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Determination of Relationship and Path Co-efficient between Pod Yield and Yield Component Traits of Groundnut Cultivars

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Abstract

Twenty - five groundnut genotypes, obtained from National Oilseed Research Program (NORP), Nawalpur, Nepal along with local checks (B -4, Baidehi, Rajshree and Jayanti) were used to study correlation and path co-efficient among pod yield and yield component traits in groundnut. The pod yield ha^{-1} showed highly significant and positive association with days to maturity, sound matured kernel (SMK)%, pod length, pod width and kernel lengthbutthe highlysignificant and negative association was shown with days to flowering, pod plant^{-1}, shoots length, shelling % and specific leaf area. Partitioning the total yield contributions into individual and combined effect showed that days to maturity, root length, pod width, pod length and kernel length made individual high positive direct contribution to pod yield ha^{-1}.Days to flowering, shoot length, shelling %, SMK% and100 kernel weights had direct negative contribution with pod yield ha^{-1}. Therefore, days to maturity, root length, pod width, pod length and kernel length were identified to be the important traits which could be used in selection for yield.

Key words: correlation coefficient, association, path analysis, groundnut

Introduction

The cultivated groundnut *Arachis hypogaea* L. is one of the most important oil and protein producing legume crops of the semi-arid tropics. It is originated from South America and has spread to several other countries. Groundnut cultivation in Nepal was confined only in kitchen garden during seventies. However, this crop was commercially grown with the beginning of early eighties and the total area was around 6000 ha while the area increased to 10000 ha during nineties. In recent years, the area has increased to 15000 ha. The low rate of increase in area is mainly due to high cost of cultivation, high labor requirement and limited availability of seeds. The average productivity of groundnut is 1000kg/ha, which is very low as compared to other countries. In the fiscal year 2004/05 groundnut oil of worth Rs.201420 was imported from overseas countries, (NORP 2008). Four varieties of groundnut, B-4, Janak, Jyoti and Jayanti have been released for general cultivation. In sandy soils near the river basins farmers desire to grow only one crop of groundnut having normal maturity period.

In any crop yield is determined by many related traits. It is a sum total of the contributions made by different yield contributing traits. Thus for effective yield improvement, a knowledge of these traits is very important in selection and improvement of crops. Therefore, it is important to understand the relationships between yield and component characters associated with it. Correlation analysis measures the mutual association between a pair of variables independent of other variables under consideration (Owen & Jones 1977).

Groundnut is an unpredictable crop due to its underground pods development. Nut yield is not only polygenically controlled, but also influenced by its component characters (Alam *et al.* 1985). For improvement of yield in groundnut direct selection is often misleading. The knowledge of existing variability and degree of association between yield contributing characters and their relative contribution in yield is essential for developing high yielding genotypes in groundnut.

Correlation studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components. Path coefficient is essential to accumulate optimum combination of yield contributing characters and to know the implication of the interrelationships of various characters in a single genotype. Considering the above points, the present study was under taken to evaluate the genotypes for yield and their components and to estimate the inter-relationship among the agronomic traits in groundnut.

Methodology

The experiment was conducted at the experimental farm of the National Oilseed Research Program (NORP), Nawalpur, Sarlahi district during July 2010 to January 2011.The area lies in the Central Terai with high potential for groundnut crop. Total area of the farm is 33 ha and lies between 85^0 35' 52" east longitude and 27^0 03' 86" north latitude. Average altitude of the district is 144 msl. Average annual temperature was maximum of 38 to 40^{o}C and minimum of 4 to 5^{o}C. Average annual rainfall was about 1200 to 1500 mm. Soil of the experimental plot was sandy loam in texture with soil pH of 5.5 in the area. The climate was sub-tropical in average. It was dry with moderate temperature during vegetative and flowering stage and low rain at flowering with low temperature at late flowering and maturity stage of the crop. Twenty five genotypes collected from NORP and ICRISAT along with local check varieties (B-4 and Jayanti) were used to study the different genetic components. The experimental plots were prepared properly with basal dose of fertilizers application i.e. 20:40:20 Kg.NPK ha¯1.

The experiment was laid out in randomized compact block design (RCBD) with 3 replications. The unit plot size was 2.5X1.2 m^2. The distance between rows and plants was 30 and 15 cms respectively. On the other hand plot to plot and replication to replication distance was 0.5 and 1.0 m respectively. Seeds of genetic materials were sown on 4thjuly in 2010 and 12th July in 2011. Seeds were sown in furrow at the depth of 4 cms approximately.

