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Research Article

Assessment of genetic variability, character association and path analysis of kernel yield and yield components in groundnut *(Arachis hypogaea* L.*)*

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Abstract
The present study was carried out in the Department of Oilseeds, during *rabi*, 2021 at Tamil Nadu Agricultural University, Coimbatore to study the genetic variability, correlation and path analysis using thirty promising genotypes of groundnut. Kernel yield and its component characters were recorded. The magnitude of PCV and GCV values were higher for the characters *viz.,* number of branches, total biomass, 100 kernel weight, leaf area ratio and leaf area index. Total number of branches, total biomass and 100 kernel weight exhibited high heritability and high genetic advance as per cent of mean. Kernel yield showed significant positive association with pod yield, mature pods, number of pods and shelling percentage. The importance of these characters was also confirmed through path analysis, as they had direct implications on kernel yield. As a result, selection based on these traits will result in increased kernel yield in groundnut.

Keywords: Groundnut, genetic variability, correlation, path analysis, kernel yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops of the world. It contains 48-50 per cent oil, 25-28 per cent easily digestible protein, 10-20 per cent carbohydrates and provides 564 kcal of energy for every 100 g of kernel. In addition, groundnut is a rich source of several micronutrients and health enhancing components, including minerals, antioxidants and vitamins along with some biologically active polyphenols, flavonoid and isoflavones (Janila *et al.,* 2013). Though India is a leading producer of groundnut covering an area of 5.80 m. ha out of world coverage of 27.66 m. ha., its productivity is low (1631 kg/ha) when compared to the USA (4254 kg/ha), China (3906 kg/ha), Argentina (3498 kg/ha) (FAO, 2020). Knowledge on existing genetic variability helps in the selection of superior plants and hence, it is essential to assess the existing genetic variability before starting any breeding programme. Success of any breeding programme relies on the genetic variability present in the germplasm which forms the basis of any crop improvement programme. Overall kernel yield per plant in groundnut is governed by multiple yield components, making it a quantitatively inherited character. Plant breeders should understand the direction and size of correlation between diverse characters in order to attain the goal of improved output for enhancing crop yield potential. Understanding the links between yield and yield components is critical for making most of these correlations during selection. Traits that are positively correlated with yield are considered effective because selection for such traits would result in the simultaneous improvement in yield

(Mahalakshmi *et al.*, 2005). The correlation coefficient may be confounded with indirect effect due to frequent association inherent in trait inter-relationship. The applicability of correlation can be more visibly understood by path analysis, which permits the partitioning of correlation to direct and indirect effects, thus would serve a valuable tool in breeding programmes (Dewey and Lu, 1959; Gomes and Lopes, 2005). In light of this, the current study aimed to determine genetic variability, simple correlation, as well as path coefficients of important traits on kernel yield per plant in order to develop an effective selection strategy.

MATERIALS AND METHODS

Thirty promising groundnut genotypes were evaluated in Randomised block design (RBD) with two replications. Each genotype was planted with 3 m row length and 30 x l0 cm spacing. The study was carried out at Tamil Nadu Agricultural University in Coimbatore, Tamil Nadu during *rabi,* 2021-2022 under irrigated condition. The data was recorded for 15 characters *viz.*, plant height (cm), number of branches per plant, days to first flowering, total number of flowers per plant, total number of pods per plant , number of mature pods per plant, pod yield per plant (g), kernel yield per plant (g), 100 kernel weight (g), shelling per cent, oil content (%), SPAD chlorophyll content, Leaf Area Ratio (cm^2g^{-1}), Leaf Area Index and total biomass per plant (g) . In each replication, five randomly selected plants per genotype were observed. For the statistical analysis, mean values were used. PCV and GCV were computed based on the methods given by Burton (1952) and classified as suggested by Sivasubramanian and Madhavamenon (1973). Heritability and genetic advance were calculated by the formula used by Johnson *et al*. (1955). Simple correlation coefficients were calculated among the genotypes using the formulae suggested by Al-Jibouri *et al.* (1958). Path coefficient analysis was carried out by using simple correlation coefficients as per the method suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Genetic variability is the prerequisite for initiating an effective and successful breeding programme. In this study, presence of variability was confirmed through a range of variation for each character in thirty promising groundnut genotypes. The range of variation for plant height was 15.38 – 56.00 cm (**Table 1**). Likewise, the characters number of branches per plant (4 -11), number of pods per plant (5 - 21), number of mature pods per plant (4 - 20), total biomas (16.9 - 78.18 g), shelling percentage (21.09 - 60.5),100 kernel weight (31 - 69.2 g), SPAD chlorophyll content (22.27 - 48.97), days to first flowering (29 - 39 days), total number of flowers (25 - 45), leaf area ratio (17.32 -78.24), leaf area index (1.66 - 9.13), Oil content (33.71 - 57.93%), pod yield per plant (4.08 - 21.62 g) and kernel yield (2.07 - 10.42 g) and these traits were also showed adequate variation among the genotypes.

