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Study on Correlation and Path Coefficient Analysis in Groundnut (*Arachis hypogea* L.)

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ABSTRACT

Groundnut, or *Arachis hypogaea* L., is an important legume that is grown all over the world and is used for both commercial and subsistence farming in arid and semi-arid environments. Its economic importance and income-generating potential make it a cash crop. The researchwas conducted to evaluate the phenotypic and genotypic correlation coefficients between yield and yield-related traits and to ascertain the direct and indirect effects of yield-related traits on yield per plant using path coefficient analysis. The correlation analysis showed that at the genotypic level, shelling percentage, dry pod yield, no. of mature pods per plant, 100 kernel weight, and harvest index has a positive relation with kernel yield whereas for phenotypic correlation, shelling percentage, dry pod yield, no. of mature pods per plant, 100 pod weight showed a positive significant relationship with kernel yield. The path analysis revealed that biological yield, plant height, no. of primary branches, dry pod yield, shelling percentage, and 100 pod weight all character shows a direct positive effect on kernel yield per plant at both genotypic and phenotypic levels.

Key words : *Groundnut, Coefficient analysis*

Introduction

Groundnut (*Arachis hypogaea L.*) is an important oilseed crop with chromosomal number 2n= 4x = 40. It is a self-pollinated crop belong to the fabaceae family, cultivated globally in tropical and subtropical region. In groundnut the flowers on the plant appear above the ground, but after pollination, a unique characteristic of peanuts occurs. Following pollination, a small peg develops on the flower base, pushing the fertilized ovary underground, because of their underground development of peanuts, they are called as groundnuts. The ovary matures into a peanut pod containing one to three seeds, which we know as peanuts. India contributes nineteen percentage of groundnut production after China. India is the second-largest producer of groundnuts, with 101 lakh tonnes under cultivation and productivity of 1863 kg per hectare in 2021–2022, ranking first in the world (agricoop.nic.in). Forty percent of the groundnuts are produced worldwide are consumed as food, and the remaining sixty percent are crushed to obtain oil for industrial and edible uses (Birthal *et al.*, 2010). The nutritional composition of groundnut includes 45–50% oil per 100 g dry weight, 25–28 percent easily digested protein, 10–20 percent carbs, and 565 kcal. Kernel yield in groundnuts is a complex trait influenced by various yield component characters, making direct selection for yield ineffective. Consequently, it is recommended to select various component traits that condition kernel yield in groundnuts. In this regard, understanding the nature and magnitude of the association between kernel yield and its component traits is crucial for breeders to devise an effective selection strategy. The first step towards improving crops is to obtain

information on the correlation coefficient between the yield components and kernel yield. Although the correlations provide information on the component characteristics, they might not correctly represent the relative significance of both the direct and indirect effects of these traits on pod yield. Therefore, the aim of this research was to determine the relative importance of each yield component as well as the magnitude of the correlations between them and yield.

Materials and Methods

The present research consists of twenty-nine groundnut genotypes with one check (JL-24). The plant material was obtained from Department of Genetics and Plant breeding, School of agriculture, ITM University, Gwalior. The field trial was conducted at Crop Research Centre-1, School of Agriculture, ITM University, Gwalior, Madhya Pradesh. The genotypes were evaluated using Randomized Block Design (RBD) with three replications during the Kharif season 2023. The entire area used for the experiment was 240 square meters. Five plants were randomly selected for each genotype in each of the three block and these plants were used to record observations like, Days to 50 % Flowering, Days to maturity, Number of primary branches, Plant height (cm), Number of mature pods per plant, Dry Pod yield per plant (g), Shelling percentage (g), 100 pod weight (g), 100 kernel weight (g), Biological yield per plant, Harvesting index (%), Kernel yield per plant (g).

Statistical analysis

For the statistical analysis, the mean values were calculated. The genotypic and phenotypic correlation was carried out in accordance with Searle's 1961 suggestion; the correlation coefficient varies from -1 to +1. Dewey and Lu's 1959 suggestion for path coefficient analysis involved a range of 0 to 1.