Observations on days to 75% flowering, days to maturity, plant height, pods plant^{-}1, seed pod $^{-}$1,100 seed weight, pod length, pod width, seed length, seed width, pod yield plot^{-}1, shelling % and SMK %(Sound matured kernel).The shelling and (SMK)percentage were calculated by using the following formula:

$$\text{Shelling \%} = \frac{\text{Net kernel weight in gram -shell weight}}{\text{Total pod weight in gram}} \times 100$$

$$\text{Sound Matured Kernel (SMK)\%} = \frac{\text{Bold kernel}}{\text{Total no of kernel per plant}} \times 100$$

The data were subjected to statistical analysis for correlation co-efficient and path co-efficient analysis following SAS software package as formulae given by Wright (1921)and technique first used by Dewey and Lu (1959) in plant breeding.

Results and Discussion

Genotypic correlation coefficients between pod yield and other characters were estimated and presented in Table 1.

The days to flowering showed positive association with pod yield , root length, shoot length, shelling percentage, kernel per pod, kernel width, specific leaf area and spectrometer chlorophyll meter reading (SCMR). However, days to maturity, leaf spot severity, root - shoot ratio, pod yield, sound matured kernel, 100 kernel weight, pod length, pod width and kernel length showed negative correlation with days to flowering.

Days to maturity showed positive correlation with leaf spot severity, root length, root - shoot ratio, pod yield, sound matured kernel percent, 100 kernel weight, kernel per pod, pod length, pod width and kernel length and SCMR. But, characters such as pod per plant, shoot length, shelling percentage, kernel width and specific leaf area were negatively associated with days to maturity.

The cercospora leaf spot severity showed negative correlation with pod per plant, root and shoot length, shelling percent, 100 kernel weight, kernel per pod, pod length, kernel width, specific leaf area and SCMR. However, positive correlation was observed with root shoot ratio, pod yield per plot, sound matured kernel percent, pod width and kernel length.

Table 1. Correlation coefficients among independent variable traits of groundnut genotypes

Traits	DTF	DTM	PODPP	RL	SL	S	SMK	HKW	KPP	PL	PW	KL	KW	SLA	SCMR	PYH	Fat%
DTF	**1.00**	-.179*	.328**	.030	.259**	.145	-.199*	-.139	.099	-.067	-.318**	-.233**	.018	.175*	.013	-.408**	-.213
DTM		**1.00**	-.372**	.131	-.279**	-.222**	.104	.011	.088	.078	.227**	.143	-.175*	-.361**	.067	.438**	-.116
PODPP			**1.00**	-.036	.382**	.153	-.282**	-.067	-.015	-.254**	-.373**	-.264**	.008	.354**	-.004	-.452**	.173
RL				**1.00**	.237**	-.077	-.120	-.011	.001	-.026	.019	-.078	-.101	-.090	.052	.033	-.098
SL					**1.00**	.195*	-.309**	.014	-.142	-.154	-.270**	-.179*	.110	.469**	-.153	-.425**	-.035
S						**1.00**	-.045	.052	-.022	-.010	-.056	-.137	.081	.116	-.025	-.193*	-.121
SMK							**1.00**	-.062	-.070	-.056	.037	.060	.026	-.058	.040	.202*	.050
HKW								**1.00**	-.056	.372**	.389**	.420**	.344**	-.026	-.051	.000	-.091
KPP									**1.00**	.072	.124	.026	.056	-.117	.078	.124	.011
PL										**1.00**	.479**	.406**	.235**	-.180*	-.075	.257**	-.219
PW											**1.00**	.446**	.176*	-.335**	.030	.432**	-.280*
KL												**1.00**	.370**	-.217**	.021	.283**	-.169
KW													**1.00**	.144	-.105	-.112	-.029
SLA														**1.00**	-.053	-.434**	.278*
SCMR															**1.00**	-.011	-.045
PYH																**1.00**	-.117
Fat%																	**1.00**

*. Correlation is significant at 0.05 level (2-tailed).**. Correlation is significant at 0.01 level (2-tailed).

DTF=Days to flowering, DTM= Days to maturity, LS=Leaf spot severity, PODPP=Pod per plant, RL=Root length, SL=Shoot length, RSR=Root shoot ratio, PPPLT=Pod per plot, s= Shelling %, SMK=Sound Matured kernel%, HKW=100 kernel weight, KPP= Kernel per pod, PL=Pod length, PW= Pod width, KL=Kernel length, KW=Kernel width, SLA=Specific leaf area, SCMR=Spectrometer chlorophyll meter reading

Pods per plant had positive correlation with shoot length, shelling percent, kernel width and specific leaf area. Negative association was found with root length, shoot length, pod yield per plot, sound matured kernel percent, 100 kernel weight, kernel per pod, pod length and width, kernel length and SCMR. Chandola *et al*. (1973) had reported that number of pods in plant, primary branches, and pod weight were positively correlated with grain yield in peanut.