High PCV values were observed for the characters leaf area index, leaf area ratio, number of mature pods per plant, pod yield per plant, kernel yield per plant, number of pods per plant, plant height, number of branches per plant, total biomass per plant and 100 kernel weight (**Table 1**). Similarly, high GCV values were found for the characters *viz.,* leaf area index, leaf area ratio number of branches per plant, total biomass per plant, leaf area

Table 1. Estimates of GCV, PCV, heritability and genetic advance in thirty genotypes of groundnut

Character	Mean	Minimum	Maximum	PCV (%)	GCV (%)	h^2 (%)	GA(% of Mean)
Plant height (cm)	25.01	15.38	56.00	21.41	9.19	18.43	8.13
Number of branches per plant	6.88	4.00	11.00	26.39	22.81	74.71	40.63
Number of pods	10.90	5.00	21.00	27.51	11.76	18.28	10.36
Number of mature pods per plant	9.60	4.00	20.00	31.23	17.26	30.54	19.65
Total biomass (g)	43.00	16.90	78.18	23.64	22.78	92.81	45.21
Shelling %	48.71	21.09	60.50	12.37	5.50	19.77	5.04
100 kernel weight (g)	44.83	31.00	69.20	21.84	20.11	84.78	38.15
SPAD	34.68	22.27	48.97	13.91	1.42	1.04	0.30
Days to 1st flowering	33.03	29.00	39.00	5.23	1.28	6.00	0.64
Total number of flowers per plant	35.19	25.00	45.00	10.64	2.61	6.03	1.32
Leaf Area Ratio (cm^2g^{-1})	38.17	17.32	78.24	31.37	22.07	49.52	32.00
Leaf Area Index	4.01	1.66	9.13	42.76	25.53	35.65	31.41
Oil content (%)	47.90	33.71	57.93	9.32	7.11	58.22	11.18
Pod yield per plant (g)	11.16	4.08	21.62	31.06	14.26	21.08	13.49
Kernel yield per plant (g)	5.36	2.07	10.42	31.00	7.98	6.63	4.23

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Table 2. Correlation analysis for yield and yield related traits in various genotypes of Groundnut

Character	Plant height	Number of branches per plant	Total number of pods per plant	Number of mature pods per plant	Total biomass	Shelling %	100 kernel weight	SPAD	Days to 1st flowering	Total number of flowers per plant	Leaf Area Ratio	Leaf Area Index	Oil content	Pod yield per plant	Kernel yield per plant
Plant height	1.0000														
Number of branches per plant	-0.3484**	1.0000													
Total number of pods per plant	0.0344	0.1236	1.0000												
Number of mature pods per plant	0.0598	0.1154	0.9628 **	1.0000											
Total biomass	0.2535	0.1020	0.0938	0.1277	1.0000										
Shelling %	0.0249	-0.2142	-0.1094	-0.0909	-0.3583**	1.0000									
100 kernel weight	0.3557 **	-0.2140	0.3093*	0.2835*	0.2210	-0.0996	1.0000								
SPAD	0.1909	0.0251	-0.0291	-0.0272	0.1268	-0.0834	0.0680	1.0000							
Days to 1st flowering	0.0368	0.0907	-0.1887	-0.2060	0.4812**	-0.1281	-0.0421	0.0937	1.0000						
Total number of flowers per plant	0.1064	0.0417	0.0096	-0.0203	0.3484**	-0.1566	0.1359	0.2154	0.0777	1.0000					
Leaf Area Ratio	-0.0846	-0.1417	0.0278	0.0423	0.1225	-0.0313	0.1923	0.0163	0.0617	0.2196	1.0000				
Leaf Area Index	-0.0016	0.0605	0.4055**	0.4104**	0.3841**	-0.1652	0.3419**	0.0748	0.0287	0.2517	0.8294**	1.0000			
Oil content	0.1621	0.0987	0.1543	0.1934	0.1555	0.1198	-0.2084	-0.0181	0.0625	0.0024	-0.0695	-0.0176	1.0000		
Pod yield per plant	0.0293	0.2113	0.7783**	0.8076**	0.1535	-0.2626*	0.2780 *	-0.0707	-0.1878	-0.1055	-0.0573	0.3290*	0.1634	1.0000	
Kernel yield per plant	0.0485	0.0662	0.6939 **	0.7283 **	-0.0005	0.3030*	0.2540*	-0.1127	-0.2102	-0.1736	-0.0831	0.2360	0.1835	0.8227**	1.0000

