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Studies on Genetic Variability for Yield, Yield Attributing Traits, Physiological and Quality Traits in Groundnut [*Arachis hypogaea* L.]

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A B S T R A C T

An experiment was carried out to estimate the genetic parameters such as variability, heritability and genetic advance, for yield, physiological and quality traits in 30 genotypes of groundnut. The genotypic coefficient of variation for all characters studies were less than the phenotypic coefficient of variation indicating the interaction of genotype with the environment. High heritability coupled with high genetic advance as per cent of mean was observed for specific leaf area at 45 DAS, plant height, number of primary branches per plant, number of mature pods per plant, number of secondary branches per plant, 100-pod weight, 100-kernel weight, total soluble sugars, sucrose content and total free amino acids indicating the preponderance of additive gene action in expression of these characters and selection would be effective for improvement of these characters. High heritability with moderate genetic advance as per cent of mean was exhibited by the characters sound mature kernel per cent and harvest index. Moderate heritability coupled with high genetic advance as per cent of mean was exhibited by the characters *viz.,* dry haulms yield per plant, pod yield per plant and kernel yield per plant suggesting that phenotypic selection can be used for improvement of these characters.

Introduction

The cultivated groundnut (*Arachis hypogaea* L.), is a self-pollinated, autotetraploid (2n = 4x = 40). It belongs to family Fabaceae, herbaceous legume. Groundnut is a native of South America (Brazil) and grown in over 100 countries, between 40^{o} N to 40^{o} S latitude in tropical warm climate. Groundnut is a king of vegetable oil seeds in India and occupies pre-eminent position in national edible oil economy. Groundnut in India is primarily used as an oilseed, it is also consumed directly as food because of its palatability. It contains 36-54 % of edible oil, 22-36% of easily digestible protein and 18 % of carbohydrates in its seeds. Apart from this, groundnut kernels contain many health enhancing nutrients such as minerals, antioxidants, vitamins and are rich in mono-unsaturated fatty acids. They also contain antioxidants like *p*-coumaric acid and resveratrol, vitamin E

and many important B-complex groups of thiamine, pantothenic acid, vitamin B-6, folates and niacin.

As groundnut is an important oilseed crop used for confectionary purpose, there is a need to improve the quality traits of groundnut. Value addition through quality enhancement will earn huge foreign exchange. Hence selection for quality traits in groundnut is necessary in breeding programmes.

Genetic variability is an essential prerequisite for crop improvement programme for obtaining high yielding varieties, through the estimation of different genetic parameters like components of variances, genotypic and phenotypic coefficient of variability, heritability and genetic advance. In genetic studies, characters with high genotypic coefficient of variation indicate the potential for an effective selection. Heritability and genetic advance is a useful tool for the plant breeders in determining the direction and magnitude of selection. Therefore, the present study was planned to estimate the genetic parameters for physiological, yield and quality traits in groundnut.

Materials and Methods

The present investigation was carried out during *kharif*, 2018 at Regional Agricultural Research Station, Tirupati. The experimental material comprised of 30 groundnut genotypes which were raised in Randomised Block Design, each entry being sown in three rows of 5 m length with a spacing of 30 × 10 cm. The data were recorded from five randomly selected plants in each of the genotype per replication for physiological, yield and quality traits. Days to 50 % flowering and days to maturity were recorded on plot basis. The mean values were used for analysis for variance. The statistical analysis for variance was worked out according to Panse and Sukhatme (1961). Phenotypic and genotypic coefficients of variation were calculated based on the method advocated by Burton (1952). Heritability and genetic advance as per cent of mean were estimated as per the formula given by Johnson *et al.*, (1955).

Results and Discussion

The analysis of variance showed significant differences among the genotypes for all the characters studied (Table 1) which gives the evidence of sufficient variability among the genotypes. Phenotypic coefficient of variation is greater than genotypic coefficient of variation indicating the effect of environment on these traits (Table 2).

