Website : www.asthafoundation.in
Frontiers in Crop Improvement
Vol 11 (2) : 98-102 (July-2023) Print ISSN : 2393-8234 Online ISSN : 2454-6011
Astha Foundation, Meerut (U.P.) India

Correlation and Path Analysis Studies of Kernel Yield and its Component Traits in Groundnut (*Arachis hypogaea* L.) Genotypes

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Abstract

Groundnut is an important oilseed crop of India. Groundnut is an important source of oil, food and feed legume. Correlation coefficient analysis is useful in identifying the component traits which can be used for yield improvement of groundnut. Path coefficient analysis provides a thorough understanding of contribution of various traits by partitioning the correlation coefficient into components of direct and indirect effects. This study aimed to quantify the relationship and contributions of various traits to kernel yield. Thirty-six diverse genotypes/ varieties of groundnut were evaluated during *kharif* 2018 for genetic parameters *viz.*, correlation and path analysis. The genotypes were raised in randomized block design with three replications at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Gwalior, Madhya Pradesh. The experimental result showed that positive correlation and positive direct effect on kernel yield per hectare were observed for plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod yield per plant, 100 pod weight, 100 kernel weight, kernel yield per plant, pod yield per hectare and sound mature kernel. Therefore, these traits can be used for groundnut improvement program as well as developing high yielding varieties of groundnut.

Key words : *Correlation, path coefficient, kernel yield, groundnut.*

Introduction

Groundnut (*Arachis hypogaea* L.) is a member of *Papilionaceae,* subfamily of the *Fabaceae* family which comprises important edible oil seed crops in the world. The cultivated groundnut (*Arachis hypogaea* L.) originated in South America. It is popularly known as the "King" of oilseeds or "Wonder nut" or "Poor man's cashew nut" or "earthnut" (1). Groundnut is a self-pollinated, annual, herbaceous legume crop. A complete seed of groundnut is called as pod and contains one to five kernels, which develops underground in a needle like structure called as peg. After the pollination, aerial pegs grow into the soil and then convert into a pod. Groundnut has taproot system, which has many nodules, present in root and lateral roots. There are four botanical types of groundnut namely Virginia runner, Virginia bunch, Valencia and Spanish bunch and they differs in their chemical composition and oil quality. Virginia bunch type seeds are richer in oil and chemical contents followed by Spanish bunch. Protein content is higher in Valencia, while soluble sugars are higher in Virginia runner seeds. Highest oleic acid has been observed in Valencia type.

India is the second largest producer of groundnut after China. It is the largest oilseed in India in terms of production. It is an important source of oil, food and feed legume. Groundnut contains on an average 40.1% fat, 25.3% protein and is fairly a rich source of calcium, iron and vitamin B complex like thiamine, riboflavin, niacin and vitamin A. It has multifarious usages. It is not only used as a major cooking medium for various food items but also utilized for manufacture of soap, cosmetics, shaving cream, lubricants, etc. In fact, it plays a pivotal role in oilseed economy of India. Groundnut haulms constitute nutritious fodder for livestock. They contain protein (8-15%), lipids (1-3%), minerals (9-17%) and carbohydrate (38-45%) at levels higher than those of the cereal fodders. The digestibility of nutrients in groundnut haulm is around 53% and that of crude protein is 88% in animals (2).

Studies of correlation allow breeders to understand the strength of the relationship between different characters as well as the direction of changes expected during selection. Correlation and path analysis will determine the magnitude of association between yield and its components and also bring out relative importance of their direct and indirect effects, thus providing an obvious understanding of their association with seed yield. Path analysis is standardized partial regression coefficient which splits the correlation coefficient into the measure of direct and indirect effect and measure the direct and indirect contribution of each independent variable on the depend variable (4).

Received : June-2023; Revised : June-2023; Accepted : July-2023

Table-1 : List of groundnut genotypes used in the present study.

