Original Research Article

ASSESSMENT OF GENETIC VARIABILITYIN GROUNDNUT (*Arachishypogaea* L.)

Abstract

The present study was carried out with thirty advanced breeding lines of groundnut for estimation of geneticvariability, heritability and genetic advance. Analysis of variance revealed highly significant differences among genotypes for all the studied charactersindicating that there is substantial variability among the genotypes for these traits. High estimates ofGCV and PCV was observed for pod yield per plant, kernel yield per plant, dry haulm yield per plantand number of mature pods per plant. High heritability coupled with high genetic advance as per cent of mean were recorded for number of mature pods per plant, pod yield per plant,kernel yield per plant, dry haulm yield per plant, number of immature pods per plant, plant height, harvest index and hundred kernel weight indicating the preponderance of additive gene action in expression of these traits and hence simple phenotypic selection would be effective for improvement of these characters.

Keywords: Groundnut, Genetic variability, Heritability, Genetic advance

Introduction

“Groundnut (*Arachishypogaea* L.) is an allotetraploid, self-pollinating species within the *Fabaceae* family, characterized by a chromosome number of 2n = 4x = 40. It is a major oilseed crop and grain legume, cultivated annually in tropical and subtropical regions worldwide. Native to South America, it is known by various regional names, including wonder legume, peanut, earthnut, goober peas, monkey nut, and manila nut.It is a source of high-quality edible oil (44-56%), protein (22-30%) on a dry seed basis, carbohydrates (10-25%), vitamins (E, K, and B complex), minerals (Ca, P, Mg, Zn and Fe) and fiber” (Hampannavar*et al*. 2018). “India is the world's second-largest producer of groundnut with a yield of 101 lakh tonnes and a productivity of 1863 kg per hectare in 2021-22 (agricoop.nic.in). In Andhra Pradesh, groundnut is grown over 5.94 lakh hectares with production of 6 lakh tonnes and productivity of 1011 kg per hectare" (Directorate of Economics and Statistics, Govt. of A.P, India, 2022-2023).

"Being a highly self-pollinated crop, it has narrow genetic base ending up in the need for creation of more variability in segregating population. Genetic variability is a necessary component of any breeding programme as this provides wider chances for selection. Thus, effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability exist in the material and also to the extent which it is heritable" (Meghala et al., 2019).

"Heritability and genetic advance areuseful biometric tools that breeders can use to assess the degree and direction of selection" (Zaman *et al.* 2011). "Broad sense heritability is the ratio of genotypic variance to the phenotypic variance which is heritable. It serves as a good indicator regarding the transmission of characters from their parents to offsprings. Genetic advance under selection provides an idea about genetic gain in the trait for the selection of best individual genotypes from the source population. High heritability alone is insufficient for effective selection in advanced generationswithout significant genetic advance. Both heritability and genetic advance as per cent of the mean gives a very good indication of the nature of inheritance and effectiveness of selection for specific characters" (Hampannavar et al. 2018).

The present study was undertaken with thirty advanced breeding lines aimed for the estimation of diverse genetic parameters such as GCV, PCV, heritability and genetic advance as percent of mean for yield and quality traits in groundnut.

MATERIALS AND METHODS

An experiment comprising 30 advanced breeding lines of groundnut was sown at the farm of Agricultural Research Station, Kadiri during *Rabi* season (December to April), 2023-2024.The seed material used for the study was from ARS, Kadiri of ANGRAU.These genotypes were sown in a Randomized Block Design (RBD) with three replications. In each replication, every genotype was sown in continuous three row plots of 3 m length with a spacing of 30 cm between the rows and 10 cm between the plants within the row.Recommended package of practices was followed for raising the crop. Supplementary irrigation was given as and when required to protect the crop.Observations were recorded on yield and yield attributing traits namely, days to first flowering, days to 50 % flowering, days to maturity, plant height, number of mature pods per plant, number of immature pods per plant, dry haulm yield per plant (g), pod yield per plant (g), kernel yield per plant (g), shelling per cent, hundred kernel weight (g), sound mature kernel (%), harvest index (%), oil content (%) and protein content (%).Observations were recorded for all the genotypes separately on randomly chosen five competitive plants in each genotype in each replication for all the characters except for days to first flowering, days to 50% flowering and days to maturitywhich were recorded on plot basis.

The data collected was subjected to standard statistical analysis *viz.*, analysis of variance and magnitude of genetic variability were performed following the standard procedures, phenotypic and genotypic coefficient of variation as suggested by Burton (1952), heritability in broad sense and genetic advance was estimated as recommended by Lush (1940) and Johnson *et al.*(1955) respectively. Table 2 indicated the categorization of various genetic parameters.

