Andhra Pradesh J Agril. Sci : 9(1): 16-21, 2023

ASSESSMENT OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE AMONG ADVANCED BREEDING LINES OF GROUNDNUT (*Arachis hypogea* L.)

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Date of Receipt: 23-11-2022 Date of Acceptance: 27-02-2023

ABSTRACT

A Field experiment with 30 advanced breeding lines of groundnut was carried out for assessment of genetic variance, heritability (broad sense) and genetic advance as per cent of mean for 17 metric traits. The analysis of variance revealed the existence of highly significant differences among the entries for all the characters studied. The phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV) for all the traits studied implying that these characters were highly influenced by the environmental effects. High PCV and GCV values (>20%) was recorded for Pod yield plant^{-1}, Kernel yield plant^{-1}, dry haulms yield plant^{-1} and number of mature pods plant^{-1}. High heritability (> 60%) coupled with high genetic advance as per cent of mean was registered for plant height, hundred pod weight, kernel yield plant^{-1}, dry haulms yield plant^{-1}, number of primary branches plant^{-1}, number of mature pods plant^{-1}, harvest index and pod yield plant^{-1} indicating that these characters were governed by additive gene effects and could be chosen as selection criteria for formulating breeding strategies in groundnut.

KEYWORDS: PCV, GCV, Heritability, Genetic Advance as per cent of mean, RBD.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a self-pollinated crop belongs to the botanical family Fabaceae of sub-family Papilionaceae, commonly known as the legume, bean, or pea family. Groundnut is rich in essential nutrients (USDA nutrient data, 2020). In 100-gram groundnuts provide 2,385 kilojoules (570 kilocalories) of food energy and are an excellent source (defined as more than 20% of the Daily Value, DV) of several B vitamins, vitamin E, and several dietary minerals.

In 2021, world production of groundnut (reported as peanuts in shells) was 49 MT. China had 16.6 million tonnes about 36 per cent of global production, followed by India (14%). Other significant producers were Nigeria, Sudan and the United States. In India the total cultivated area under groundnut is 60.9 lakh ha, production is 10.21 MT with productivity of 1676 kg ha^{-1}. In Andhra Pradesh, it is cultivated in an area of 8.69 lakh ha, production is 7.74 MT with productivity of 894 kg ha^{-1}. (Directorate of Economics and Statistics, 2021).

Growing demand for food security has spiked the need of genetic improvement of crop germplasm. Genetic variability being a best option for crop cultivar improvement has intensively used in the past (Jaganathan *et al*., 2020).

Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are useful in detecting the amount of variability present in the genotypes. Heritability estimates along with genetic advance are more helpful in predicting the gain under selection than heritability estimates alone.

MATERIAL AND METHODS

Thirty advanced breeding lines of groundnut were evaluated during *kharif*, 2021 in a Randomized Block Design (RBD), replicated thrice at Dry land farm, RARS, Tirupati. Each genotype was represented by three row plot of 5 m length with inter and intra-row spacing of 30 cm and 10 cm respectively. Standard crop husbandry practices and plant protection measures suggested for this crop were followed to raise a healthy crop. Data were recorded on five randomly selected competitive plants of each genotype replication^{-1} for 17 metric traits.

The pooled data were subjected to statistical analysis to test the homogeneity for error variance was applied by utilizing the Barlletts method (Panse and Sukhatme, 1961). Heritability (broad sense and narrow sense) was estimated by formula given by Allard (1960) and Lush (1940). Genetic advance as percent of mean can be classified according to proposed by Johnson *et al.*, (1955) as low (0-10%); moderate (10-20%) and

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high (20% and above). The phenotypic and genotypic coefficients of variation were computed by the following formulae given by Burton (1952). The data was analysed through software - Indostat 9.2 version.

RESULTS AND DISCUSSION

The analysis of variance for 17 metric traits in 30 groundnut genotypes (Table 1) revealed existence of ample genetic variation in the material studied. Phenotypic and genotypic coefficients of variation, heritability in broad sense, genetic advance and genetic advance as per cent of mean for 17 characters involving 30 advanced breeding lines of groundnut are presented in Table 2. For all the characters studied, phenotypic coefficient of variation was found to be greater than genotypic coefficient of variation indicating the effect of environment on these traits. These results are in accordance with the findings of Narasimhulu *et al*. (2012), John *et al.* (2013), Kamdi *et al.* (2017), Mahesh *et al.* (2018), Nagaveni and Hasan Khan (2019), Rao *et al.* (2019), Kumari and Sashidharan (2020), Gali *et al.* (2021) and Bharath *et al.* (2022).