S. No.	Name of genotypes	Source	S. No.	Name of genotypes	Source
1.	ICGV-X-1400-65-F2	ICRISAT, Hyderbad	19.	ICGV-13227	ICRISAT, Hyderbad
2.	ICGV-13567	ICRISAT, Hyderbad	20.	ICGV-13230	ICRISAT, Hyderbad
3.	ICGV-13564	ICRISAT, Hyderbad	21.	ICGV-13233	ICRISAT, Hyderbad
4.	ICGV-13574	ICRISAT, Hyderbad	22.	ICGV-13235	ICRISAT, Hyderbad
5.	ICGV-13558	ICRISAT, Hyderbad	23.	ICGV-13237	ICRISAT, Hyderbad
6.	ICGV-13562	ICRISAT, Hyderbad	24.	ICGV-13229	ICRISAT, Hyderbad
7.	ICGV-13554	ICRISAT, Hyderbad	25.	ICGV-13240	ICRISAT, Hyderbad
8.	ICGV-13555	ICRISAT, Hyderbad	26.	ICGV-8010	ICRISAT, Hyderbad
9.	ICGV-13560	ICRISAT, Hyderbad	27.	ICGV-13243	ICRISAT, Hyderbad
10.	ICGV-13575	ICRISAT, Hyderbad	28.	ICGV-13246	ICRISAT, Hyderbad
11.	ICGV-13557	ICRISAT, Hyderbad	29.	ICGV-8110	ICRISAT, Hyderbad
12.	ICGV-8705	ICRISAT, Hyderbad	30.	ICGV-13545	ICRISAT, Hyderbad
13.	ICGV-13565	ICRISAT, Hyderbad	31.	PBS-12200	DGR, Junagath
14.	ICGV-13208	ICRISAT, Hyderbad	32.	PBS-12201	DGR, Junagath
15.	ICGV-13214	ICRISAT, Hyderbad	33.	Grinar-3	DGR, Junagath
16.	ICGV-9885	ICRISAT, Hyderbad	34.	Girnar-2	DGR, Junagath
17.	ICGV-13219	ICRISAT, Hyderbad	35.	Mallika	SKARU, Bikaner
18.	ICGV-13226	ICRISAT, Hyderbad	36.	JGN-3	JNKVV

Table-2 : Analysis of variance (ANOVA) for seed yield and other traits in 36 groundnut genotypes/varieties.

S. No.	Characters	Replications	Genotypes	Error
	Degree of freedom	2	35	70
1.	Plant height (cm)	15.26	35.85***	2.91
2.	Days to 50% flowering	0.25	11.49***	2.33
3.	Days to maturity	0.45	11.34***	2.43
4.	Number of primary branches per plant	0.0045	0.97***	0.0112
5.	Number of secondary branches per plant	0.0019	1.039***	0.012
6.	Number of pods per plant	60.03	111.30***	4.68
7.	Pod yield per plant(gm)	0.31	33.25***	0.45
8.	100 pod weight (gm)	432.25	1406.68***	33.56
9.	Kernel yield per plant (gm)	0.36	14.13***	0.19
10.	100 kernel weight (gm)	32.53	97.25***	6.53
11.	Shelling %	36.65	23.13***	10.94
12.	Sound mature kernel	0.25	40.56***	1.92
13.	Pod yield per ha.(kg)	28748.48	3751021.27***	44898.44
14.	Kernel yield per ha.(kg)	39028.59	1566367.18	21079.64

*** = Significant at .01%, ** = Significant at 1%., * = Significant at 5%

Materials and Methods

The investigation was conducted during *Kharif*, 2018 under normal irrigation conditions at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Gwalior, Madhya Pradesh (RVSKVV). The material comprised of 36 genotypes/varieties of groundnut which were sown by adopting Randomized Block Design (RBD) with three replications presented in Table 1. Each genotype was sown in 5 m length of two rows with the spacing of 30 cm between rows and 10 cm from plant to plant. The recommended agronomic practices were followed to raise a good crop. The 14 quantitative characters viz., Days to maturity, Days to 50% flowering, plant height (cm), Number of primary branches per plant, Number of secondary branches per plant, Number of pods per plant, Pod yield per plant (gm), 100 pod weight (gm), Kernel yield per plant (gm), 100-kernel weight (gm), Shelling percentage (%), Sound mature kernel (%), Pod yield per hectare (kg) and Kernel yield per hectare (kg) were recorded on five randomly selected plants from each genotype in each replication. The estimates of correlation and path coefficient analysis were calculated by using data.

