Correlation and Path coefficient Studies of Yield and its Contributing traits in Groundnut (*Arachis hypogea* L.)

ABSTRACT

Groundnut (*Arachishypogaea* L.) is a major oilseed crop of India and also an important agricultural export commodity. It is highly variable in phenotypic characters and thus it is important to investigate the variations and associations of these morphological features.Tenconfectionary type advanced breeding lines along with two checks (Kadirichitravathi and Kadir-7) were raised in a randomized block design with three replications and they were evaluated for 15 characters. Significant variations were observed among the genotypes for all the characters studied. The highest genotypic coefficient of variation was observed for hundred pod weight and hundred pod kernel weight indicating the presence of wide range of variation for this character. The dry pod yield per plant had significant positive association with hundred pod kernel weight, kernel yield per plot and positive association with plant height, no. of pods per plant and hundred pod weight. Path coefficient analysis revealed that, hundred pod weight reported the highest positive direct effect on pod yield per plot followed by hundred pod kernel weight, kernel yield per plot, days to maturity, days to 50 % flowering, plant height, final plant count and initial plant count indicating that the selection for these characters was likely to bring about an overall improvement in pod yield per plot directly.

Keywords: Groundnut; correlation; pod yield; path analysis; phenotypic and genotypic.

1. INTRODUCTION

Groundnut (*Arachishypogaea* L.) is a major oilseed crop of India and also an important agricultural export commodity. It is cultivated in 24 Mhais the world over for extraction of edible oil and food purpose. There are about 70 species of groundnut that are grown in more than 100 different countries globally. In the last decade (2000-2010), global groundnut production increased marginally. The global annual increase in production was 0.4% which was due to both, an annual increase in yield by 0.1% and in area by 0.3% (Janila et al., 2013). Over 60% of global groundnut production is crushed for extraction of oil for edible and industrial uses, while 40% is consumed as food and others (Birthalet al., 2010). The crop consists of edible oil (40–56%), protein (20–30%), carbohydrate (10–20%) and various nutritious components such as vitamin E, niacin, calcium, magnesium, phosphorus, zinc, iron, riboflavin, thiamine and potassium in its seeds. Groundnut fat consists of monounsaturated fatty acid, oleic acid (36-81.3%) polyunsaturated fatty acid, linoleic acid (3.9-40.2%) (Janila et al., 2016).The economic importance and narrow genetic base of groundnut has motivated scientists to characterize available germplasm against current abiotic and biotic stresses based on its morphological characteristics. (Reddyet al., 2016)

Groundnut is an major oilseed crop. Whereby more than 88% of the overall oil seedoutput is accounted for by soybean (34%), groundnut (29%) and mustard (27%).Meanwhile, more than 80% of vegetable oil comes from mustard (35%), soybean(23%) and groundnut (25%) (Sheteet *al*., 2023).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.Studies on correlation coefficients of different characters are useful to identify desirable traits that contribute to improve the grain yield and help to ascertain the degree to which these traits are assorted with economic productivity. Path coefficient analysis provide information about the direct and indirect effects of component characters on grain yield for enhancing the usefulness of selection for pod yield improvement in Groundnut. Thus, the objective of the present study was to describe relationships between grain yield and its components.

The correlation coefficient among yield traits and its components help to provide information about their performance and association with one another in the selection programme, whereas path coefficient analysis provides information about their direct and indirect cause of association (Kumbharet *al*., 2024).

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2. MATERIALS AND METHODS

The field experiment was conducted during *Rabi,* 2023-24 at Regional Agricultural Research Station, Palem, Telangana. The experimentation site has a semi-arid climate and is located at 16º351 latitude, 78º11 longitude, and 642 m above mean sea level in the Southern Telangana Zone. ten confectionary type advanced breeding lines along with two checks (Kadirichitravathi and Kadir-7) were raised in a randomized block design with three replications with spacing of 30 cm between rows and 10 cm between the plants. Recommended package of practices followed to ensure a good crop. The data on 15 morphological characters namely Initial plant count , Final plant count, Days to initial flowering, Days to 50 % flowering, Plant height (cm), No. of pods per plant, Hundred pod weight (g), Hundred pod kernel weight (g),Hundred kernel weight (g), Sound mature kernel, Shelling %, Days to maturity, Dry haulm yield (g/plot), Kernel yield (g/plot) and Dry pod yield (g/plot) were recorded.