Results and Discussion

Correlation coefficient analysis

The result revealed that 50% flowering shows negative and significant genotypic correlation with primary branches (-0.772), 100 kernel weight (-0.468), plant height (-0.375), similar results for days to maturity, shelling %, 100 kernel weight, and Kernel yield per plant reported by Rao *et al.,* (2019). In phenotypic correlation, a negative and significant correlation is shown for primary branches (-0.513), 100 pod weight (-0.311), and plant height (-0.274), comparable result for no. of mature pods per plant was observed by Kumari *et al.,* (2020), for plant height Khaniya *et al.,*(2023).Days to maturity show a negative and highly significant genotypic correlation with kernel yield per plant (-0.339), number of mature pods per plant (-0.289), shelling percentage (-0.292), similar result was reported for biological yield, 100 kernel weightby Patel *et al*. (2021). In phenotypic correlation, negative and highly significant correlations were found in kernel yield per plant (-0.311), negative and significant correlations were shown for the number of mature pods per plant (-0.266), shelling percentage (-0.239), harvest index (-0.216), similar results for days to maturity and kernel yield per plant was observed by Iqbal *et al*. (2017). In genotypic correlation, plant height shows a positive and highly significant correlation with 100 kernel weights (0.471), primary branches (0.449), and the number of mature pods per plant (0.351). In phenotypic correlation, a positive significant correlation is shown for 100 kernel weights (0.377), the number of mature pods per plant (0.328), and the primary branch (0.315), Identical result for shelling % at both was reported by Kumari *et al.,* (2020).Primary branches show positive highly significant genotypic correlation for 100 kernel weight (0.520), plant height (0449), 100 pod weight (0.403), dry pod yield (0.282), and number of mature pods per plant (0.267). In phenotypic correlation recorded positive and highly significant for 100 kernel weight (0.332), plant height (0.315), 100 pod weight (0.292), and number of mature pods per plant (0.223), the comparable result for 50 % flowering and 100 kernel weight was reported by Kumari *et al.,* (2020) at genotypic correlation and Days to maturity at phenotypic correlation. The number of mature pods per plant shows a positive and highly significant genotypic correlation with kernel yield per plant (0.684), dry pod yield (0.571), shelling percentage (0.522). In phenotypic correlation, a positive and highly significant correlation is shown for kernel yield per plant (0.638), dry pod yield (0.505), shelling percentage (0.459). Similar results for both for kernel yield per plant was observed by Kumari *et al.,* (2020). In genetic correlation, dry pod yields are genotypically correlated with kernel yield per plant (0.721), number of mature pods per plant (0.571), harvest index

(0.478). In phenotypic correlation, a positive and highly significant correlation was observed for kernel yield per plant (0.650), harvest index (0.518), number of mature pods per plant (0.505), 100 kernel weight (0.396), 100 pod weight (0.385), and biological yield (0.236). Shelling percentage shows a positive and highly significant genotypic correlation with kernel yield per plant (0.817), number of mature pods per plant (0.533), 50% flowering (0.301), and 100 kernel weights (0.362). In phenotypic correlation, shelling percentage shows a positive and highly significant correlation with kernel yield per plant (0.783), number of mature pods per plant (0.459), and positive and significant correlation for 100 kernel weights (0.213), similar result for phenotypic correlation for kernel yield per plant and harvest index was observed by Kumari *et al.,* (2020), for days to maturity at genotypic correlation shown by Rao*et al.,* (2019).

