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RESEARCH ARTICLE

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Genetic Variability, Character Association and Path Analysis for Pod Yield and its Component Characters in Groundnut [*Arachis hypogaea* (L.)]

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ABSTRACT

Background: Groundnut is an important oilseed crop in the India. The groundnut kernels serve as a rich source of edible oil (48-50%) and quality protein (25-28%). In crop improvement programme, availability of sufficient genetic variability is of immense importance. The knowledge of nature and magnitude of genetic variance controlling yield and yield components is a prerequisite for improvement of yield in any crop.

Methods: The present investigation was undertaken to assess the genetic variability and character associations for pod yield and component characters in 45 genotypes of groundnut. The genotypes were raised in randomized complete block design with three replications during *kharif* 2019 at SKNAU, Jobner (Rajasthan).

Result: The analysis of variance revealed significant differences among the genotypes for all the characters studied indicating presence of wide genetic variation for different characters. In the present investigation, high genetic advance coupled with high heritability and GCV was observed for biological yield per plant, 100-kernel weight, kernel yield per plant, dry pod yield per plant and pods per plant which indicated prevalence of additive gene action in their expression and these traits possessed high selective value. Kernel yield per plant, pods per plant and biological yield per plant exhibited significantly positive correlation with dry pod yield per plant both at genotypic and phenotypic levels, while shelling percentage at genotypic level only. Three characters *viz*., kernel yield per plant, pods per plant and biological yield per plant could be considered as direct selection parameters for yield improvement in groundnut because they exerted positive direct effect on dry pod yield per plant.

Key words: Correlation, Genetic advance, Genetic variability, Groundnut, Heritability, Path coefficient.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the major oilseed crop of India. It is popularly known as 'mungphali' and belongs to the family Fabaceae. Groundnut is a C_3, self pollinated, autotetraploid crop with 2n=4x=40 and can be grown successfully in tropical and subtropical areas. Botanically, groundnut can be classified into two sub-species namely, *fastigiata* and *hypogaea,* which mainly differ in their branching pattern. The sub-species *fastigiata* is sub divided into four botanical varieties, *fastigiated* (Valencia), *peruviana*, *aequatoriana* and *vulgaris* (Spanish) whereas; sub-species *hypogaea* includes varieties *hypogaea* (Virginia) and *hirsuta* (Krapovickas and Gregory, 1994).

Groundnut is one of the principal economic crops of the world; ranking 6th in edible oil production among oilseed crops, 3rd most important source of vegetable protein and 13th among food crops. It also occupies first rank in terms of acreage and production among oilseed crops of India (Nigam, 2014) with total area of about 48.10 lakh hectares and annual production of 66.9 lakh metric tonnes (Anonymous, 2019).

The large amount of variability present in any genetic material indicates the scope for further improvement of the crop (Baig *et al*., 2018). The knowledge of genetic variability existing in the different parameters contributing to yield is an important criterion for yield enhancement but in highly self-pollinated crops like groundnut, natural variation is narrow resulting in limited scope for selection opportunity. Similarly, information on the nature of associations between yield and its component characters and their direct and indirect contributions on pod yield is necessary for efficient selection. The present investigation was carried out to assess the nature and magnitude of genetic variability available and associations between pod yield and its component characters in groundnut which would help to utilize them in the genetic improvement of the crop.

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MATERIALS AND METHODS

Forty five genotypes of groundnut were evaluated in randomized complete block design with 3 replications at Research Farm of SKNAU Jobner, Jaipur (Rajasthan) during *kharif* 2019. Each genotype was sown in a plot of 4.0 m x 0.80 m accommodating two rows spaced at 40 cm apart. A plant to plant distance of 15 cm was maintained. Five plants per genotype per replication were randomly selected for recording the observations at appropriate stages of crop growth on characters *viz.* pods per plant, dry pod yield per plant, shelling percentage, solid mature kernel, biological yield per plant, harvest index and kernel yield per plant. However, the observations on days to 50 per cent flowering, days to maturity and 100-kernel weight were recorded on plot basis. The data were subjected to analysis of variance (Panse and Sukhatme, 1985) to determine genotypic and phenotypic coefficients of variation (Burton and De vane, 1953), broad sense heritability (Hanson *et al.,* 1956) and 1955). The genotypic and phenotypic correlation coefficients were calculated as described by Singh and Choudhary (1985) and as per formula given by Johnson *et al*. (1955). Path analysis was done as suggested by Dewey and Lu (1959) to partition the correlation coefficients into the measures of direct and indirect effects.