Analysis of variance for Randomized Complete Block Design was done initially to find out the genotypic differences between the lines based on the method given by Panse and Sukhatme, 1954. The calculation of genotypic and phenotypic variances was carried out based on the formula given by Burton,1953. The variance and covariance components for each pair of characteristics were calculated by the methods described by Falconer et al.,1996 from which the phenotypic and genotypic correlation coefficients were calculated. The estimated values of correlation coefficients were the compared with table values of correlation coefficients at 5% and 1% levels of significance in order to test their significance. The correlation coefficients are further divided into direct and indirect effects of independent factors on the dependent variable in path coefficient analysis proposed by Wright,1921 and elaborated by Dewey and Lu,1959. All the mentioned analyses were performed using the INDOSTAT software.

3. RESULTS AND DISCUSSION

According to analysis of variance among the genotypes studied there were significant variations observed for all the characters under study among the genotypes studied. The values of Phenotypic and genotypic coefficients of variation are given in Table 1. The GCV values ranged from 0.72 to 16.99. High GCV was observed in hundred pod weight (16.99) and hundred pod kernel weight (16.17) indicating the presence of wide range of variation for this character, which can be improved further by individual selection. The low GCV values were recorded for plant height (12.11), No. of pods per plant (8.17),dry pod yield per plot (7.18), kernel yield per plot (6.44), dry haulm yield per plot (6.35), shelling % (4.02),days to maturity (3.98), sound mature kernels (3.79), days to initial flowering(2.60), hundred kernel weight (2.14),final plant count (1.0), days to 50 % flowering (0.86), initial plant count (0.72) and which indicates that environment had a major influence on the expression of these characters. The values of PCV were recorded between 2.31 to 18.04. high estimates of PCV were recorded for hundred pod kernel weight (18.04) and hundred pod weight (17.42), plant height (12.86),), kernel yield per plot (10.93), dry haulm yield per plot (10.68), dry pod yield per plot (10.65) were observed with moderate estimates of PCV. Low estimates of PCV (<10%) were observed in No. of pods per plant (9.23), mature kernels (7.95), shelling % (6.51), hundred kernel weight (4.35), days to maturity (4.15), sound days to initial flowering(3.75), final plant count (2.57), days to 50 % flowering (3.24), and initial plant count (2.31). PCV values are greater than GCV values across all traits, showing that variation was induced not only by genotypes but also by environmental influences. Similar results were found in studies of Kumari and Sasidharan, 2020, Aruna et al. 2019 Shinde et al., 2019 and Mandal et al., 2017 and Madhuri et al.,2022.

The genotypic and phenotypic correlation coefficients (Table 2) were studied and the results of genotypic correlations revealed that dry pod yield per plant had significant positive association with hundred pod kernel weight (0.3602) and kernel yield per plot (1.1925). These results emphasized the effectiveness of these characters in terms of their contribution towards pod yield per plant. Kumari and Sasidharan, 2020.Pod yield per plant showed a significant negative association with initial plant count (-0.3283), final plant count (-0.9940) and days to 50 % flowering (-0.4215). Whereas the characters plant height (0.1950), no. of pods per plant (0.2129), hundred pod weight (0.317) showed non-significant positive association with it. While it was showing negative and non significant association with days to initial flowering (-0.2447), hundred kernel weight (-0.3113), sound mature kernel (-0.0675), shelling percentage (-0.1336),days to maturity (-0.1892) and dry haulm yield (-0.0302) (Shinde et al., 2019). Positive interdependence between pod yield per plant and the characters of plant height, no. of pods per plant, hundred pod weight would aid in increasing the pod yield levels and therefore more emphasis should be given to these characters.

According to the results presented in the table (3), path coefficient analysis revealed that, hundred pod weight reported the highest positive direct effect on pod yield per plot followed by hundred pod kernel weight, kernel yield per plot, days to maturity, days to 50 % flowering, plant height, final plant count and initial plant count indicating that the selection for these characters was likely to bring about an overall improvement in pod yield per plant directly. As a result, it is advised that these traits can be considered as most important yield contributing characters for selection. The negative direct effects on pod yield were exhibited by days to initial flowering, no. of pods per plant,, hundred kernel weight,shelling % and dry haulm yield. These results were in accordance to the findings of Patel et al. (2021), Mandalet al. (2017) and Mohapatra and Khan (2020).