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

Table 3. Path coefficient analysis of yield and yield related traits in various genotypes of groundnut

Character	Plant height	Number of branches per plant	Total number of pods per plant	Number of mature pods per plant	Total biomass	Shelling %	100 kernel weight	SPAD	Days to 1st flowering	Total number of flowers per plant	Leaf Area Ratio	Leaf Area Index	Oil content	Pod yield per plant	Correlation for Kernel Yield
Plant height	-0.0263	0.0127	0.0004	-0.0020	0.0095	0.0146	0.0091	-0.0011	0.0013	0.0009	0.0078	-0.0001	-0.0067	0.0285	0.0485
Number of branches per plant	0.0092	-0.0364	0.0014	-0.0039	0.0038	-0.1255	-0.0054	-0.0002	0.0033	0.0004	0.0131	0.0045	-0.0041	0.2061	0.0662
Total number of pods per plant	-0.0009	-0.0045	0.0111	-0.0324	0.0035	-0.0641	0.0079	0.0002	-0.0069	0.0001	-0.0026	0.0298	-0.0064	0.7592	0.6939**
Number of mature pods per plant	-0.0016	-0.0042	0.0106	-0.0337	0.0048	-0.0532	0.0072	0.0002	-0.0076	-0.0002	-0.0039	0.0302	-0.0080	0.7877	0.7283**
Total biomass	-0.0067	-0.0037	0.0010	-0.0043	0.8227	-0.2099	0.0056	-0.0008	0.0177	0.0029	-0.0113	0.0283	-0.0065	0.1497	-0.0005
Shelling %	-0.0007	0.0078	-0.0012	0.0031	-0.0134	0.5858	-0.0025	0.0005	-0.0047	-0.0013	0.0029	-0.0122	-0.0050	-0.2561	0.3030*
100 kernel weight	-0.0094	0.0078	0.0034	-0.0095	0.0083	-0.0583	0.0255	-0.0004	-0.0015	0.0011	-0.0178	0.0252	0.0086	0.2711	0.2540*
SPAD	-0.0050	-0.0009	-0.0003	0.0009	0.0047	-0.0489	0.0017	-0.0060	0.0034	0.0018	-0.0015	0.0055	0.0007	-0.0690	-0.1127
Days to 1st flowering	-0.0010	-0.0033	-0.0021	0.0069	0.0180	-0.0751	-0.0011	-0.0006	0.0367	0.0007	-0.0057	0.0021	-0.0026	-0.1832	-0.2102
Total number of flowers per plant	-0.0028	-0.0015	0.0001	0.0007	0.0130	-0.0917	0.0035	-0.0013	0.0028	0.0084	-0.0203	0.0185	-0.0001	-0.1029	-0.1736
Leaf Area Ratio	0.0022	0.0052	0.0003	-0.0014	0.0046	-0.0183	0.0049	-0.0001	0.0023	0.0018	-0.0926	0.0611	0.0029	-0.0559	-0.0831
Leaf Area Index	0.0000	-0.0022	0.0045	-0.0138	0.0144	-0.0968	0.0087	-0.0004	0.0011	0.0021	-0.0768	0.0736	0.0007	0.3209	0.2360
Oil content	-0.0043	-0.0036	0.0017	-0.0065	0.0058	0.0702	-0.0053	0.0001	0.0023	0.0000	0.0064	-0.0013	-0.0415	0.1594	0.1835
Pod yield per plant	-0.0008	-0.0077	0.0086	-0.0272	0.0057	-0.1538	0.0071	0.0004	-0.0069	-0.0009	0.0053	0.0242	-0.0068	0.9754	0.8227**

Residual effect =0.1588

Note: Diagonal values are the direct effects and the off diagonal are indirect effects

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ratio and 100 kernel weight. Similar results for high PCV and GCV were reported by Shoba *et al.* (2009), John (2005), Meta and Monpara (2010) in groundnut. Higher PCV and GCV were found for number of branches, total biomass, 100 kernel weight, leaf area ratio and leaf area index. It indicates the variations among these characters were high. Moderate PCV was expressed for shelling percentage, SPAD chlorophyll, total number of flowers, while moderate GCV for total number of pods, number of mature pods and pod yield. It was earlier observed by Sudhir kumar *et al.* (2008) in groundnut. Moderate to high PCV and GCV indicated that the characters were amenable for improvement by selection.