Genotypic correlation for 100-pod weight shows positivehighly significant for character 100 kernel weight (0.532), dry pod weight (0.439), primary branches (0.403). In phenotypic correlation, positive highly significant results were found in 100 kernel weights (0.423), dry pod yields (0.385), primary branches (0.292), identical result for 50 % flowering at genotypic correlation was observed by Rao *et al.,* (2019). 100 kernel weight shows a positive and highly significant genotypic correlation with 100 pod weight (0.532), primary branches (0.520), kernel yield per plant (0.476). In phenotypic correlation, 100 kernel weights show a positive highly significant correlation with 100 pod weight (0.423), kernel yield per plant (0.409). While a positive and significant correlation is shown for the character harvest index (0.033) and days to maturity (0.06), In genotypic correlation, character shows a positive and highly significant correlation with 100 kernel weight (0.365), and dry pod yield (0.269) In phenotypic correlation, the character shows a positive and highly significant correlation for character 100 kernel weight (0.277) and dry pod yield.The harvest index shows a positive and highly significant genotypic correlation for characters such as dry pod yield (0.478), number of mature pods per plant (0.373), 100 pod weight (0.329), kernel yield per plant (0.317). In phenotypic correlation, dry pod yield (0.518), no. of mature pods per plant (0.329), kernel yield per plant (0.267), and 100 pod weight (0.229) show a positive and highly significant phenotypic correlation, comparable result for 50 % flowering, shelling % and biological yield was reported by Pachauri *et al.,* (2022) at phenotypic correlation. 100 pod weight, kernel yield per plant, no. mature pods pod per plant was reported by Pachauri *et al.,* (2023). In genotypic correlation, biological yield shows a positive and highly significant correlation with 100 kernel weight (0.365), and dry pod yield (0.269) shows a positive and significant genotypic correlation. In phenotypic correlation, the character shows a positive and highly significant correlation for character 100 kernel weight (0.277) and dry pod yield (0.236), the similar result for 50% flowering, plant height, and harvest index at phenotypic correlation was reported by Pachauri *et al.,* (2022).The genotypic correlation for kernel yield per plant shows a positive highly significant correlation for characters shelling percentage (0.817), dry pod yield (0.721), no. of mature pods per plant (0.684). While a positive non-significant genotypic correlation was observed in biological yield (0.193), plant height (0.174), primary branches (0.164), *a* similar result was noted by Nagaveni *et al.,* (2019) that the dry pod yield, number of mature pods, and 100 pod weight were similar. while the positive non-significant genotypic correlation was observed in biological yield (0.193), plant height (0.174), primary branches (0.164),similar result was observed by Nagaveni *et al.,,* (2019) except for biological yield per,. In phenotypic correlation, a positive highly significant correlation was observed for shelling percentage (0.783), dry pod yield (0.650), no. of mature pods per plant (0.638), 100kernel weights (0.409), and harvest index (0.267), similar result for plant height was reported by Gali *et al.,* (2023), for days to 50 % flowering similar result was reported by Kumari *et al.,* (2020), Pachauri *et al.,* (2022) for plant height at both genotypic and phenotypic correlation.

Path coefficient analysis

Direct effects of various characters on seed yield per plant

In genotypic path analysis out of twelve characters, six characters showed positive direct effects on kernel yield per plant viz., plant height (0.02764), primary branches (0.02775), dry pod yield (0.62034),shelling percentage (0.79360), 100 pod weight (0.05336), biological yield (0.01347).In phenotypic path analysis plant height (0.00323), primary branches (0.00551), dry pod yield (0.68339), shelling % (0.75837), 100 Kernel weight (0.00439), Similar

Table 1. Correlation co-efficient between yield and yield attributing traits in 30 groundnut genotypes, during the kharif season