The characters, number of primary branches per plant, number of secondary branches per plant, number of mature pods per plant, dry haulms yield per plant, sucrose content, total soluble sugars and total free amino acids exhibited high GCV and PCV indicating ample amount of variation among the genotypes and selection would be effective for further improvement of these characters.

Moderate GCV and high PCV was exhibited by plant height, kernel yield per plant, pod yield per plant. Moderate GCV and moderate PCV was exhibited by specific leaf area at 45 DAS, 100-pod weight and 100-kernel weight. Whereas, low GCV and moderate PCV was exhibited by harvest index.

The characters days to 50 % flowering, days to maturity, SPAD chlorophyll meter reading at 45 DAS, shelling per cent, sound mature kernel per cent, oil content and protein content recorded low values of GCV and PCV.

The heritability in broad sense ranged from 33.5 % (shelling per cent) to 96.8 % (sound mature kernel per cent). High heritability coupled with high genetic advance as per cent

of mean were recorded for the characters *viz.*, specific leaf area at 45 DAS, plant height, number of primary branches per plant, number of mature pods per plant, number of secondary branches per plant, 100-pod weight, 100-kernel weight, total soluble sugars, sucrose content and total free amino acids indicating the preponderance of additive gene action in expression of these characters and selection would be effective for improvement of these characters.

High heritability with moderate genetic advance as per cent of mean was exhibited by the characters sound mature kernel per cent and harvest index. The characters *viz.*, days to 50 % flowering, oil content and protein content recorded high heritability coupled with low genetic advance as per cent of mean.

Moderate heritability coupled with high genetic advance as per cent of mean was exhibited by the characters *viz.*, dry haulms yield per plant, pod yield per plant and kernel yield per plant suggesting that pedigree method of breeding and phenotypic selection can be used for improvement of these characters. Moderate heritability and low genetic advance as per cent of mean were recorded for the characters days to maturity, SPAD chlorophyll meter reading at 45 DAS, shelling per cent.

The results of analysis of variance were in accordance with the results obtained by Nath and Alam (2002), Narasimhulu *et al.*, (2012), John *et al.*, (2013), Kamdi *et al.*, (2017) and Mahesh *et al.*, (2018).

The results of Mahesh *et al.*, (2018), Kamdi *et al.*, (2017), Bhargavi *et al.*, (2017) and Gupta *et al.*, (2015) were similar to the present report of high GCV and PCV for number of primary branches per plant, number of mature pods per plant and dry haulms yield per plant. High estimates of GCV for total soluble sugars and sucrose content was also reported by Rathod and Toprope (2017). High GCV and PCV for number of secondary branches per plant was in accordance with the results obtained by Korat *et al.*, (2009).

Earlier, Chavadhari *et al.*, (2017) and Yusuf *et al.*, (2017) have reported moderate values of GCV and PCV for plant height. Moderate to high variability for pod yield per plant was reported by John *et al.*, (2013), Omprakash and Nadaf (2017). Moderate variability for 100-kernel weight and 100-pod weight was similar to the reports of Korat *et al.*, (2010) and Mahesh *et al.*, (2018).

Lower estimates of GCV and PCV for days to 50 % flowering was in accordance with the results of Vasanthi *et al.*, (2015), Chavadhari *et al.*, (2017) and Mahesh *et al.*, (2018). Chavadhari *et al.*, (2017) also reported low estimates of GCV and PCV for days to maturity. In the present study shelling per cent, protein content and oil content were showed low estimates of GCV and PCV. These results were conformity with the findings of Vasanthi *et al.*, (2015), Omprakash and Nadaf (2017) and Mahesh *et al.*, (2018). The low variability estimates recorded for SPAD chlorophyll meter reading at 45 DAS and sound mature kernel per cent were conformity with the findings of John *et al.*, (2009) and Bhargavi *et al.*, (2017).