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Table 1 Estimation of genetic parameters for 15 traits in 10 advanced lines and parents

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
ECV	2.425	2.762	2.697	3.130	4.347	4.290	3.861	8.002	4.856	8.812	7.657	1.151	8.588	8.837	7.867
GCV	0.724	1.006	2.608	0.861	12.111	8.174	16.996	16.174	2.141	3.797	4.024	3.987	6.356	6.441	7.184
PCV	2.314	2.572	3.752	3.246	12.867	9.232	17.429	18.046	4.359	7.951	6.515	4.150	10.685	10.935	10.654
General mean	134.250	128.389	37.861	42.083	16.472	18.778	152.028	107.889	64.889	81.278	71.056	120.750	941.361	974.917	1374.111

C1 Initial plant count C2 Final plant count C3 Days to initial flowering C4 Days to 50 % flowering C5 Plant Height (cm)

C6 No. of pods per plant C7 Hundred pod weight (g) C8 Hundred pod kernel weight (g) C9 Hundred Kernel Weight (g) C10 Sound mature kernel

C11 Shelling % C12 Days to maturity C13 Dry haulm yield (g/plot) C14 Kernel yield (g/plot) C15 Dry pod yield (g/plot)

Table 2 **Phenotypic (P) and Genotypic (G) correlation coefficient analysis of yield and yield component characters in Groundnut**

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Character		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	P	**1.0000**	0.5114 * *	0.5270 * * *	0.7633 * * *	0.5483 * * *	0.4079 *	0.1338	0.1966	-0.0305	0.0138	0.1750	-0.0285	0.0734	0.2604	0.1596
	G	**1.0000**	-0.7804**	0.6159**	1.2549**	-0.8759**	-0.0356	-0.6684**	-0.4928**	0.5594**	-0.0034	-0.8102**	0.1476	-0.7755 **	0.0828	-0.3283*
C2	P		**1.0000**	0.0118	0.2486	0.1836	0.1623	0.1367	0.2444	0.1173	0.0118	0.3223	-0.0591	0.0771	0.1577	-0.0482
	G		**1.0000**	0.8552**	0.4693**	-0.1690	-0.0586	-0.4103	-0.2912	0.3588*	0.5358**	-0.5370**	0.2418	-0.9032 **	-0.7726**	-0.9940**

C3	P			**1.0000**	0.6572 * * *	0.1761	0.4615 * *	-0.1617	-0.1389	0.0339	-0.0160	-0.0004	0.3264	-0.0231	-0.0424	-0.0384
	G			**1.0000**	-0.0353	-0.0647	0.2416	-0.1816	-0.2620	-0.4291**	-0.2387	0.3171	0.5183	-0.0223	-0.4527**	-0.2447
C4	P				**1.0000**	0.2198	0.3626 *	0.2866	0.3296 *	0.0039	-0.1127	0.1130	-0.0125	0.0622	0.1485	0.0850
	G				**1.0000**	-0.2987	-0.1998	1.3373	1.3148	-0.4666**	-0.1535	0.3815	-0.0601	0.4512 **	-0.5927**	-0.4215**
C5	P					**1.0000**	0.0254	0.1316	0.0898	0.1163	0.0630	-0.1006	-0.3474 *	0.1814	0.1122	0.1690
	G					**1.0000**	-0.1472	0.1601	0.0955	-0.2934	-0.2814	0.2663	-0.3826	0.3263	0.0716	0.1950
C6	P						**1.0000**	-0.1233	-0.1122	0.0299	-0.1695	0.0160	0.3433 *	0.0125	0.1780	0.1845
	G						**1.0000**	-0.1102	-0.1362	-0.1954	0.1429	0.0550	0.4072 **	-0.0510	0.1995	0.2129
C7	P							**1.0000**	0.9295***	0.0739	-0.0666	-0.0842	-0.1529	-0.1542	0.1599	0.2053
	G							**1.0000**	1.0326	0.1682	0.2013	0.0499	-0.1537	-0.2176	0.3460	0.3187
C8	P								**1.0000**	0.0261	-0.1517	0.2853	-0.1880	-0.1505	0.2918	0.1105
	G								**1.0000**	0.1580	0.1105	0.3073	-0.1513	-0.1422	0.2281	0.3602*
C9	P									**1.0000**	0.0812	-0.1038	-0.0748	0.1289	-0.0957	-0.0520
	G									**1.0000**	0.4430	0.0134	0.3014	-0.1117	-0.3594*	-0.3113
C10	P										**1.0000**	-0.2593	-0.1246	0.1515	0.2001	0.3577*
	G										**1.0000**	0.4316**	0.2339	-0.5727	-0.3217	-0.0675