The magnitude of GCV values were low for the characters plant height, oil content, kernel yield per plant, total number of flowers per plant, shelling percentage, days to first flowering and SPAD chlorophyll content. The low estimates were also reported by Pradhan and Patra (2011) in groundnut for shelling per cent and pod yield. Therefore, these characters have less scope for improvement through selection. In the present study, high heritability was noticed for the character total biomass per plant followed by 100 kernel weight and the number of branches per plant (**Table 1**). Similar results were reported by Rao *et al.* (2015), Patil *et al.* (2006), Sudhir Kumar *et al.* (2008) and John *et al.* (2019) for yield and its component characters in groundnut. High heritability with high genetic advance was observed for total number of branches, total biomass and 100 kernel weight, indicating selection may be effective for the improvement of these traits. Low heritability with low genetic advance was found for plant height, total number of pods, shelling percentage, SPAD cholorophyll, days to first flowering, total number of flowers and kernel yield indicated that these traits were highly influenced by environment and selection would be ineffective (Mohan Vishnuwardhan *et al.*, 2013).

Kernel yield per plant was found to be significant and positively correlated with pod yield per plant, number of mature pods per plant, total number of pods per plant and shelling percentage **(Table 2)**. This was earlier reported by Kumar *et al*. (1998) for pod yield per plant, Balaiah *et al.* (1980) for number of mature pods per plant, Surbhi Jain *et al.* (2016) for total number of pods per plant and by Trivikrama reddy *et al.* (2017) for shelling percentage. Therfore pod yield per plant, number of mature pods per plant, total number of pods per plant and shelling percentage may be relied upon for selection so as to increase the kernel yield per plant.

Among the traits identified for increasing kernel yield per plant, when the inter correlation was considered, pod yield per plant had highly significant positive association with number of mature pods per plant and total number of pods per plant. This was already reported by John *et al*. (2019) for pod yield per plant and number of mature pods per plant and Surbhi Jain *et al.* (2016) for total number of pods per plant. Similarly, the number of mature pods per plant expressed highly significant and positive correlation with total number of pods per plant, which was earlier confirmed by Mahalakshmi *et al*. (2005). Total number of pods per plant exhibited highly significant and positive association with leaf area index.

The path coefficient analysis revealed that pod yield per plant, total biomass and shelling percentage had expressed positive direct effect on kernel yield per plant **(Table 3)**. This was earlier reported by Vijayasekhar (2002) for pod yield per plant, Pavan Kumar *et al*. (2014) for total biomass and Shukla *et al*. (2014) for shelling percentage and kernel yield per plant. The characters *viz.,* leaf area index, days to first flowering, 100 kernel weight, total number of pods per plant and total number of flowers per plant also expressed positive direct effect on kernel yield per plant. Hence, these characters may be depended upon for selection as they are having positive direct effect on kernel yield per plant. Similar results were reported by Trivikrama Reddy *et.al*. (2017). The characters *viz.,* total number of pods per plant, number of mature pods per plant, leaf area index and 100 kernel weight showed positive indirect effect on kernel yield per plant through pod yield per plant.

In the present study, residual effect observed was 0.1588, indicating the need to add other independent variables which contribute significantly to yield to obtain a clear picture of the relationship between yield and its component traits.

The characters *viz*., pod yield per plant, total number of pods per plant, number of mature pods per plant and shelling percentage were found to be the major contributors for improving the kernel yield per plant. Hence, importance should be given for these traits while making selections for the improvement of yield in groundnut.

REFERENCES

Al-Jibouri, H.A., Miller, A.R. and Robinson, H.F. 1958. Genotypic and environmental variances and covariances in upland cotton crosses of interspecific origin. *Journal of Agronomy,* **50**: 633-637. [Cross Ref]

Balaiah, C., Reddy, P.S. and Reddy, M.V. 1980. Correlation studies of some yield components in the segregating population of the groundnut cross J 11 x Gujarat narrow leaf mutant. *Indian Journal of Agricultural Science,* **50**: 213-215

Burton, G.W. (1952).Quantitative inheritance in grasses. Proc. 6th Int. Grasslands Cong. J., 1:227-283

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat

grass seed production. *Agronomy Journal,* **51**: 515-518. groundnut *(Arachis hypogaea* L.*). Madras Agricultural Journa1,* **79**(9): 500-504. [Cross Ref]

Gomes, R.L.F and Lopes, A.C.A. 2005. Correlations and path analysis in peanut. *Crop Breeding and applied Biotechnology,* **5**(1):105-110. [Cross Ref]

Janila, P., Nigam,S.N., Manish, K.P, Pandey, Nagesh, P. and Ranjeev, K.V. 2013 Groundnut Improvement: Use of Genetic and Genomic Tools. *Frontier in plant science,* **4**: 1-33. [Cross Ref]

John, K., Vasanthi, R.P., Venkateswarlu, O. and Haranath Naidu, P. 2005. Variability and correlation studies for quantitative traits in Spanish bunch groundnut *(Arachis hypogaea* L.*)* genotypes. *Legume Research*, **28**(3): 189-193.