High heritability coupled with high genetic advance as per cent of mean for number of mature pods per plant was also reported by Shashikumara *et al.*, (2016), Bhargavi *et al.*, (2016), Chavadhari *et al.*, (2017) and Mahesh *et al.*, (2018). High heritability coupled with high genetic advance as per cent of mean for plant height was reported by Mahesh *et al.*, (2018), Patil *et al.*, (2014) and Nath and Alam (2002). Mahesh *et al.*, (2018) and Vasanthi *et al.*, (2015) reported similar kind of results for number of primary branches per plant.

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

S. No	Character	Mean sum of squares		
		Replications (df:2)	Treatments (df:29)	Error (df:58)
1	Days to 50 % flowering	4.8111*	10.728**	1.029
2	Days to maturity	0.177	3.832**	0.729
3	SPAD chlorophyll meter reading at 45 DAS	124.57**	17.365**	5.853
4	Specific leaf area at 45 DAS (cm^2 g^{-1})	29.219	2387.473**	51.717
5	Plant height (cm)	7.703	77.38**	12.881
6	Number of primary branches per plant	0.689	4.466**	0.284
7	Number of secondary branches per plant	0.024	3.876**	0.047
8	Number of mature pods per plant	2.884	66.146**	7.023
9	Hundred pod weight (g)	14.092	622.716**	13.146
10	Hundred kernel weight (g)	6.544	149.44**	3.078
11	Shelling per cent	17.04	34.312**	13.666
12	Sound mature kernel per cent	2.011	68.9**	0.756
13	Dry haulms yield per plant (g)	3.748	116.168**	23.331
14	Harvest index (%)	36.7	94.351**	16.339
15	Kernel yield per plant (g)	4.426	28.96**	6.59
16	Oil content (%)	0.08	0.72**	0.07
17	Protein content (%)	1.77**	0.70**	0.12
18	Sucrose content (g $100g^{-1}$)	0.03	3.37**	0.06
19	Total soluble sugars (%)	0.11	33.56**	0.18
20	Total free amino acids (µg g^{-1})	0.01	0.13**	0.01
21	Pod yield per plant (g)	8.54	40.94**	11.20

*, ** significance at 5 % and 1 % level of probability, respectively.

Table.2 Mean, range, coefficient of variation, heritability (broad sense) and genetic advance as per cent of mean for physiological, yield, its attributes and quality traits in 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	33.47	28.66	36.33	3.23	4.26	5.37	6.16	75.8	3.22	9.63
2	Days to maturity	110.95	108.33	112.66	1.03	1.76	0.91	1.19	58.6	1.6	1.44
3	SPAD chlorophyll meter reading at 45 DAS	44.71	40	49.33	3.83	9.69	4.38	6.96	39.6	2.53	5.67
4	Specific leaf area at 45 DAS (cm^2 g^{-1})	232.37	191.18	285.26	778.58	830.3	12.01	12.4	93.8	55.66	23.96
5	Plant height (cm)	26.44	17.13	37.4	21.5	34.38	17.53	22.17	62.5	7.55	28.56
6	Number of primary branches per plant	5.01	3	7.16	1.39	1.67	23.52	25.81	83.1	2.21	44.17
7	Number of secondary branches per plant	2.19	0.4	4.63	1.27	1.32	51.56	52.5	96.4	2.28	104.29
8	Number of mature pods per plant	18.73	12.06	28.6	19.7	26.73	23.69	27.59	73.7	7.85	41.91
9	Hundred pod weight (g)	99.21	73.62	129.4	203.19	216.33	14.36	14.82	93.9	28.45	28.68
10	Hundred kernel weight (g)	40.32	31.2	58.06	48.78	51.86	17.32	17.86	94.1	13.95	34.6
11	Shelling per cent	66.56	60.33	71.86	6.88	20.54	3.94	6.81	33.5	3.12	4.69
12	Sound mature kernel per cent	86.71	76.31	96.77	22.71	23.47	5.49	5.58	96.8	9.65	11.13
13	Dry haulm yield per plant (g)	25.73	17.06	43.26	30.94	54.27	21.61	28.62	57	8.65	33.62
14	Harvest index (%)	48.55	40.14	59.2	26	42.34	10.5	13.4	61.4	8.23	16.95
15	Kernel yield per plant (g)	14.26	9.4	22.13	7.45	14.05	19.14	26.28	53.1	4.09	28.72
16	Oil content (%)	47.48	46.6	48.3	0.21	0.29	0.97	1.13	74.1	0.82	1.73
17	Protein content (%)	25.32	24.6	26.35	0.19	0.31	1.74	2.21	61.5	0.71	2.81
18	Sucrose content (g $100g^{-1}$)	2.38	0.75	4.44	1.1	1.17	44.05	45.4	94.1	2.09	88.03
19	Total soluble sugars (%)	10.18	3.82	15.1	11.12	11.31	32.76	33.02	98.4	6.81	66.94
20	Total free amino acids (µg g^{-1})	0.77	0.4	1.58	0.04	0.05	25.89	29.23	78.5	0.36	47.24
21	Pod yield per plant (g)	21.44	15.86	29.13	9.91	21.11	14.68	21.43	47	4.44	20.73