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C11	P											**1.0000**	-0.1072	-0.0070	0.3823*	-0.2266
	G											**1.0000**	-0.0172	-0.3779	0.4904**	-0.1336
C12	P												**1.0000**	-0.0722	-0.1768	-0.1092
	G												**1.0000**	-0.1183	-0.2144	-0.1892
C13	P													**1.0000**	-0.0325	-0.0495
	G													**1.0000**	0.1861	-0.0302
C14	P														**1.0000**	0.8093**
	G														**1.0000**	1.1925**

*significant at 5 percent level; ** significant at 1 percent level

P: Phenotypic correlation coefficient; **G:** Genotypic correlation coefficient.

C1 Initial plant count C2 Final plant count C3 Days to initial flowering C4 Days to 50 % flowering C5 Plant Height (cm)

C6 No. of pods per plant C7 Hundred pod weight (g) C8 Hundred pod kernel weight (g) C9 Hundred Kernel Weight (g) C10 Sound mature kernel
C11 Shelling % C12 Days to maturity C13 Dry haulm yield (g/plot) C14 Kernel yield (g/plot) C15 Dry pod yield (g/plot)

Table 3: Phenotypic (P) and Genotypic (G) path coefficient analysis of yield and yield component characters in groundnut

Character		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	P	**-0.0250**	-0.0128	-0.0132	-0.0191	-0.0137	-0.0102	-0.0033	-0.0049	0.0008	-0.0003	-0.0044	0.0007	-0.0018	-0.0065	0.1596
	G	**0.0043**	-0.0033	0.0026	0.0053	-0.0037	-0.0002	-0.0028	-0.0021	0.0024	0.0000	-0.0034	0.0006	-0.0033	0.0004	-0.3283*
C2	P	-0.0016	**-0.0031**	0.0000	-0.0008	-0.0006	-0.0005	-0.0004	-0.0008	-0.0004	0.0000	-0.0010	0.0002	-0.0002	-0.0005	-0.0482
	G	-0.0070	**0.0090**	0.0077	0.0042	-0.0015	-0.0005	-0.0037	-0.0026	0.0032	0.0048	-0.0048	0.0022	-0.0081	-0.0070	-0.9940**