Results and Discussion

Analysis of variance for yield and yield attributes revealed significant differences for all the characters studied indicating the presence of considerable amount of variation among the genotypes for the traits studied

Table-3 : Genotypic (above) and phenotypic (below) diagonal correlation coefficient analysis for among the characters in groundnut.

	Plant height	Days to 50% flowering	Days to maturity	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Pod yield per plant	100 pod weight	Kernel yield per plant	100 kernel weight	Shelling %	Sound mature kernel	Pod yield per ha.	Kernel yield per ha
Plant height	-	-0.4921***	-0.4991***	0.3127***	-0.1565	0.4083***	0.2825**	0.0927	0.2642**	0.2305*	-0.3228***	0.4189***	0.2830**	0.2671**
Days to 50% flowering	-0.2969**	-	1.0000****	-0.1114	-0.1299	-0.4552***	-0.3931***	-0.1563	-0.3985***	-0.4098***	-0.1580	-0.6037***	-0.3956***	-0.3993***
Days to maturity	-0.2932**	0.9914***	-	-0.0852	-0.1030	-0.4249***	-0.3906***	-0.1830	-0.3962***	-0.4261***	-0.1299	-0.6185***	-0.3931***	-0.3969***
Number of primary branches per plant	0.2740**	-0.0875	-0.0656	-	0.2282*	0.5183***	0.4699***	-0.0611	0.4681***	0.1574	-0.0515	0.3409***	0.4689***	0.4693***
No. of secondary branches per plant	-0.1330	-0.1154	-0.0951	0.2099*	-	0.0189	0.2054*	0.2617**	0.2237*	0.0856	-0.4362***	0.0261	0.2024*	0.2233*
Number of pods per plant	0.3323***	-0.3714***	-0.3431***	0.4847***	0.0367	-	0.6134***	-0.2856**	0.6118***	-0.0464	0.2715**	0.1869	0.6094***	0.6117***
Pod yield per plant (gm)	0.2378*	-0.3009**	-0.2978**	0.4566***	0.1973*	0.5699***	-	0.5502***	0.9997***	0.4760***	-0.1504	0.3419***	1.0000***	0.9999***
100 pod weight	0.0664	-0.1125	-0.1382	-0.0555	0.2410*	-0.2402*	0.5149***	-	0.5514***	0.6718***	-0.4381***	0.3163***	0.5516***	0.5522***
Kernel yield per plant	0.2228*	-0.3095**	-0.3034**	0.4559***	0.2161*	0.5749***	0.9935***	0.5138***	-	0.4868***	-0.1331	0.3544***	0.9990***	1.0000***
100 kernel weight	0.1685	-0.2835**	-0.2890**	0.1488	0.0904	-0.0356	0.4421***	0.5817***	0.4559***	-	0.0972	0.6953***	0.4755***	0.4886***
Shelling %	-0.1665	-0.1599	-0.1324	-0.0440	-0.2022*	0.1174	-0.1204	-0.2661**	-0.0946	0.0337	-	0.4009***	-0.1491	-0.1333
Sound mature kernel	0.3362***	-0.3490***	-0.3538***	0.3274***	0.0152	0.1378	0.3143***	0.2803**	0.3172***	0.5561***	0.1946*	-	0.3456***	0.3549***
Pod yield per ha.	0.2387*	-0.3082**	-0.3053**	0.4567***	0.1968*	0.5696***	0.9989***	0.5188***	0.9932***	0.4429***	-0.1122	0.3171***	-	0.9992***
Kernel yield per ha.	0.2260*	-0.3092**	-0.3030**	0.4576***	0.2162*	0.5741***	0.9933***	0.5155***	0.9998***	0.4579***	-0.0977	0.3186**	0.9931***	-

***= Signiicant at 0.1%, ** = Significant at 1%., * = Significant at 5%

(Table-2). Phenotypic and genotypic correlation coefficients between kernel yield per plant and other yield characters and among themselves were estimated in order to access the direction and magnitude of association (Table-3).