Root length showed positive association with shoot length, root shoot ratio, pod width and SCMR. However, it was observed to have negative association with pod yield per plot, shelling percent, SMK percent , 100 kernel weight, pod length, kernel length and width and specific leaf area.

Similarly, shoot length showed to have positive association with shelling percent, 100 kernel weight, kernel width and specific leaf area but negative association with root - shoot ratio, pod yield per plot, sound matured kernel percent, kernel per pod, pod length and width, kernel length and SCMR.

The root shoot ratio showed positive association with r pod yield per plot, SMK percent, 100 kernel weight, and kernel per pod, pod length, kernel length and SCMR. However, the characters shelling percent, kernel weight and specific leaf area were shown to have negative correlation.

Pod yield per plot was positively associatied with shelling percent , SMK percent , kernel per pod, pod length, pod width, kernel length and SCMR. However, it was observed to have negative association with 100 kernel weight, kernel width and specific leaf area.

Shelling percent was positively associated with 100 kernel weight, kernel width and specific leaf and negatively associated with SMK%, kernel per pod, pod length and width, kernel length and SCMR.

Korat *et al.* (2010) reported that the ground nut pod yield had significant positive association with shelling percentage, 100 kernel weight, while day to maturity had negative correlation with yield.

Mukhtar *et al.* (2011) also reported that pod yield of groundnut was positively and significantly correlated with all the components assessed (number of mature pods, number of pods plant, pod yield plant, seed yield plant , haulm yield plant , hundred seed weight and total dry matter) except shelling percentage.

Table 2. Path coefficient analysis showing direct and indirect effects of independent variables on grain yield of groundnut genotypes.

DTM	LS	PODPP	RL	SL	RSR	PPPLT	S	SMK	HKW	KPP	PL	PW	KL	KW	SLA	SCMR	R^2 PYH
-0.03	-0.07	-0.01	0.00	-0.04	0.03	-0.19	-0.02	0.01	0.01	0.00	-0.01	-0.03	-0.01	-0.00	0.00	-0.00	-0.41
0.14	0.05	0.01	0.02	0.04	-0.04	0.15	0.03	-0.00	-0.00	0.00	0.01	0.02	0.01	0.01	-0.00	-0.00	0.44
0.04	**0.17**	0.01	-0.01	0.04	-0.02	0.22	0.00	-0.02	0.01	-0.00	-0.00	0.01	0.00	0.02	-0.00	0.01	0.49
-0.05	-0.06	**-0.02**	-0.01	-0.05	0.04	-0.21	-0.02	0.01	0.00	-0.00	-0.02	-0.04	-0.02	-0.00	0.00	0.00	-0.45
0.02	-0.01	0.00	**0.16**	-0.03	-0.09	-0.02	0.01	0.01	0.00	0.00	-0.00	0.00	-0.00	0.01	-0.00	-0.00	0.03
-0.04	-0.04	-0.01	0.04	**-0.14**	0.08	-0.24	-0.02	0.01	-0.00	-0.00	-0.01	-0.03	-0.01	-0.01	0.00	0.01	-0.42
0.05	0.02	0.01	0.10	0.08	**-0.14**	0.16	0.02	-0.01	-0.00	0.00	0.01	0.02	0.00	0.01	-0.00	-0.01	0.33
0.05	0.08	0.01	-0.01	0.08	-0.05	**0.45**	-0.00	-0.01	0.00	0.00	0.02	0.04	0.02	0.00	-0.00	-0.01	0.69
-0.03	-0.00	-0.00	-0.01	-0.03	0.03	0.00	**-0.12**	0.00	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01	0.00	0.00	-0.19
0.01	0.06	0.01	-0.02	0.04	-0.02	0.14	0.01	**-0.05**	0.00	-0.00	-0.01	0.00	0.00	-0.00	-0.00	-0.00	0.20
0.00	-0.04	0.00	-0.00	-0.00	-0.00	-0.00	-0.01	0.00	**-0.04**	-0.00	0.03	0.04	0.03	-0.02	-0.00	0.00	0.00
0.01	-0.01	0.00	0.00	0.02	-0.02	0.10	0.00	0.00	0.00	**0.00**	0.01	0.01	0.00	-0.00	-0.00	-0.00	0.12
0.01	-0.01	0.01	-0.00	0.02	-0.01	0.10	0.00	0.00	-0.02	0.00	**0.09**	0.05	0.02	-0.02	-0.00	0.00	0.26
0.03	0.02	0.01	0.00	0.04	-0.03	0.20	0.01	-0.00	-0.02	0.00	0.04	**0.10**	0.03	-0.01	-0.00	-0.00	0.43
0.02	0.01	0.01	-0.01	0.03	-0.01	0.11	0.02	-0.00	-0.02	0.00	0.04	0.04	**0.06**	-0.02	-0.00	-0.00	0.28
-0.02	-0.05	-0.00	-0.02	-0.02	0.02	-0.01	-0.01	-0.00	-0.01	0.00	0.02	0.02	0.02	**-0.06**	0.00	0.01	-0.11
-0.05	-0.03	-0.01	-0.01	-0.07	0.06	-0.24	-0.01	0.00	0.00	-0.00	-0.02	-0.03	-0.01	-0.01	**0.00**	0.00	-0.43
0.01	-0.02	0.00	0.01	0.02	-0.02	0.04	0.00	-0.00	0.00	0.00	-0.01	0.00	0.00	0.01	-0.00	**-0.06**	-0.01