RESULTS AND DISCUSSION

The results of the analysis of variance revealed significant differences among the genotypes of groundnut for all the ten characters indicating the existence of variability among the groundnut genotypes, which is basic requirement to bring about the genetic enhancement in a crop. The estimates of phenotypic coefficients of variation (PCV) were found to be higher than estimates of genotypic coefficients of variation (GCV) for all the ten characters which showed that the apparent variation is not only due to genotypes but also due to the influence of environment. Similar results were reported earlier by Korat *et al*. (2009) and Ladole *et al.* (2009). Highest PCV was observed for kernel yield per plant followed by biological yield per plant, dry pod yield per plant, pods per plant, 100-kernel weight and harvest index. Similar results were also reported for most of the characters by Vekariya *et al.* (2011), for dry pod yield and kernel yield by Rao *et al*. (2015). Highest GCV was observed for biological yield per plant followed by kernel yield per plant, dry pod yield per plant, pods per plant, 100-kernel weight and harvest index. Similar results for kernel yield per plant, harvest index and biological yield per plant in groundnut have been reported by Chavadhari *et al.* (2017) and for dry pod yield (kg/ha) by Nagaveni and Hasan (2019). Heritability is a good index of the transmission of characters from parents to their offspring. The estimates of heritability help the plant breeder to know which character is expected to respond more to selection pressure and in prediction of response to selection. If heritability is high for a character, breeders can go for individual (or mass) selection whereas in case of characters of lower heritability pedigree, sib or progeny test can be employed. Perusal of Table 1 indicated that the heritability was high for biological yield per plant followed by pods per plant, 100-kernel weight, dry pod yield per plant, kernel yield per plant, days to maturity, solid mature kernel and days to 50% flowering. Similar results were reported for number of kernels per pod, 100-kernel weight, days to maturity and pod yield per plant by Korat *et al*. (2009), for biological yield per plant by Bhargavi *et al.* (2016). The highest genetic advance expressed as percentage of mean was observed for biological yield per plant followed by kernel yield per plant, dry pod yield per plant, pods per plant and 100-kernel weight. The characters *viz.,* solid mature kernel, days to 50% flowering and harvest index showed moderate genetic advance. Similar findings have been reported in groundnut by Zaman *et al.* (2011) and Kadam *et al.* (2018). In the present investigation, high genetic advance as a percentage of mean along with high heritability and GCV was observed for biological yield per plant, kernel yield per plant, 100-kernel weight, pods per plant and dry pod yield per plant. This indicated the existence of lesser environmental influence and prevalence of additive gene action in their expression and these traits possessed high selective value. These characters could be further improved through

Table 1: Estimates of parameters of variability for different traits in groundnut.

Characters	Range	Mean	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (%)	GA as percentage of mean
Days to 50% flowering	21.00-30.33	25.91	7.48	9.23	65.65	12.48
Days to maturity	109.00-130.00	117.27	4.25	4.78	78.97	7.78
Pods per plant	10.00-40.00	19.77	32.55	34.76	87.68	62.78
Dry pod yield per plant (g)	9.00-35.00	17.01	33.80	36.60	85.25	64.28
Shelling (%)	59.00-73.67	65.84	4.44	7.48	35.26	5.48
Solid mature kernel (%)	67.00-95.00	84.41	7.75	9.25	70.20	13.38
100- kernel weight (g)	37.53-72.06	51.78	16.47	17.60	87.62	31.76
Biological yield per plant (g)	25.06-95.00	50.48	35.58	36.71	93.92	71.02
Harvest index (%)	23.96-40.00	34.08	9.21	15.48	35.40	11.29
Kernel yield per plant (g)	5.87-23.45	11.23	34.93	38.03	84.34	66.08

Table 2: Genotypic and phenotypic correlation coefficients between different characters in groundnut.