C3	P	0.0047	0.0001	**0.0088**	0.0058	0.0016	0.0041	-0.0014	-0.0012	0.0003	-0.0001	0.0000	0.0029	-0.0002	-0.0004	-0.0384
	G	0.0415	-0.0577	**-0.0675**	0.0024	0.0044	-0.0163	0.0122	0.0177	0.0289	0.0161	-0.0214	-0.0350	0.0015	0.0305	-0.2447
C4	P	0.0241	0.0079	0.0208	**0.0316**	0.0069	0.0115	0.0091	0.0104	0.0001	-0.0036	0.0036	-0.0004	0.0020	0.0047	0.0850
	G	0.0479	0.0179	-0.0013	**0.0382**	-0.0114	-0.0076	0.0510	0.0502	-0.0178	-0.0059	0.0146	-0.0023	0.0172	-0.0226	-0.4215**
C5	P	0.0008	0.0003	0.0003	0.0003	**0.0014**	0.0000	0.0002	0.0001	0.0002	0.0001	-0.0001	-0.0005	0.0003	0.0002	0.1690
	G	-0.0146	-0.0028	-0.0011	-0.0050	**0.0167**	-0.0025	0.0027	0.0016	-0.0049	-0.0047	0.0044	-0.0064	0.0054	0.0012	0.1950
C6	P	0.0002	0.0001	0.0002	0.0001	0.0000	**0.0004**	0.0000	0.0000	0.0000	-0.0001	0.0000	0.0001	0.0000	0.0001	0.1845
	G	0.0021	0.0034	-0.0139	0.0115	0.0085	**-0.0577**	0.0064	0.0079	0.0113	-0.0082	-0.0032	-0.0235	0.0029	-0.0115	0.2129
C7	P	0.1028	0.1051	-0.1243	0.2202	0.1011	-0.0948	**0.7684**	0.7143	0.0568	-0.0512	-0.0647	-0.1175	-0.1185	0.1229	0.2053
	G	-1.5391	-0.9449	-0.4181	3.0793	0.3686	-0.2537	**2.3026**	2.3777	0.3872	0.4635	0.1149	-0.3540	-0.5010	0.7966	0.3187
C8	P	0.1620	-0.2013	0.1144	-0.2715	-0.0740	0.0924	-0.7658	**-0.8239**	-0.0215	0.1250	-0.2351	0.1549	0.1240	-0.2404	0.1105
	G	1.1255	0.6650	0.5984	-3.0028	-0.2181	0.3110	-2.3583	**-2.2838**	-0.3610	-0.2523	-0.7019	0.3455	0.3248	-0.5209	0.3602*
C9	P	0. 0006	-0.0022	-0.0006	-0.0001	-0.0022	-0.0006	-0.0014	-0.0005	**-0.0190**	-0.0015	0.0020	0.0014	-0.0024	0.0018	-0.0520
	G	0.0333	-0.0213	0.0255	0.0277	0.0174	0.0116	-0.0100	-0.0094	**-0.0594**	-0.0263	-0.0008	-0.0179	0.0066	0.0214	-0.3113
C10	P	0.0001	-0.0001	0.0001	0.0005	-0.0003	0.0008	0.0003	0.0007	-0.0004	**-0.0045**	0.0012	0.0006	-0.0007	-0.0009	0.3577*
	G	0.0000	0.0028	-0.0013	-0.0008	-0.0015	0.0008	0.0011	0.0006	0.0023	**0.0053**	0.0023	0.0012	-0.0030	-0.0017	-0.0675
C11	P	-0.0580	-0.1068	0.0001	-0.0374	0.0333	-0.0053	0.0279	-0.0945	0.0344	0.0859	**-0.3313**	0.0355	0.0023	-0.1267	-0.2266
	G	0.0056	0.0037	-0.0022	-0.0026	-0.0018	-0.0004	-0.0003	-0.0021	-0.0001	-0.0030	**-0.0069**	0.0001	0.0026	-0.0034	-0.1336
C12	P	0.0001	0.0001	-0.0007	0.0000	0.0007	-0.0007	0.0003	0.0004	0.0002	0.0003	0.0002	**-0.0021**	0.0002	0.0004	-0.1092
	G	0.0143	0.0234	0.0501	-0.0058	-0.0370	0.0393	-0.0149	-0.0146	0.0291	0.0226	-0.0017	**0.0966**	-0.0114	-0.0207	-0.1892

C13	P	-0.0015	-0.0015	0.0005	-0.0012	-0.0036	-0.0002	0.0031	0.0030	-0.0026	-0.0030	0.0001	0.0014	**-0.0200**	0.0007	-0.0495
	G	0.0301	0.0350	0.0009	-0.0175	-0.0127	0.0020	0.0084	0.0055	0.0043	0.0222	0.0147	0.0046	**-0.0388**	-0.0072	-0.0302
C14	P	0.2745	0.1662	-0.0447	0.1566	0.1182	0.1877	0.1685	0.3075	-0.1009	0.2109	0.4029	-0.1864	-0.0343	**1.0540**	0.8093**
	G	0.0776	-0.7242	0.4244	-0.5557	0.0671	0.1870	0.3243	0.2138	-0.3370	-0.3016	0.4597	-0.2010	0.1744	**0.9375**	1.1925**

Residual effect: 0.0763**P:** Phenotypic path coefficient; **G:** Genotypic path coefficient.

C1 Initial plant count C2 Final plant count C3 Days to initial flowering C4 Days to 50 % flowering C5 Plant Height (cm)

C6 No. of pods per plant C7 Hundred pod weight (g) C8 Hundred pod kernel weight (g) C9 Hundred Kernel Weight (g) C10 Sound mature kernel
C11 Shelling % C12 Days to maturity C13 Dry haulm yield (g/plot) C14 Kernel yield (g/plot) C15 Dry pod yield (g/plot)

4. CONCLUSION

Based on the study of GCV, PCV, correlation and path coefficient analysis among 10 advanced ground lines and parents we conclude that kernel yield per plot, hundred pod kernel weight, hundred pod weight, plant height and no. of pods per plant are the most essential characters contributed significantly towards higher pod yield per plot Such a positive interdependence between pod yield per plant and among these traits would aid in increasing the pod yield levels and therefore, while selecting groundnuts, more emphasis should be given to these characters.

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