The characters, Pod yield plant^{-1} (GCV: 40.10%; PCV: 41.23%), Kernel yield plant^{-1} (GCV: 38.12%; PCV: 39.68%), dry haulms yield plant^{-1}(GCV: 37.81%; PCV: 38.08%), number of mature pods plant^{-1} (GCV: 32.75%; PCV: 33.47%), number of primary branches plant^{-1} (GCV: 26.94%; PCV: 28.04%), harvest index (GCV: 21.93%; PCV: 22.54%) and plant height (GCV: 20.81%; PCV: 20.92%) exhibited high GCV and PCV. These results are in accordance with the findings of Hampannavar *et al*. (2018), Meghala *et al*. (2019), Venkataravana *et al.* (2020), Veer *et al.* (2021), Gali *et al*. (2021) and Mitra *et al.* (2021).

Moderate GCV and moderate PCV was exhibited by hundred pod weight (GCV: 17.31%; PCV: 17.41%) and hundred kernel weight (GCV: 13.67%; PCV: 14.43%)

Table 1. Analysis of variance for physiological, yield attributes and quality traits in advanced breeding lines of groundnut

S. No	Characters	Mean sum of squares		
		Replications (df : 2)	Genotypes (df : 29)	Error (df : 58)
1.	Days to 50% flowering	2.033	4.031**	0.860
2.	Days to maturity	1.88	4.132**	0.870
3.	SPAD chlorophyll meter reading at 45 DAS	1.027	7.263**	1.783
4.	Specific leaf area at 45 DAS (cm^2 g^{-1})	126.317	1166.803**	341.840
5.	Relative water content (%)	35.901	85.278**	26.113
6.	Harvest index (%)	5.047	306.989**	5.643
7.	Plant height (cm)	5.616	516.552**	1.821
8.	Number of primary branches plant^{-1}	0.525	10.726**	0.289
9.	Number of mature pods plant^{-1}	2.593	58.560**	0.847
10.	Hundred pod weight (g)	14.233	1486.055**	5.785
11.	Hundred kernel weight (g)	8.611	124.691**	4.599
12.	Shelling per cent	31.061	97.270**	10.061
13.	Kernel yield plant^{-1} (g)	6.437	76.746**	2.080
14.	Dry haulms yield plant^{-1} (g)	2.968	221.013**	1.034
15.	Pod yield plant^{-1}(g)	6.955	183.806**	3.450
16.	Oil content (%)	0.119	10.752**	0.077
17.	Protein content (%)	0.252	10.610**	0.084

** Significant at 1% level

Table 2. Estimates of genetic parameters for physiological, yield attributes and quality traits in advanced breeding lines of groundnut