Characters		Days to 50% flowering	Days to maturity	Pods per plant	Shelling (%)	Solid mature kernel (%)	100-kernel weight (g)	Biological yield per plant (g)	Harvest index (%)	Kernel yield per plant (g)	Dry pod yield per plant (g)
Days to 50% flowering	r_g	1	0.998**	-0.142	-0.381**	-0.200*	0.132	-0.103	0.056	-0.193*	-0.133
	r_p	1	0.804**	0.120	-0.130	-0.159	0.115	-0.090	-0.004	-0.152	-0.129
Days to maturity	r_g		1	-0.151	-0.387**	-0.115	0.105	-0.087	-0.040	-0.191*	-0.148
	r_p		1	-0.100	-0.102	-0.125	0.089	-0.070	-0.057	-0.153	-0.117
Pods per plant	r_g			1	0.206*	-0.124	-0.007	0.953**	0.027	0.994**	0.998**
	r_p			1	0.105	-0.117	0.003	0.863**	-0.004	0.885**	0.908**
Shelling (%)	r_g				1	0.336**	-0.160	0.016	0.530**	0.409**	0.226**
	r_p				1	0.165	-0.089	-0.010	0.164	0.209*	0.083
Solid mature kernel (%)	r_g					1	-0.145	-0.188*	0.267**	-0.068	-0.108
	r_p					1	-0.100	-0.161	0.190*	-0.074	-0.109
100-kernel weight (g)	r_g						1	0.159	-0.409**	-0.009	0.020
	r_p						1	0.148	-0.239**	-0.006	0.001
Biological yield per plant (g)	r_g							1	-0.435**	0.919**	0.947**
	r_p							1	-0.236**	0.827**	0.875**
Harvest index (%)	r_g								1	0.110	0.028
	r_p								1	0.074	0.058
Kernel yield per plant (g)	r_g									1	0.997**
	r_p									1	0.870**

*Significant at P = 0.05 and **Significant at P = 0.01.

Table 3: Estimates of direct and indirect effects of different traits on pod yield in groundnut.

Characters		Days to 50% flowering	Days to maturity	Pods per plant	Shelling (%)	Solid mature kernel (%)	100-kernel weight (g)	Biological yield per plant (g)	Harvest index (%)	Kernel yield per plant (g)	Correlation with dry pod yield/plant (g)
Days to 50% flowering	G	**0.0071**	-0.0321	-0.0879	0.0222	0.0025	0.0058	-0.0334	0.0102	-0.0222	-0.133
	P	**-0.0185**	-0.0025	-0.0464	0.0004	0.0021	-0.0038	-0.0452	-0.0006	-0.0147	-0.129
Days to maturity	G	0.0076	**-0.0302**	-0.0937	0.0225	-0.0014	0.0046	-0.0282	-0.0073	-0.0219	-0.148
	P	-0.0149	**-0.0031**	-0.0387	0.0003	0.0016	-0.003	-0.0354	-0.0095	-0.0148	-0.117
Pods per plant	G	-0.0010	0.0045	**0.6191**	-0.0120	-0.0015	-0.0003	0.3105	0.0049	0.1190	0.998**
	P	0.0022	0.0003	**0.3854**	-0.0004	0.0015	-0.0001	0.4332	-0.0007	0.0860	0.908**
Shelling (%)	G	-0.0027	0.0117	0.1278	**-0.0583**	0.0042	-0.0071	0.0051	0.0979	0.0470	0.226**
	P	0.0024	0.0003	0.0406	**-0.0033**	-0.0022	0.0029	-0.005	0.0273	0.0203	0.083
Solid mature kernel (%)	G	-0.0014	0.0034	-0.0765	-0.0195	**0.0124**	-0.0064	-0.0612	0.0492	-0.0078	-0.108
	P	0.0029	0.0003	-0.0452	-0.0006	**-0.0136**	0.0033	-0.0809	0.0316	-0.0072	-0.109
100-kernel weight (g)	G	0.0009	-0.0031	-0.0045	0.0093	-0.0018	**0.0444**	0.0517	-0.0756	-0.0010	0.020
	P	-0.0021	-0.0003	0.0013	0.0003	0.0013	**-0.0333**	0.0742	-0.0399	-0.0006	0.001
Biological yield per plant (g)	G	-0.0007	0.0026	0.5898	-0.0009	-0.0023	0.0070	**0.3259**	-0.0804	0.1056	0.947**
	P	0.0016	0.0002	0.3325	0.0001	0.0021	-0.0049	**0.5022**	-0.0393	0.0803	0.875**
Harvest index (%)	G	0.0004	0.0012	0.0165	-0.0309	0.0033	-0.0182	-0.1419	**0.1847**	0.0126	0.028
	P	0.0001	0.0001	-0.0016	-0.0006	-0.0026	0.0079	-0.1187	**0.1664**	0.0071	0.058
Kernel yield per plant (g)	G	-0.0013	0.0057	0.6411	-0.0238	-0.0008	-0.0003	0.2995	0.0203	**0.1149**	0.997**
	P	0.0028	0.0004	0.3411	-0.0007	0.001	0.0001	0.4151	0.0122	**0.0972**	0.870**