In general, for most of the characters under study, the genotypic correlation coefficients were higher in magnitude than phenotypic correlation coefficients. High genotypic correlations as compared to their phenotypic counterparts indicated strong inherent association between the characters studied and its expression is lessened due to influence of environment. Correlation studies revealed that ten out of fourteen characters viz., plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod yield per plant, 100 pod weight, 100 kernel weight, kernel yield per plant, pod yield per hectare and sound mature kernel exhibited significant positive association at both genotypic and phenotypic levels with kernel yield per plant. Similar results were also reported by (5, 6, 7, 8, 9). The highest significant positive correlation at both levels was observed for the character pod yield per plant.

The Table pertaining to the path direct and indirect effects of yield parameters on kernel yield is presented in Table-4. The kernel yield per hectare was dependent character and output of direct and indirect effects of independent characters (variables) like days to maturity, days to 50% flowering, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod yield per plant (gm), 100 pod weight (gm), kernel yield per plant (gm), 100-kernel weight (gm), shelling percentage (%), sound mature kernel (%) and pod yield per hectare (kg). Results of path coefficient analysis of different characters contributing towards kernel yield per hectare showed that kernel yield per plant (0.9994) had highest positive direct effect on kernel yield per hectare followed by pod yield per hectare (0.0253), days to maturity (0.0115), 100 pod weight (0.0027), 100 kernel weight (0.0024), plant height (0.0022), number of primary branches per plant (0.0022), number of pods per plant (0.0013) and sound mature kernel (0.0002). Conversely, the highest negative direct effect on kernel yield per hectare was registered by pod yield per plant (-0.0296) following by days to 50% flowering (-0.0106), shelling percentage (-0.0033) and number of secondary branches per plant (-0.0008). Similar results were also reported by (10, 11, 12, 13).

Conclusions

Genotypic and phenotypic correlation analysis revealed that ten characters viz., plant height, number of primary

Table-4 : Path coefficient analysis showing direct (bold) and indirect effects of different characters on seed yield per plant.