High heritability coupled with high genetic advance as per cent of mean for 100-kernel weight were also reported by Mahalakshmi *et al.,* (2005), John *et al.,* (2009), Patil *et al.,* (2014), Rao *et al.,* (2014), Gupta *et al.,* (2015), Vasanthi *et al.,* (2015), Bhargavi *et al.,* (2017), Mahesh *et al.,* (2018) and Kakeeto *et al.,* (2019). High heritability coupled with high genetic advance as per cent of mean for 100-pod weight were also reported by Nath and Alam (2002), Gupta *et al.,* (2015), Chavadari *et al.,* (2017) and Kumar *et al.,* (2019). High heritability coupled with high genetic advance as per cent of mean for sucrose content and total soluble sugars were also reported by Rathod and Toprope (2018). Korat *et al.,* (2017) reported high heritability coupled with high genetic advance as per cent of mean for number of secondary branches per plant.

High heritability with moderate genetic advance as per cent of mean for sound mature kernel per cent and harvest index were also reported by Kumar *et al.,* (2019) and Shashikumara *et al.,* (2016) respectively. The characters *viz.,* days to 50 % flowering, oil content and protein content recorded high heritability coupled with low genetic advance as per cent of mean. Similar kind of results for days to 50 % flowering reported by Patil *et al.,* (2014). High heritability coupled with low genetic advance as per cent of mean for protein content and oil content reported by Bhargavi *et al.,* (2016), Gupta *et al.,* (2015) and Kumar *et al.,* (2019).

Moderate heritability coupled with high genetic advance as per cent of mean was also reported by Vasanthi *et al.,* (2015) and Kumar *et al.,* (2019) for pod yield per plant and kernel yield per plant. Kamdi *et al.,* (2017) reported similar kind of results for moderate heritability coupled with high genetic advance as per cent of mean for dry haulms yield per plant.

Moderate heritability and low genetic advance as per cent of mean for SPAD chlorophyll meter reading was in conformity with the findings of Srivalli and Nadaf (2016). Medium to high heritability coupled with low genetic advance as per cent of mean for days to maturity in the present study is similar to the reports of Korat *et al.,* (2009). The estimates recorded for shelling per cent was in conformity with the findings of Rao *et al.,* (2014).

High heritability was recorded for sound mature kernel per cent followed by number of secondary branches per plant. High heritability coupled with high genetic advance as per cent of mean was observed for specific leaf area at 45 DAS, plant height, number of primary branches per plant, number of mature pods per plant, number of secondary branches per plant, 100-pod weight, 100-kernel weight, total soluble sugars, sucrose content and total free amino acids. Moderate heritability coupled with high genetic advance as per cent of mean was exhibited by the characters *viz.,* dry haulms yield per plant, pod yield per plant and kernel yield per plant indicating the preponderance of additive gene action in expression of these characters and selection would be effective for improvement of these characters.

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