Correlation and Path Analysis of Kernel Yield and its Components in Groundnut (*Arachis hypogaea* L.)

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A B S T R A C T

Character association and path analysis were carried out for kernel yield and its component characters in six parents and their 15 F_1 crosses in groundnut. The genotypic correlation coefficients were observed to be relatively of higher magnitude than the corresponding genotypic and phenotypic correlation coefficients indicating strong inherent association between the characters. Kernel yield per plant possessed significant positive association with pod yield per plant, mature pods per plant, 100-kernel weight, pods per plant, pegs per plant, harvest index and shelling percentage at both the genotypic and phenotypic levels. Path analysis also revealed the importance of these traits as they had direct effects on kernel yield. Therefore, selection based on these characters will lead to simultaneous improvement in kernel yield in groundnut.

Introduction

Biometrical procedures such as correlations and path analysis establish the extent of association between yield and its attributes, so that these yield components may form additional criteria for selection in breeding programmes. Yield is a complex entity and depends on the expression of a number of traits known as yield components. The knowledge of association of yield components with yield components with yield and among themselves will be helpful in the improvement of a complex character like yield for which direct selection is not very effective. The correlations with path analysis would give a better appreciation of cause and effect relationship between different pairs of characters.

Materials and Methods

The materials for the study comprised of six parents and their 15 F_1 crosses obtained in a

half diallel method were raised in a RBD replicated thrice with a spacing of 30×10 cm at S.V. Agricultural College, Tirupati, Andhra Pradesh. Data were recorded on a ten randomly selected plants in each entry of each replication for thirteen quantitative traits *viz*., branches per plant, days to 50% flowering, days to maturity, plant height, pegs per plant, pods per plant, mature pods per plant, per cent pod set, harvest index, shelling percentage, 100-kernel weight, pod yield per plant and kernel yield per plant. Phenotypic and genotypic correlations were worked out using the formula suggested by Jhonson *et al.,* (1955). The path coefficient analysis was carried out according to Dewey and Lu (1959).

Results and Discussion

The differences among the genotypes were significant for all the characters studied. Genotypic correlations were of higher magnitude than the phenotype correlations (Table 1) indicating strong inherent association between the two corresponding characters and selection for these characters might be rewarding.

The characters pod yield per plant, mature pods per plant, 100-kernel weight, pods per plant, pegs per plant, harvest index and shelling percentage had highly significant and positive association with kernel yield per plant in the and also exhibited significant positive inter-correlations among themselves.

These results indicated that selection for these characters would simultaneously bring improvement in the associated characters and finally in yield (Mahalakshmi *et al.,* 2005, Patil *et al.,* 2006, Sumathi and Muralidharan *et al.,* 2007, Sawargaonkar *et al.,* 2010, Shukla *et al.,* 2014, Shashi Kumara *et al.,* 2015, Jain *et al.,* 2016, Ramakrishnan *et al.,* 2017 and Rajarathinam *et al.,* 2017). Kernel

yield also had non-significant positive association with plant height, per cent pod set, days to 50% flowering and days to maturity. These observations were in conformity with the reports of Alam *et al.,* (1985) for days to maturity and plant height; Rasheed *et al.,* (2015) for plant height.

Contrary to these findings, Dhaliwal *et al.,* (2010), Sawargaonkar *et al.,* (2010) and Vange and Maga (2014) noticed significant positive association of plant height, days to 50% flowering, days to maturity on kernel yield in groundnut.

Kernel yield had non-significant negative association with branches per plant and it was in conformity with the findings of Antony *et al.,* (2000). Contrary to this, significant positive association between kernel yield per plant and branches per plant was reported by Khanpara *et al.,* (2010), Vange and Maga (2014) and Prabhu *et al.,* (2016) in groundnut.

The phenotypic correlation between kernel yield and its component characters were partitioned in to the direct and indirect components (Table 2).

The pod yield exerted the highest positive direct effect on kernel yield followed by shelling percentage and pegs per plant. Similar results were reported by Shukla *et al.,* (2014) for shelling percentage and Vijayasekhar (2002) for pod yield and pegs per plant; for pod yield by Shoba *et al.,* (2012), Thirumala Rao, (2016) and Rajarathinam *et al.,* (2017); for pod yield per plant and shelling percentage by Pavan Kumar *et al.,* (2014). Through pegs per plant characters such as days to maturity, pods per plant, mature pods per plant, pod yield per plant exhibited negative indirect effect on kernel yield per plant, whereas shelling percentage displayed positive indirect influence.