		Plant height	Days to 50% flowering	Days to maturity	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Pod yield per plant	100 pod weight	Kernel yield per plant	100 kernel weight	Shelling %	Sound mature kernel	Pod yield per ha.	Correction coefficient (r) value of kernel yield per hectare
Plant height	G	0.0038	-0.0018	-0.0019	0.0012	-0.0006	0.0015	0.0011	0.0003	0.0010	0.0009	-0.0012	0.0016	0.0011	0.2671**
	P	0.0022	-0.0007	-0.0007	0.0006	-0.0003	0.0007	0.0005	0.0001	0.0005	0.0004	-0.0004	0.0008	0.0005	0.2260*
Days to 50% flowering	G	0.0318	-0.0647	-0.0647	0.0072	0.0084	0.0295	0.0254	0.0101	0.0258	0.0265	0.0102	0.0391	0.0256	-0.3993***
	P	0.0032	-0.0106	-0.0105	0.0009	0.0012	0.0039	0.0032	0.0012	0.0033	0.0030	0.0017	0.0037	0.0033	-0.3032**
Days to maturity	G	-0.0325	0.0651	0.0651	-0.0055	-0.0067	-0.0277	-0.0254	-0.0119	-0.0258	-0.0277	-0.0085	-0.0403	-0.0256	-0.3969***
	P	-0.0034	0.1114	0.0115	-0.0008	-0.0011	-0.0040	-0.0034	-0.0016	-0.0035	-0.0033	-0.0015	-0.0041	-0.0035	-0.3030**
Number of primary branches per plant	G	0.0005	-0.0002	-0.0001	0.0017	0.0004	0.0009	0.0008	-0.0001	0.0008	0.0003	-0.0001	0.0006	0.0008	0.4693***
	P	0.0006	-0.0002	-0.0001	0.0022	0.0005	0.0011	0.0010	-0.0001	0.0010	0.0003	-0.0001	0.0007	0.0010	0.4576***
Number of secondary branches per plant	G	0.0001	0.0001	0.0001	-0.0001	-0.0005	0.0000	-0.0001	-0.0001	-0.0001	0.0000	0.0002	0.0000	-0.0001	0.2233*
	P	0.0001	0.0001	0.0001	-0.0002	-0.0008	0.0000	-0.0002	-0.0002	-0.0002	-0.0001	0.0002	0.0000	-0.0002	0.2162*
Number of pods per plant	G	0.0014	-0.0016	-0.0015	0.0018	0.0001	0.0035	0.0022	-0.0010	0.0021	-0.0002	0.0010	0.0007	0.0021	0.6117***
	P	0.0004	-0.0005	-0.0004	0.0006	0.0000	0.0013	0.0007	-0.0003	0.0007	0.0000	0.0002	0.0002	0.0007	0.5741***
Pod yield per plant (gm)	G	-0.0346	0.0481	0.0478	-0.0575	-0.0251	-0.0751	-0.1224	-0.0674	-0.1224	-0.0583	0.0184	-0.0419	-0.1224	0.9999***
	P	-0.0070	-0.0089	0.0088	-0.0135	-0.0058	-0.0169	-0.0296	-0.0152	-0.0294	-0.0131	0.0036	-0.0093	-0.0296	0.9933***
100 pod weight	G	0.0006	-0.0010	-0.0012	-0.0004	0.0017	-0.0019	0.0037	0.0067	0.0037	0.0045	-0.0029	0.0021	0.0037	0.5522***
	P	0.0002	0.0003	-0.0004	-0.0001	0.0006	-0.0006	0.0014	0.0027	0.0014	0.0016	-0.0007	0.0008	0.0014	0.5155***
Kernel yield per plant	G	0.2550	-0.3846	-0.3828	0.4518	0.2158	0.5904	0.9648	0.5321	0.9651	0.4698	-0.1285	0.3420	0.9641	1.0000***
	P	0.2226	-0.3093	-0.3032	0.4557	0.2160	0.5746	0.9929	0.5135	0.9994	0.4556	-0.0945	0.3170	0.9926	0.9998***
100 kernel weight	G	0.0011	-0.0020	-0.0021	0.0008	0.0004	-0.0002	0.0023	0.0032	0.0023	0.0048	0.0005	0.0034	0.0023	0.4886***
	P	0.0004	-0.0007	-0.0007	0.0004	0.0002	-0.0001	0.0010	0.0014	0.0011	0.0024	0.0001	0.0013	0.0010	0.4579***
Shelling %	G	-0.0020	-0.0003	-0.0002	-0.0001	-0.0008	0.0005	-0.0003	-0.0008	-0.0002	0.0002	0.0018	0.0007	-0.0003	-0.1333
	P	0.0006	0.0005	0.0004	0.0001	0.0007	-0.0004	0.0004	0.0009	0.0003	-0.0001	-0.0033	-0.0006	0.0004	-0.0977
Sound mature kernel	G	-0.0423	0.0029	0.0029	-0.0016	-0.0001	-0.0009	-0.0016	-0.0015	-0.0017	-0.0033	-0.0019	-0.0047	-0.0016	0.3549***
	P	0.0001	-0.0001	-0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000	0.0002	0.0001	0.3186***
Pod yield per ha.	G	0.0423	-0.0592	-0.0588	0.0701	0.0303	0.0911	0.1495	0.0825	0.1494	-0.0711	-0.0223	0.0517	0.1495	0.9992***
	P	0.0060	-0.0078	-0.0077	0.0116	0.0050	0.0144	0.0253	0.0131	0.0251	0.0112	-0.0028	0.0080	0.0253	0.9931***

Note : Residual effect: Phenotypic = 0.31841 and Genotypic = 0.68614

branches per plant, number of secondary branches per plant, number of pods per plant, pod yield per plant, 100 pod weight, 100 kernel weight, kernel yield per plant, pod yield per hectare and sound mature kernel exhibited positive significant association with kernel yield per hectare, indicated that direct selection for these traits may lead increase in genetic potential of kernel yield. Path analysis revealed that traits viz., kernel yield per plant followed by pod yield per hectare, days to maturity, 100 pod weight, 100 kernel weight, plant height, number of primary branches per plant, number of pods per plant and sound mature kernel exhibited highest positive direct effect on kernel yield per hectare, therefore may be used for further improving kernel yield attributes breeding programme of groundnut.

Acknowledgement

First author is grateful Department of Genetics and Plant Breeding, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior for providing facilities for the conduct of the research and thankful to Directorate of Groundnut Research, Junagarh for providing the seed material.

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