Results and discussion

The analysis of variance carried out among fifteen yield and yield attributing traits revealed significant differences among the genotypes for all the characters studied, indicating the presence of ample amount of variability among the advanced breeding lines (Table 1). The mean, range, coefficients of genotypic and phenotypic variation, heritability and genetic advance of all the traits are given in the Table 3. The component of variance revealed phenotypic coefficient of variation (PCV) was found to be greater than genotypic coefficient of variation (GCV) indicating the effect of environment on the expression of these traits.Similar findings were reported by Gali*et al.* (2021) and Mitra *et al.* (2021).

“High estimates of GCV and PCV values were observed for pod yield per plant, kernel yield per plant, number of mature pods per plantand dry haulm yield per plantindicating ample amount of variation among the genotypes and hence, individual plant selection can be effective for improving the aforementioned traits for achieving higher yields. High estimates of GCV and PCV have been also reported for pod yield per plant, kernel yield per plant and number of mature pods per plant” byMeghala*et al.* (2019), Pappammal*et al.* (2020) and Gali*et al.* (2021); for dry haulm yield per plant by Hampannavar*et al.* (2018) and Nagaveni and Hasan Khan (2019).

In the present study, moderate values of GCV and PCV was exhibited by number of immature pods per plant,harvest index, hundred kernel weight and plant height. Similar findings were made by Patil *et al.*(2014) and Ashutosh *et al.* (2017).

“Lowestimates of GCV and PCV was observed for protein content, shelling per cent, days to maturity, oil content, days to first flowering, days to 50% flowering and sound mature kernel indicating the existence of less variability among the genotypes evaluated and limited scope of selection for these traits.Similar results have also been reported for days to 50% flowering and days to maturity” by Meghala*et al*. (2019) and Suthar *et al.* (2023); for oil content and protein content by Kumar *et al.* (2019) and Kumari and Sasidharan (2020); and for sound mature kernel per cent and shelling per cent by Hampannavar*et al.* (2018) and Kulheri*et al.* (2022).

“High estimates of heritability was observed for number of mature pods per plant followed by pod yield per plant,kernel yield per plant, dry haulm yield per plant, number of immature pods per plant, plant height, harvest index, hundred kernel weight, days to maturity, sound mature kernel per cent and protein content revealing that these characters are least influenced by the environmental effects. Moderate heritability was registered for days to first flowering and oil content. Low heritability was exhibited by shelling percent and days to 50% flowering which revealed that these characters are highly influenced by environmental effects and genetic improvement through selection will be difficult due to masking effects of the environment on the genotypic effects.Moderate genetic advance was recorded for harvest index where as all the other traits recorded low genetic advance” (Hampannavar et al., 2018).

“High genetic advance as per cent of mean was observed for pod yield per plant, kernel yield per plant,number of mature pods per plant, dry haulm yield per plant,number of immature pods per plant, harvest index, plant height and hundred kernel weight indicating that these traits were governed by additive gene action and direct selection will be rewarding for improvement of these characters.Protein content recorded moderate genetic advance as per cent of mean. Days to maturity, days to first flowering, shelling percent, oil content, sound mature kernel per cent and days to first flowering exhibited low genetic advance as per cent of mean indicating that these characters are governed by non-additive gene action and hence, heterosis breeding may be useful” (Meghala et al., 2019).

“High heritability coupled with high genetic advance as per cent of mean were recorded for number of mature pods per plant, pod yield per plantkernel yield per plant, dry haulm yield per plant, number of immature pods per plant, plant height, harvest index and hundred kernel weight indicating the preponderance of additive gene action in expression of these traits and selection would be effective for improvement of these characters.Similar results were reported by Shrotri *et al.* (2021) and Kulheri*et al.* (2022) for pod yield per plant, kernel yield per plant and hundred kernel weight; Hampannavar*et al.* (2018) and Gali *et al.* (2021) for number of mature and immature pods per plant; Mahesh *et al.* (2018) for plant height and dry haulm yield per plantand Suthar *et al.* (2023) for harvest index.

High heritability along with moderate genetic advance as per cent of mean was exhibited by the character protein content. Similar findings were reported by Gali *et al.* (2021) and Veer and Kumar (2021).Days to maturity and sound mature kernel recorded high heritability coupled with low genetic advance as per cent of mean which indicated the presence of non- additive gene action.Similar findings were also revealed by Gali *et al.* (2021) and Yadav *et al.* (2023) for days to maturity and Hampannavar*et al.* (2018)and Kulheri*et al.* (2022) for sound mature kernel.