		50%F	Dm	Ph	Pb	Nmpp	Dpy	S%	100pw	100kw	By	Hi	Kyp
50%F	Rg	1											
	Rp	1											
Dm	Rg	-0.014	1										
	Rp	0.063	1										
Ph	Rg	-0.375**	-0.092	1									
	Rp	-0.274**	-0.096	1									
Pb	Rg	-0.772**	-0.062	0.449**	1								
	Rp	-0.513**	-0.036	0.315**	1								
Nmpp	Rg	-0.218*	-0.289**	0.351**	0.267*	1							
	Rp	-0.186	-0.266*	0.328**	0.223*	1							
Dpy	Rg	-0.327**	-0.221*	0.192	0.282**	0.571**	1						
	Rp	-0.203	-0.198	0.155	0.175	0.505**	1						
S%	Rg	0.301**	-0.292**	0.087	-0.031	0.533**	0.198	1					
	Rp	0.175	-0.239*	0.088	0.017	0.459**	0.052	1					
100pw	Rg	-0.468**	0.17	0.112	0.403**	0.234*	0.439**	-0.19	1				
	Rp	-0.311**	0.159	0.145	0.292**	0.208*	0.385**	-0.133	1				
100kw	Rg	-0.315**	0.075	0.471**	0.520**	0.403**	0.405**	0.362**	0.532**	1			
	Rp	-0.198	0.06	0.377**	0.332**	0.352**	0.396**	0.213*	0.423**	1			
By	rg	-0.019	0.144	0.167	0.171	-0.007	0.269*	0.006	0.012	0.365**	1		
	rp	-0.017	0.116	0.158	0.116	-0.005	0.236*	0.031	0.064	0.277**	1		
Hi	rg	-0.198	-0.252*	-0.005	0.025	0.373**	0.478**	0.096	0.329**	-0.057	-0.706**	1	
	rp	-0.123	-0.216*	-0.022	0.003	0.329**	0.518**	-0.03	0.229*	0.033	-0.693**	1	
Kyp	rg	0.005	-0.339**	0.174	0.164	0.684**	0.721**	0.817**	0.113	0.476**	0.193	0.317**	1
	rp	-0.005	-0.311**	0.166	0.132	0.638**	0.650**	0.783**	0.13	0.409**	0.196	0.267*	1

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

result was reported by Venkataravana *et al.*, (2019).Comparable result was observed by Pachauri *et al.*, (2022) for character days to maturity and harvest index at phenotypic path analysis, characters like shelling percentage, dry pod yield, primary branches, 100 kernel weight, plant height showed a direct effect on kernel yield per plant, similar result for plant height, 100 kernel weight was resulted by Reddy *et al.*, (2014).

Indirect effects of various characters on seed yield per plant

Characters like 50 % flowering shows indirect positive effect via., Shelling percentage (0.239), 100 kernel weight (0.0348), no of mature pods per plant (0.0145), harvest index (0.0104), and days to maturity (0.0002), at the genotypic level. While at phenotypic level characters like shelling percentage (0.1323), harvest index (0.0116), no. of mature pods per plant (0.0062), 100 pod weight (0.0015), and biological yield (0.0009)shows a positive indirect effect. Days to maturity show positive indirect through harvest index (0.0133), no. of mature pods per plant (0.0192), 100 pod weight (0.0090), biological yield (0.0019), and 50 % flowering (0.0004) at the genotypic level. In phenotypic path analysis, the days to maturity shows positive indirect effects for kernel yield per plant were harvest index (0.0205), no. of mature pods per plant (0.0088), and 100 kernel weight (0.0002). At the genotypic level, the plant height shows a positive indirect effect on kernel yield per plant where dry pod yield (0.1192), shelling percentage (0.0686), 50 % flowering

(0.0127), primary branches (0.0124), 100 pod weight (0.0060), biological yield (0.0022), harvest index (0.0002), days to maturity (0.0001). Plant height observed positive indirect effect through dry pod yield (0.10586), shelling percentage (0.0671), 50 % flowering (0.0034), harvest index (0.0020), primary branches (0.0017), 100 kernel weight (0.0016), days to maturity (0.0015). at the phenotypic level.Based on the genotypic level the primary branches show positive indirect effect on characters shelling percentage (0.1749), 50 % flowering (0.0262), 100 pod weight (0.0215), plant height (0.0124), biological yield (). 0023, days to maturity (0.0001). At the phenotypic level, primary branches per plant show positive indirect effect via. Dry pod yield (0.1195), shelling percentage (0.0132), 50 % flowering (0.0065), 100 kernel weight (0.0014), shelling percentage (0.0132), plant height (0.0010), days to maturity (0.0005). The number of mature pods per plant shows positive indirect effect on kernel yield was observed on shelling percentage (0.4231), dry pod yield (0.3543), 100 pod weight (0.0125), plant height (0.0097), primary branches (0.0074), 50 % flowering (0.0074), days to maturity (0.0001). At phenotypic level no. of mature pods per plant shows positive indirect effects on kernel yield per plant were shelling percentage (0.3479), dry pod yield (0.3452), days to maturity (0.0043), 50 % flowering (0.0023), 100 kernel weight (0.0015), primary branches (0.0010), biological yield (0.0003), Dry pod yield shows a positive direct effect on kernel yield per plant were shelling percentage (0.1569), 100 pod weight (0.02343), 50 % flowering (0.0110), primary branches (0.0078), plant height

