334**	-0.735**	0.862**	-0.265**	0.131
	r_p				0.091	0.089	0.116	-0.031	0.042	0.069	-0.160*	0.438**	-0.241**	0.059
No. of Secondary Branches / Plant	r_g					0.292**	0.235	-0.158*	-0.065	-0.341**	0.199*	-0.383**	0.185*	-0.059
	r_p					0.258**	0.174	-0.120	-0.051	-0.241**	0.103	-0.328**	0.105	-0.051
No. of Pods/Plant	r_g						0.990**	-0.045	0.506**	0.456**	-0.125*	-0.046	0.278**	0.045
	r_p						0.924**	-0.022	0.352**	0.386**	-0.063	-0.034	0.187*	0.053
No. of Mature Pods/Plant	r_g							0.027	0.488**	0.582**	-0.028	0.0812	0.348**	0.103
	r_p							0.012	0.304**	0.459**	-0.068	0.070	0.247**	0.114
Sound Mature Kernels (%)	r_g								-0.059	-0.162*	0.111	0.151	-0.146	0.018
	r_p								0.015	-0.143*	0.096	0.127	-0.157	0.006
100-Kernel Weight g)	r_g									0.363**	-0.490**	0.083	0.023	0.099
	r_p									0.233*	-0.198*	0.035	0.095	0.094
Kernel Yield/Plant (g)	r_g										-0.353**	0.270**	0.270**	0.048
	r_p										-0.1165	0.192*	0.335**	0.011
Shelling Out-Turn (%)	r_g											-0.257**	-0.247**	-0.213
	r_p											-0.208*	-0.075	-0.109
Biological Yield/Plant (g)	r_g												-0.758**	-0.041
	r_p												-0.687**	-0.056
Harvest Index (%)	r_g													0.2050
	r_p													0.1493

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

Characters	Days to 50 Per Cent Flowering	Days to Maturity	Plant Height (cm)	No. of Secondary Branches /Plant	No. of Pods /Plant	No. of Mature Pods /Plant	Sound Mature Kernels (%)	100-Kernel Weight (g)	Kernel Yield /Plant (g)	Shelling Out-Turn (%)	Biologial Yield /Plant (g)	Harvest Index (%)	Oil Content (%)	Genotypic Correlation with Pod Yield/Plant
Days to 50 Per Cent Flowering	**0.673**	0.008	0.005	0.059	-0.327	0.443	-0.030	-0.213	-0.453	-0.043	-0.014	0.231	0.003	0.342 *
Days to Maturity	-0.154	**-0.035**	0.000	-0.159	-0.299	0.296	0.117	0.143	0.069	0.001	0.007	-0.245	0.269	0.008
Plant height (cm)	-0.293	0.002	**-0.012**	-0.021	0.186	0.515	0.107	0.151	-0.303	-0.139	-0.033	1.177	-0.374	0.590**
No. of Secondary Branches/Plant	-0.105	-0.014	-0.000	**-0.379**	-0.496	0.390	0.075	-0.052	0.309	0.037	0.014	-0.523	0.262	-0.482**
No. of Pods/Plant	0.129	-0.006	-0.001	-0.111	**-1.696**	1.641	0.021	0.406	-0.414	-0.023	-0.011	-0.063	0.393	0.264**
No. of Mature Pods/Plant	0.180	-0.006	-0.003	-0.089	-1.680	**1.656**	-0.012	0.392	-0.528	-0.005	-0.025	0.110	0.492	0.479**
Sound Mature Kernels (%)	0.043	0.008	0.002	0.060	0.076	0.044	**-0.475**	-0.047	0.147	0.021	0.004	0.207	-0.207	-0.112
100-Kernel Weight (g)	-0.178	-0.006	-0.002	0.025	-0.858	0.809	0.028	**0.803**	-0.330	-0.099	-0.025	0.114	0.033	0.318**
Kernel Yield/Plant(g)	0.336	0.002	-0.004	0.129	-0.773	0.964	0.077	0.291	**-0.908**	-0.066	-0.012	0.369	0.383	0.789**
Shelling Out-Turn (%)	-0.153	-0.000	0.009	-0.075	0.212	-0.046	-0.053	-0.393	0.320	**0.189**	0.053	-0.351	-0.350	-0.638**
Biological Yield/ Plant (g)	0.114	0.006	-0.010	0.145	0.079	0.134	-0.072	0.067	-0.246	-0.048	**0.010**	1.365	-0.072	0.472**
Harvest Index (%)	0.001	-0.006	0.003	-0.070	-0.472	0.577	0.069	0.018	-0.246	-0.046	-0.051	**-1.035**	1.414	0.154
Oil Content (%)	0.039	0.001	-0.001	0.022	-0.077	0.170	0.008	0.080	-0.044	-0.040	-0.251	-0.057	**0.289**	0.140

**, ** Significant at 5 % and 1% levels, respectively* *Residual effect, R = -0.232* *N.B.: Values at diagonal indicated direct effects of respective character*

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