Moderate heritability and low genetic advance as percent of mean were registered for the characters oil content and days to first flowering indicates that these characters were highly influenced by environment in the expression of these traits and genetic advance can help to predict the extent of genetic improvement that can be achieved for the traits. Similar results were made by Kumar *et al.* (2019) and Suthar *et al.* (2023) for oil content.Low heritability and low genetic advance as percent of mean was exhibited by shelling percent and days to 50% flowering which indicates that environment is playing significant role in expression of these traits and selection would be ineffective.Similar results were reported by Meghala*et al.* (2019) and Kulheri*et al.* (2022) for shelling percent.

Conclusion

Based on the results, it can be concluded that phenotypic selection would be more effective for improvement of traits such as pod yield per plant, kernel yield per plant, dry haulm yield per plantand number of mature pods per plant, as these characteristics exhibited high genotypic and phenotypic coefficients of variation (GCV and PCV).High heritability coupled with high genetic advance as per cent of mean was recorded for number of mature pods per plant, pod yield per plant, kernel yield per plant, dry haulm yield per plant, number of immature pods per plant, plant height, harvest index and hundred kernel weight indicating prevalence of additive gene action in their expression displays that selection through these traits would be worthwhile.

Table 1. Analysis of variance for pod yield and yield attributing traits in 30 advanced breeding lines of groundnut

S.No.	Character	Mean Sum of Squares (MSS)		
		Replications (df:2)	Genotypes (df:29)	Error (df:58)
1.	Days to first flowering	0.43	4.53**	0.82
2.	Days to 50% flowering	7.08	10.60**	4.99
3.	Days to maturity	27.10	100.06**	14.80
4.	Plant height	6.78	38.66**	3.40
5.	No. of mature pods per plant	3.51	34.73**	1.23
6.	No. of immature pods per plant	0.60	2.72**	0.19
7.	Dry haulm yield per plant	8.39	61.89**	2.71
8.	Pod yield per plant	6.78	54.06**	2.23
9.	Kernel yield per plant	2.75	22.20**	0.95
10.	Shelling per cent	41.88	59.00**	26.90
11.	Hundred kernel weight	22.39	86.86**	11.22
12.	Sound mature kernel (%)	7.37	23.67**	3.70
13.	Harvest index	36.37	110.10**	11.93
14.	Oil content	18.53	21.33**	9.22
15.	Protein content	5.04	11.00**	1.91

**Significant at 1% level

Table 2. Categorization of genetic parameters

Estimates	GCV and PCV (%)	Heritability (broad sense) (%)	Genetic advance (%)
Low	Less than 10	Less than 30	Less than 10
Medium	10 to 20	30 to 60	10 to 20
High	More than 20	More than 60	More than 20

Table 3. Estimates of genetic parameters for pod yield and yield attributes in advanced breeding lines of groundnut

S.No	Character	Mean	Range		Variance		Coefficient of variation		Heritability (Broadsense)	Genetic advance (GA)	Genetic advance as per cent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to first flowering	30.57	28.67	32.67	1.24	2.06	3.64	4.70	60.00	1.77	5.80
2.	Days to 50 % flowering	40.24	37.33	43.67	1.87	6.86	3.40	6.51	27.28	1.47	3.66
3.	Days to maturity	120.50	107.00	130.67	28.42	43.22	4.42	5.46	65.76	8.91	7.39
4.	Plant height	28.64	21.77	35.90	11.75	15.16	11.97	13.59	77.55	6.22	21.72
5.	No. of mature pods per plant	13.87	9.40	24.40	11.17	12.40	24.09	25.39	90.05	6.53	47.10
6.	No. of immature pods per plant	5.43	2.87	7.47	0.84	1.04	16.90	18.74	81.28	1.71	31.39
7.	Dry haulm yield per plant	20.04	12.87	29.12	19.73	22.44	22.17	23.64	87.93	8.58	42.82
8.	Pod yield per plant	15.72	8.89	27.50	17.28	19.51	26.44	28.09	88.57	8.06	51.25
9.	Kernel yield per plant	10.21	5.81	16.04	7.08	8.03	26.08	27.77	88.20	5.15	50.45
10.	Shelling percent (%)	69.18	59.47	76.00	10.70	37.60	4.73	8.86	28.46	3.60	5.20
11.	Hundred Kernel Weight	41.56	31.10	51.17	25.22	36.43	12.08	14.52	69.21	8.61	20.71
12.	Sound Mature Kernel (%)	86.88	80.67	92.66	6.66	10.36	2.97	3.70	64.27	4.26	4.90
13.	Harvest index	39.94	31.15	58.57	32.72	44.65	14.32	16.73	73.28	10.09	25.26
14.	Oil content	46.56	42.03	53.18	4.04	13.26	4.32	7.82	30.45	2.28	4.91
15.	Protein content	26.08	22.71	29.13	3.03	4.94	6.67	8.52	61.28	2.81	10.76

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