Table 2. Genotypic (rg) and phenotypic (rp) path coefficients among 12 characters in groundnut

		0.5	dm	ph	pb	nmpp	dpy	s%	100pw	100kw	by	hi	KYP
0.5	P	-0.0339	0.0002	-0.0103	-0.0214	0.0145	-0.203	0.239	-0.0249	0.0348	-0.0002	0.0104	0.005
	G	-0.01273	-0.001	-0.00088	-0.0028	0.0062	-0.139	0.132	0.0016	-0.0009	0.00093	0.0117	-0.005
dm	P	0.00047	-0.0017	-0.00253	-0.0017	0.0193	-0.137	-0.232	0.0091	-0.0083	0.00194	0.0133	-0.339
	G	-0.0008	-0.0162	-0.00031	-0.0002	0.0089	-0.135	-0.181	-0.0008	0.0003	-0.0064	0.0205	-0.311
ph	P	0.01274	0.0002	0.02764	0.01246	-0.023	0.119	0.069	0.006	-0.0521	0.00224	0.0003	0.174
	G	0.00348	0.0016	0.00323	0.00173	-0.011	0.106	0.067	-0.0007	0.0017	-0.0087	0.002	0.166
pb	P	0.02623	0.0001	0.01241	0.02775	-0.018	0.175	-0.024	0.0215	-0.0576	0.00231	-132	0.164
	G	0.00653	0.0006	0.00101	0.00551	-0.007	0.12	0.013	-0.0015	0.0015	-0.0064	-0.0003	0.132
nmpp	P	0.0074	0.0005	0.00971	0.00742	-0.067	0.354	0.423	0.0125	-0.0445	-0.0001	-0.0197	0.684
	G	0.00237	0.0043	0.00106	0.00123	-0.033	0.345	0.348	-0.0011	0.0015	0.0003	-0.0312	0.638
dpy	P	0.01109	0.0004	0.00531	0.00783	-0.038	0.62	0.157	0.0234	-0.0448	0.00362	-0.0252	0.721
	G	0.00259	0.0032	0.0005	0.00096	-0.017	0.683	0.039	-0.002	0.0017	-0.013	-0.0492	0.650
s%	P	-0.01023	0.0005	0.00239	-0.0009	-0.036	0.123	0.794	-0.0101	-0.0401	0.00009	-0.0051	0.817
	G	-0.00222	0.0039	0.00029	0.0001	-0.015	0.035	0.758	0.0007	0.0009	-0.0017	0.0029	0.783
100pw	P	0.0159	-0.0003	0.00311	0.01119	-0.016	0.272	-0.151	0.0534	-0.0589	0.00016	-0.0174	0.113
	G	0.00396	-0.0026	0.00047	0.00161	-0.007	0.263	-0.101	-0.0051	0.0019	-0.0035	-0.0218	0.13
100kw	P	0.01069	-0.0001	0.01301	0.01444	-0.027	0.251	0.288	0.0284	-0.1106	0.00492	0.003	0.476
	G	0.00252	-0.001	0.00122	0.00183	-0.012	0.271	0.161	-0.0022	0.0044	-0.0153	-0.0031	0.409
by	P	0.00065	-0.0002	0.0046	0.00476	0.0005	0.167	0.005	0.0006	-0.0404	0.01347	0.0373	0.193
	G	0.00022	-0.0019	0.00051	0.00064	0.0002	0.161	0.023	-0.0003	0.0012	-0.0551	0.0658	0.196
hi	P	0.00672	0.0004	-0.00015	0.0007	-0.025	0.297	0.077	0.0175	0.0063	-0.0095	-0.0528	0.317
	G	0.00156	0.0035	-0.00007	0.00002	-0.011	0.354	-0.023	-0.0012	0.0001	0.03817	-0.0949	0.267*