Table.1 Phenotypic (r_p) and genotypic (r_g) correlation coefficients between kernel yield and its components in groundnut

Character		X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1	r_p	-0.289	-0.085	-0.324	0.134	0.223	0.136	0.257	-0.030	0.037	0.082	-0.043	-0.035
	r_g	-0.634**	-0.073	-0.387	0.222	0.346	0.201	0.364	-0.227	0.019	0.119	-0.193	-0.137
X_2	r_p		0.310	-0.083	0.051	-0.018	0.045	-0.120	0.305	-0.058	-0.214	0.151	0.093
	r_g		0.504*	-0.350	-0.048	-0.243	-0.087	-0.397	0.555**	-0.015	-0.323	0.036	-0.002
X_3	r_p			-0.429	0.307	0.125	0.076	-0.288	0.359	-0.105	-0.058	0.104	0.082
	r_g			-0.624**	0.439*	0.226	0.232	-0.329	0.519*	-0.204	-0.135	0.181	0.103
X_4	r_p				0.220	0.349	0.368	0.259	-0.354	-0.074	-0.064	0.193	0.214
	r_g				0.137	0.332	0.383	0.397	-0.482*	-0.076	0.032	0.394	0.320
X_5	r_p					0.882**	0.813**	-0.032	-0.037	-0.386	0.209	0.533*	0.415
	r_g					0.891**	0.847**	-0.030	0.003	-0.477**	0.122	0.618	0.445*
X_6	r_p						0.837**	0.432	-0.084	-0.224	-0.002	0.507*	0.453*
	r_g						0.858**	0.423	-0.108	-0.269	0.064	0.597*	0.479*
X_7	r_p							0.215	0.015	-0.111	0.172	0.631**	0.593**
	r_g							0.183	0.012	-0.100	0.318	0.704**	0.637**
X_8	r_p								-0.102	0.302	-0.055	0.066	0.188
	r_g								-0.187	0.422	-0.096	0.092	0.202
X_9	r_p									0.251	0.343	0.255	0.340
	r_g									0.535*	0.404	0.310	0.381
X_{10}	r_p										0.297	0.003	0.322
	r_g										0.387	0.215	0.463*
X_{11}	r_p											0.452*	0.517*
	r_g											0.604**	0.612**
X_{12}	r_p												0.906**
	r_g												0.979**

* Significant at $P = 0.05$ ** Significant at $P = 0.01$

X_1 - Branches per plant

X_2 - Days to 50% flowering

X_3 - Days to maturity

X_4 - Plant height (cm)

X_5 - Pegs per plant

X_6 - Pods per plant

X_7 - Mature pods per plant

X_8 - Per cent pod set

X_9 - Harvest index

X_{10} - Shelling percentage

X_{11} - 100-Kernel weight

X_{12} - Pod yield per plant (g)

X_{13} - Kernel yield per plant (g)

Table.2 Phenotypic (*P*) and genotypic (*G*) path coefficients between kernel yield and its components in groundnut