S. No.	Character	Mean	Range		Variance		Coefficient of Variation		Heritability (Broad sense) (%)	Genetic advance (GA)	Genetic advance as per cent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	27.03	24.00	29.33	1.05	1.91	3.80	5.12	55.10	1.57	5.81
2.	Days to maturity	103.04	100.00	105.33	1.09	1.95	1.01	1.36	55.68	1.60	1.55
3.	SPAD chlorophyll meter reading at 45 DAS	40.31	36.00	42.73	1.82	3.61	3.35	4.71	50.59	1.98	4.91
4.	Specific leaf area at 45 DAS (cm^2 g^{-1})	169.93	140.43	237.90	274.98	616.83	9.75	14.61	44.58	22.80	13.42
5.	Relative water content (%)	56.38	49.89	72.87	19.72	45.83	7.87	12.00	43.03	6.00	10.64
6.	Harvest index (%)	45.68	26.06	65.69	100.44	106.09	21.93	22.54	94.68	20.08	43.97
7.	Plant height (cm)	62.92	33.11	89.67	171.57	173.39	20.81	20.92	98.95	26.84	42.65
8.	Number of primary branches $plant^{-1}$	6.92	5.00	12.40	3.47	3.76	26.94	28.04	92.31	3.69	53.32
9.	Number of mature pods $plant^{-1}$	13.38	6.53	23.87	19.23	20.08	32.75	33.47	95.78	8.84	66.04
10.	Hundred pod weight (g)	128.26	77.66	179.33	493.42	499.20	17.31	17.41	98.84	45.49	35.46
11.	Hundred kernel weight (g)	46.27	33.33	61.00	40.03	44.63	13.67	14.43	89.69	12.34	26.67
12.	Shelling per cent	68.38	52.44	79.78	29.06	39.13	7.88	9.14	74.29	9.57	13.99
13.	Kernel yield $plant^{-1}$ (g)	13.08	5.56	25.90	24.88	26.96	38.12	39.68	92.29	9.87	75.43
14.	Dry haulms yield $plant^{-1}$ (g)	22.64	12.40	45.47	73.32	74.36	37.81	38.08	98.61	17.51	77.35
15.	Pod yield $plant^{-1}$ (g)	19.33	7.73	35.77	60.11	63.56	40.10	41.23	94.57	15.53	80.33
16.	Oil content (%)	49.44	45.62	53.39	3.55	3.63	3.81	3.85	97.87	3.84	7.77
17.	Protein content (%)	25.31	21.28	28.48	3.50	3.59	7.40	7.48	97.65	3.81	15.06

suggesting that individual trait selection can be resorted for improvement of these traits. The similar results are also observed in the findings of Roy *et al.* (2018) and Mitra *et al.* (2019).

High heritability was recorded for plant height (98.95%), hundred pod weight (98.84%), dry haulms yield plant^{-1} (98.61%), oil content (97.87%), protein content (97.65%), number of mature pods plant^{-1} (95.78%), harvest index (94.68%), pod yield plant^{-1} (94.57%), number of primary branches plant^{-1} (92.31%), kernel yield plant^{-1} (92.29%), hundred kernel weight (89.69%) and shelling per cent (74.29%) indicating that the effect of environment is least in expression of these characters. The results are in conformity with findings of Veer *et al*. (2021).

Higher genetic advance as per cent of mean was recorded for pod yield plant^{-1} (80.33%), dry haulms yield plant^{-1} (77.35%), kernel yield plant^{-1} (75.43%), number of mature pods plant^{-1} (66.04%), number of primary branches plant^{-1} (53.32%), harvest index (43.97%), plant height (42.65%), hundred pod weight (35.46%) and hundred kernel weight (26.67%) indicating that these characters were governed by additive gene effect and the selection for these characters will be rewarding in crop improvement.

High heritability coupled with high genetic advance as per cent of mean for pod yield plant^{-1}, plant height, number of mature pods plant^{-1}, shelling per cent, harvest index, number of primary branches plant^{-1} and kernel yield plant^{-1} were also reported by Narasimhulu *et al.* (2012), Rao *et al*. (2014), Gupta *et al.* (2015), Vasanthi *et al.* (2015), Choudhary *et al.* (2016), Chavadhari *et al*. (2017), Yusuf *et al*. (2017), Mahesh *et al.* (2018), Nagaveni and Hasan khan (2019), Gali *et al*. (2021), Shuro (2021) and Bharath *et al.* (2022),

The characters, Pod yield plant^{-1}, Kernel yield plant^{-1}, dry haulms yield plant^{-1} and number of mature pods plant^{-1} exhibited high GCV and PCV indicating ample amount of variation among the genotypes and the selection would be effective for further improvement of these characters.

High heritability coupled with high genetic advance as per cent of mean were recorded for characters *viz.,* plant height, hundred pod weight, dry haulms yield plant^{-1}, number of mature pods plant^{-1}, harvest index, pod yield plant^{-1}, number of primary branches plant^{-1}, kernel yield plant^{-1} and hundred kernel weight indicating preponderance of additive gene action in expression of these characters and selection would be effective for improvement of these characters.

ACKNOWLEDGEMENT

The authors are highly thankful to Acharya N.G. Ranga Agricultural University (ANGRAU), Guntur, Andhra Pradesh, India for providing advanced breeding lines of groundnut to embellish this study.

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