Residual effect (G) = 0.07099, Residual effect (P) = 0.11255 **Significant at P = 0.01, Diagonal values (Bold): Direct effects.
Where G=Genotypic level, P=Phenotypic level.

individual plant selection. Bhargavi *et al.* (2016) and Tirkey *et al.* (2018) reported similar findings in groundnut.

Association analysis

The genotypic correlation coefficients were generally higher than the respective phenotypic correlation coefficients indicating the preponderance of genetic variance on expression of characters (Table 2). Dry pod yield per plant had positive and significant correlation with pods per plant, biological yield per plant and kernel yield per plant at genotypic as well as phenotypic levels and shelling percentage at genotypic level only. These characters can be considered as criteria for selection for higher yield as these were mutually and directly associated with dry pod yield. Days to 50 per cent flowering showed significant and positive correlation with days to maturity at both the levels. Pods per plant also had significant and positive correlation with biological yield per plant and kernel yield per plant at both the levels. Shelling percentage had significant and positive correlation with kernel yield per plant. Similarly solid mature kernel also showed significant and positive correlation with harvest index. Biological yield per plant also exhibited significant and positive correlation with kernel yield per plant. Similar results were reported by Channayya *et al.* (2011), Vekariya *et al*. (2011), Babariya and Dobariya (2012), Prabhu *et al*. (2015), Reddy *et al*. (2017) and Tirkey *et al*. (2018) and Mitra *et al*. (2021).

Path coefficient analysis

Path coefficient analysis was carried out at both genotypic and phenotypic levels by taking dry pod yield per plant as dependent variable and all the remaining characters as independent variables (Table 3). Direct effects at genotypic level were stronger than the phenotypic level. Pods per plant followed by biological yield per plant, harvest index and kernel yield per plant established high positive direct effects on dry pod yield per plant. These traits were also correlated positively with dry pod yield. Therefore, direct selection for these characters will be effective in improving dry pod yield in groundnut. The information could be utilized in formulating a sound selection criterion in groundnut breeding programme for genetic improvement to develop high yielding genotypes. Similar results were also reported by Mane *et al.* (2008). Meta and Monpara (2010) also observed that pods per plant and kernel yield per plant were important component traits of pod yield. Shelling percentage had negative direct effect but its positive correlation resulted due to indirect effect *via* pods per plant followed by harvest index, kernel yield per plant, days to maturity and biological yield per plant. 100-kernel weight was a character exhibiting positive correlation; its direct effect was positive at genotypic level but negative at phenotypic level. The positive correlation in this character at phenotypic level was due to high indirect positive effect *via* biological yield per plant, pods per plant and solid mature kernel.

CONCLUSION

The present investigation revealed highly significant differences among the genotypes of groundnut for all the traits studied. Based upon the genotypic coefficient of variation, phenotypic coefficient of variation, heritability, genetic advance as percentage of mean, character association and path analysis, it was concluded that pods per plant, kernel yield per plant and biological yield per plant were most important yield contributing components and should be included in selection criteria for future breeding programme in groundnut. Overall appraisal of the mean performance revealed that the genotypes RG 604, RG 584, RG 644, DGR 7 and RRCG 95195 were found superior with reference to dry pod yield per plant and one or more yield contributing characters.

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