DTFD=Days to flowering, DTM= Days to maturity, LS=Leaf spot severity, PODPP=Pod per plant, RL=Root length, SL=Shoot length, RSR=Root shoot ratio, PPPLT=Pod per plot, s= Shelling %, SMK=Sound Matured kernel%, HKW=100 kernel weight, KPP= Kernel per pod, PL=Pod length, PW= Pod width, KL=Kernel length, KW=Kernel width, SLA=Specific leaf area, SCMR=Spectrometer chlorophyll meter reading.

SMK% was observed positively associated with pod width, kernel length and width, and SCMR was negatively associated with 100 kernel weight, kernel per pod, pod length and Specific leaf area.

While 100 kernel weight recorded positive association with pod length and width, kernel length and kernel width were negatively associated with kernel per pod and SCMR.

Kernel per pod positively associated with pod length and width, kernel length and width and SCMR except specific leaf area.

Pod length was found to have positive association with pod width, kernel length and width while it was negative with specific leaf area and SCMR.

Similarly, Pod width was positively associated with kernel length and width and SCMR except specific leaf area. Kernel length was positively associated with kernel width and SCMR and negative with specific leaf area. Kernel width was also found positively associated with specific leaf area and negatively associated with SCMR. The specific leaf area, known as drought related trait was found negatively associated with SCMR.

Pod per plant SMK percent and kernel per pod were positively correlated with oil content (fat %) and SLA was significantly positive with oil content. However, pod width was found to have significant negative association with oil content.

Associations of characters determined by correlation coefficients may not provide an exact picture of the relative importance of direct and indirect influence of each of the yield components on yield. To determine the interrelationship between grain yield and other yield attributes, direct and indirect effects were worked out using path analysis at the genotypic level which also measured the relative importance of each component. The direct and indirect effects of characters on pod yield are presented in Table 2.

Pod yield was considered as a dependent variable and days to flowering, days to maturity, leaf spot severity, pod per plant, root length, shoot length, root shoot ratio, pod per plot, Shelling Percent, Sound Matured kernel percent, 100 kernel weight, kernel per pod, pod length, pod width, kernel length, kernel width, specific leaf area, spectrometer chlorophyll meter reading were causal (independent) variables.

Days to flowering showed direct negative effect with pod yield per hectare. It was having indirect positive effect with root length, root shoot ratio, sound matured kernel percentage, 100 kernel weight and specific leaf area. However, indirect negative effect was shown with days to maturity, leaf spot severity, pod per plant, shoot length, pod yield per plot, shelling percent, pod length and width, kernel length and width and SCMR.

Makanda *et al.* (2009) recorded that days to 50% flowering had a negative and significant correlation coefficient to dry pod yield for the September planting.

Days to maturity was found to have direct positive effect with pod yield and indirect positive effect with leaf spot severity, pod per plant, root length, shoot length, pod per plot, shelling percent, pod length and width, kernel length and kernel width and negative effect with root shoot ratio, sound matured kernel percentage, 100 kernel weight, specific leaf area and SCMR.

According to Zaman *et al.* (2011) the shelling percent and days to maturity had high positive direct effect on seed yield.