John, K., Madhavi Santhoshi, M.V and Rajasekhar, P. 2019. Correlation and path analysis in groundnut *(Arachis hypogaea* L.*). International Journal of Current Microbiology and Applied Sciences,* **8**(12): 1521-1529. [Cross Ref]

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimation of genetic and environmental variability in soybeans. *Agronomy Journal*, **47**: 314-318. [Cross Ref]

Kumar, R., Ghosh, J. and Sah, J. 1998. Variability and correlation studies in mutant cultures. *Journal of Applied Biology,* **8**(2): 20-23

Mahalakshmi, P., Manivannan, N. and Muralidharan, V. 2005. Variability and correlation studies in groundnut *(Arachis hypogaea* L.*). Legume Research,* **28** (3):194-197.

Meta, H.R. and Monpara, B.A. 2010. Genetic variation and tyrait relationships in summer groundnut,*(Arachis hypogaea* L.*). Journal of Oilseeds Research*, 27(11).8-11.

Mohan Vishnuwardhan, K., Vasanthi, R.P. and Hariprasad Reddy, K. 2013. Genetic variability studies for yield, yield attributes and resistance to foliar diseases in groundnut *(Arachis hypogaea L.). Legume Research,* **36**(2): 111-115.

Patil, K. G., Kenchanagoudar, P. V., Parameshwarappa, K. G. and Salimath, P. M. 2006. A study of correlation and path analysis in groundnut. *Karnataka Journal of Agriculture Sciences,* **19**(2): 272-277.

Pavan Kumar, C., Rekha, R., Venkateswarulu, O. and Vasanthi, R.P. 2014. Correlation and path coefficient analysis in groundnut *(Arachis hypogaea* L.*). International Journal of Applied Biology and Pharmaceutical Technology,* **5**(1): 8-11.

Pradhan, K. and Patra, R.K. 2011. Variability and correlation studies on groundnut (*Arachis hypogaea* L.) germplasm. *Legume Research,* **34**(1): 26-30.

Rao, V.T, Venkanna, V. and Bhadru, D. 2015. Genetic analysis of yield and its components in groundnut (*Arachis hypogaea* L.). *International Journal of Applied Biology and Pharmaceutical Technology,* **6**(1): 223-225.

Shoba, D., Manivannan, N. and Vindhiyavarman, P. 2009. Studies on variability,heritability and genetic advance in groundnut *(Arachis hypogaea* L.*).Electronic Journal of Plant Breeding*, Volume 1, 74-77

Shukla, A.K. and Kumar Rai, P. 2014. Evaluation of groundnut genotypes for yield and quality traits. *Annals of Plant and Soil Research,* **16**(1):41-44

Sudhir, K., Venkataravana, P. and Raom, M.R.G. 2008. Evaluation of new germplasm and advanced breeding lines of groundnut *(Arachis hypogaea)* under late *kharif* situation. *Legume Research,* **31**(4): 254-258

Surbhi Jain, Singh, P.B. and Sharma, P.P. 2016. Correlation and path analysis in groundnut *(Arachis hypogaea* L.*). International Journal of Current Research,* **8**(08): 35811-35813.

Sivasubramanian, S and Madhavamenon, P. 1973. Genetic analysis of quantitative characters in rice through diallel crosses. *Madras Agricultural Journal*, **60**: 1097- 1098.

Trivikrama Reddy, A., M. Reddi Sekhar, A. Vijayabharathi, T. Lakshmi Pathy, G. Lakshmikantha Reddy and Jayalakshmi, V. 2017. Correlation and path analysis of kernel yield and its components in groundnut *(Arachis hypogaea L.). International Journal of Current Microbiology and Applied Sciences,***6**(12): 10-16. [Cross Ref]

Vijayasekhar, 2002. Genetic divergence studies through D^2 statistic and isozyme analysis in Spanish bunch groundnut *(Arachis hypogaea* L.*)* M.Sc. (Ag.). Thesis submitted to Acharya N.G. Ranga Agricultural University, Hyderabad.