Note: 50 %: 50 percent flowering, Dm: Days to maturity, Ph: Plant height, Pb: Primary branches, Nmpp: Number of mature pods per plant, DPY: Dry pod yield, S%: Shelling percentage, 100pw: 100 pod Weight, 100 kw: 100 kernel weight, By: Biological yield, Hi: Harvest index, Kyp: kernel yield per plant

(0.0053), biological yield (0.0036), days to maturity (0.0003). Dry pod yield shows positive indirect effect on kernel yield per plant was observed in shelling percentage (0.0391), days to maturity (0.0032), 50 % flowering (0.0025), 100 kernel weight (0.0017), primary branches (0.0009), plant height (0.0005) at the phenotypic level.The shelling percentage shows a positive indirect effect was shown for character dry pod yield (0.1226), plant height (0.0023), biological yield (0.0009), and days to maturity (0.0004). At the phenotypic level, the shelling percentage shows a positive indirect effect for kernel yield per plant was dry pod yield (0.0352), days to maturity (0.0032), harvest index (0.0028), 100 kernel weight (0.0009), plant height (0.0002).

At the genotypic level, 100 pod weight shows positive indirect effect was observed for dry pod yield (0.2724), 50 % flowering (0.0159), primary branches (0.0119), plant height (0.0031), and biological yield (0.0001). At the phenotypic level 100 pod weight shows a positive indirect effect was observed for dry pod yield (0.2629), 50 % flowering (0.0039), 100 kernel weight (0.0018), and primary branches (0.0016). At genotypic level 100 kernel weight has a positive indirect effect on kernel yield per plant were shelling percentage (0.2875), dry pod yield (0.2511),100 pod weight (0.02842), primary branch (0.0144), plant height (0.0130), 50 % flowering (0.0106), biological yield (0.0049), harvest index (0.0029). AT the phenotypic level maximum positive indirect effect on kernel yield per plant was observed for character dry pod yield (0.2707), shelling percentage (0.1613), 50 % flowering (0.0025), primary branches (0.00180, plant height (0.0012). Biological yield shows a positive indirect effect on kernel yield were dry pod yield (0.1667), harvest index (0.0372), shelling percentage (0.0050), primary branches (0.0047), plant height (0.0046), 100 pod weight (0.0006), 50 % flowering (0.0006).At the phenotypic level, biological yield shows a positive indirect effect was observed for dry pod yield (0.1614), harvest index (0.0657), shelling percentage (0.0232), 100 kernel weight (0.0012), primary branches (0.0006), plant height (0.0005), 50 % flowering (0.0002), no. mature pods per plant (0.0001). At the genotypic level, the harvesting index shows a positive indirect effect on kernel yield per plant. plant height (0.02764), dry pod yield (0.02775), shelling percentage (0.7936), dry pod yield (0.62034), 100 pod weight (0.0533), and biological yield (0.01347).The phenotypic path coefficient shows a positive indirect effect for kernel yield per plant through characters like plant height (0.00323), primary branches (0.00551), dry pod yield (0.68339), shelling percentage (0.75837), and 100 seed weight (00.00439).

Conclusion

In the conclusion, the result suggested the characters such as shelling percentage, dry pod yield, number of mature pods per plant, 100 kernel weight, and harvest index showed a positive correlation with kernel yield per plant in genotypic correlation analysis; likewise, in phenotypic correlation analysis, same characters shows a positive and significant correlation with kernel yield per plant. At the genotypic and phenotypic levels, plant height, primary branches, dry pod yield, shelling percentage, 100 pod weight, and biological yield showsfavourable direct effect on the number of kernels yield per plant. To optimize *Arachis hypogea* L. production, factors such as the total number of mature pods, 100 pod weight, shelling %, and dry pod yield must be given priority.

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Conflict of Interest- None

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