Leaf spot severity was recorded to have direct positive effect with pod yield and indirect negative effect with pods, shoot length, shelling percent, 100 kernel weight, pod width, kernel length and width and SCMR. Leaf spot also produced indirect negative effect with characters like root- shoot ratio, sound matured kernel percent, pod length, kernel per pod and specific leaf area.

Pod per plant recorded direct negative effect with pod yield per hectare but indirect positive effect with root shoot ratio, sound matured kernel percent, 100 kernel weight and specific leaf area. In contrast to this finding, the number of mature nuts per plant had high positive direct effect on seed yield per hectare followed by nut size and days to maturity was reported by Zaman *et al.* 2011 .

Negative effect was recorded with root length, shoot length, pod yield per plot, shelling percent, kernel per pod, pod length, pod width, kernel length and width and pod yield per hectare.

Root length was having direct positive effect with pod yield per hectare via shelling percentage, sound matured kernel percent, 100 kernel weight, kernel per pod, pod width and kernel width but it was having indirect negative effect with shoot length, root shoot ratio, pod yield per plot, pod length, kernel length, specific leaf area and SCMR.

Shoot length was observed to have direct negative effect with pod yield per hectare via pod yield per plot, shelling percentage, 100 kernel weight, kernel per pod, pod length, pod width, kernel length, kernel width but indirect positive effect was shown with sound matured kernel percentage, root shoot ratio, specific leaf area and SCMR.

Root shoot ratio was having direct negative effect with pod yield per plot via sound matured kernel percent, 100 kernel weight, specific leaf area, SCMR but indirect negative effect with pod yield per plot, shelling percent , kernel per pod, pod length, pod width, kernel length and kernel width.

Pod yield per plot had direct positive effect on pod yield per hectare via 100 kernel weight, kernel per pod, pod length, pod width, kernel length and kernel width. It had indirect negative effect with shelling percent. sound matured kernel percent, specific leaf area and SCMR.

Shelling percent had direct negative correlation with pod yield via via 100 kernel weight, kernel per pod, pod length, pod width, kernel length and kernel width. It had indirect positive effect with sound mature kernel percent, specific leaf area and SCMR.

Sound mature kernel percent had direct negative effect with pod yield via kernel per pod, pod length and kernel width. It had indirect positive effect with 100 kernel weight, pod width, kernel length, Specific leaf area and SCMR.

The 100 kernel weight showed to have direct negative effect with pod yield through kernel per pod, kernel width and specific leaf area and, it had positive indirect effect with pod length, pod width, kernel length and SCMR.

Kernel per pod had direct positive effect with pod yield per hectare via pod length, pod width and kernel length. However, it had indirect negative effect with kernel width, specific leaf area and SCMR.

Pod length having direct positive effect with pod yield through pod width, kernel length and SCMR. It had negative indirect effect with kernel width and specific leaf area.

Similarly, pod width had direct positive effect with kernel length but indirect negative effect with kernel width, specific leaf area and SCMR.

Kernel length had direct positive effect with pod yield per hectare and indirect negative effect with kernel width, specific leaf area and SCMR.

Kernel width had direct negative with pod yield per hectare and indirect positive effect with specific leaf area and SCMR.

Specific leaf area had direct positive effect with pod yield via SCMR. Chlorophyll reading had direct negative effect with pod yield.

The seed yield per plant showed the highly significant and positive association with nut size, number of nuts per plant, kernel size and days to 50% flowering.

The direct and indirect effect obtained from path analysis revealed that seed yield was positively associated with 100-kernel weight and shelling percentage, while days to maturity and sound mature kernel percent (SMK%) had negative association with seed yield. Seyyed *et al.* (2012) revealed that positive and significant association and higher contribution made to seed yield suggested that total number of kernels per plant and 100-seed weight should be given due emphasis as selection criteria for synthesis of improved ground nut genotypes.

The pod yield showed highly significant and positive association with days to maturity, SMK percent, pod length, pod width and kernel length. The highly significant and negative correlations showed with days to flowering, pod plant, shoots length, shelling percent and specific leaf area. Partitioning the total yield contributions into individual and combined effect showed that days to maturity, root length, pod width, pod length and kernel length made individual high positive direct contribution to pod yield. Days to flowering, shoot length, shelling percent, SMK percent and 100 kernel weights had direct negative contribution with pod yield. Therefore, days to maturity, root length, pod width, pod length and kernel length have been identified to be the important traits which could be used in selection of ground nut genotypes for better yield.

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