Character		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	r^2
X1	P	**-0.007**	0.011	-0.004	-0.033	0.020	-0.002	0.003	0.020	-0.002	0.012	0.003	-0.035	**-0.193**
	G	**0.072**	-0.008	0.000	0.015	-0.138	0.303	-0.018	-0.204	0.044	0.011	-0.018	-0.195	**-0.137**
X2	P	0.002	**-0.036**	0.014	-0.008	0.008	0.002	0.001	-0.009	0.024	-0.018	-0.007	0.121	**0.259**
	G	-0.046	**0.013**	0.002	0.013	0.030	-0.213	0.008	0.222	-0.108	-0.008	0.048	0.036	**-0.002**
X3	P	0.001	-0.011	**0.046**	-0.044	0.046	-0.013	0.002	-0.022	0.029	-0.033	-0.002	0.084	**0.010**
	G	-0.005	0.007	**0.004**	0.024	-0.273	0.198	-0.021	0.184	-0.101	-0.116	0.020	0.183	**0.103**
X4	P	0.002	0.003	-0.020	**0.102**	0.033	-0.035	0.008	0.020	-0.028	-0.023	-0.002	0.155	**0.020**
	G	-0.028	-0.005	-0.002	**-0.038**	-0.085	0.290	-0.035	-0.222	0.094	-0.043	-0.005	0.399	**0.320**
X5	P	-0.001	-0.002	0.014	0.022	**0.149**	-0.089	0.018	-0.002	-0.003	-0.122	0.001	0.428	**0.294**
	G	0.016	-0.001	0.002	-0.005	**-0.621**	0.779	-0.077	0.017	-0.001	-0.271	-0.018	0.626	**0.445***
X6	P	-0.001	0.001	0.006	0.036	0.132	**-0.101**	0.018	0.033	-0.007	-0.071	0.000	0.407	**0.354**
	G	0.025	-0.003	0.001	-0.013	-0.554	**0.874**	-0.078	-0.236	0.021	-0.153	-0.010	0.604	**0.479***
X7	P	-0.001	-0.002	0.004	0.038	0.121	-0.084	**0.022**	0.017	0.001	-0.035	0.005	0.507	**0.467***
	G	0.015	-0.001	0.001	-0.015	-0.526	0.750	**-0.091**	-0.102	-0.002	-0.057	-0.048	0.713	**0.637****
X8	P	-0.002	0.004	-0.013	0.026	-0.005	-0.044	0.005	**0.077**	-0.008	0.095	-0.002	0.053	**0.141**
	G	0.026	-0.005	-0.001	-0.015	0.019	0.370	-0.017	**-0.559**	0.036	0.240	0.014	0.093	**0.202**
X9	P	0.000	-0.011	0.017	-0.036	-0.006	0.008	0.000	-0.008	**0.080**	0.079	0.011	0.205	**0.245**
	G	-0.016	0.007	0.002	0.018	-0.002	-0.094	-0.001	0.105	**-0.194**	0.304	-0.060	0.314	**0.381**
X10	P	0.000	0.002	-0.005	-0.008	-0.058	0.023	-0.002	0.023	0.020	**0.315**	0.009	0.002	**0.065**
	G	0.001	0.000	-0.001	0.003	0.296	-0.235	0.009	-0.236	-0.104	**0.569**	-0.058	0.218	**0.463***
X11	P	-0.001	0.008	-0.003	-0.007	0.004	0.000	0.004	-0.004	0.027	0.094	**0.031**	0.363	**0.208**
	G	0.009	-0.004	-0.001	-0.001	-0.076	0.056	-0.029	0.054	-0.079	0.220	**-0.149**	0.612	**0.612****
X12	P	0.000	-0.005	0.005	0.020	0.080	-0.051	0.014	0.005	0.020	0.001	0.014	**0.804**	**0.771****
	G	-0.014	0.000	0.001	-0.015	-0.384	0.522	-0.064	-0.051	-0.060	0.123	-0.090	**1.012**	**0.979****

Phenotypic residual effect = 0.061 and genotypic residual effect = 0.039. Values on main diagonal denotes direct effect

X_1 - Branches per plant
X_2 - Days to 50% flowering
X_3 - Days to maturity
X_4 - Plant height (cm)

X_5 - Pegs per plant
X_6 - Pods per plant
X_7 - Mature pods per plant
X_8 - Per cent pod set

X_9 - Harvest index
X_{10} - Shelling percentage
X_{11} - 100-Kernel weight
X_{12} - Pod yield per plant (g)

Positive indirect effects of pod yield were exerted on kernel yield through days to maturity, plant height, pegs per plant, pods per plant, mature pods per plant, harvest index and 100-kernel weight. Korat *et al.,* (2010) reports are akin with our present experimental results. Days to maturity, plant height, pegs per plant, mature pods per plant, percent pod set and pod yield per plant had its indirect contribution through pods per plant, while 50% flowering and shelling percentage exerted its negative indirect influence on kernel yield per plant. Similar reports of Khanpara *et al.,* (2010) and Dhaliwal *et al.,* (2010) were in line with our present findings. Pegs per plant manifested negative indirect influence through shelling percentage but harvest index and 100-kernel weight had positive indirect effect.

Per cent pod set exhibited positively indirect contribution on kernel yield through days to 50% flowering, days to maturity and harvest index, however, branches per plant, plant height, pods per plant, mature pods per plant and shelling percentage showed negative influence on kernel yield per plant. The characters pod yield per plant, shelling percentage, harvest index and 100-kernel weight had significant positive association with kernel yield and among themselves. Hence, simultaneous improvement of these traits will be more reliable for improving kernel yield and selecting improved genotypes of groundnut. In this study, residual effect was relatively very low ($R^2 =$ 0.061) indicating that adequate characters were utilized for the study.

It could be inferred from the present study that mature pods per plant, pod yield per plant, pods per plant, pegs per plant, harvest index, shelling percentage and 100-kernel weight are the major yield contributing characters in groundnut. Therefore, due emphasis should be given to these traits in formulating the criterion in the selection programmes to evolve high yielding genotypes of groundnut.

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