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STUDIES ON GENETIC VARIABILITY AND HERITABILITY FOR YIELD AND WATER USE EFFICIENT TRAITS IN GROUNDNUT (*Arachis hypogaea* L.) UNDER RAINFED CONDITIONS

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ABSTRACT

Fifty genotypes of groundnut were evaluated for their genetic variability, heritability and genetic advance for a set of 16 agronomic and physiological characters during *kharif,* 2014. Analysis of variance revealed presence of highly significant differences among the genotypes for all characters indicating sufficient variability in the material studied. High PCV and GCV were observed for dry matter per plant, number of sound mature kernels per plant, kernel yield per plant, pod yield per plant and number of primaries per plant. High heritability coupled with high genetic advance as per cent of mean was observed for dry matter per plant, number of sound mature kernels per plant, pod yield per plant, number of primaries per plant, number of pods per plant, SLA at 60 DAS, number of seeds per pod, shelling percentage and SLA at 80 DAS indicating that these traits were mainly governed by additive gene effects and response to selection could be effected for further improvement of pod yield and its attributes through simple selection.

KEYWORDS: Genetic advance, Groundnut, Heritability, Variability.

INTRODUCTION

Groundnut is one of the main oilseed and food legume crop of India. In India it is grown in 5.5 M ha with a production of 9.6 M t and productivity of 1750 kg ha^{-1} (Annual report, NRCG 2014). Drought is the most important factor limiting the yield potential of the genotypes under rainfed conditions. Crop physiologists have identified number of traits that would help the breeder in development and identification of moisture stress tolerant genotypes with high yield potential. Development of high yielding pure line cultivars coupled with water use efficiency traits is the major breeding objective of groundnut genetic improvement inorder to obtain high productivity under rainfed conditions.

There is a need to identify the groundnut genotypes possessing desirable yield and physiological attributes to drought tolerance under rainfed conditions. Heritability is an important parameter which determines the extent of expressivity of a trait in a set of environments or agro-climatic conditions. Therefore, heritability estimates are useful in predicting genetic advance under different intensities of selection. High heritability estimates together with high genetic advance are more valid for selection than heritability estimates alone (Johnson *et al.,* 1955). Hence, considering these aspects, genetic variability studies were initiated with diverse groundnut genotypes involving both Spanish bunch and Virginia bunch botanical types in the present investigation.

MATERIAL AND METHODS

The material for the present study comprised of 50 groundnut genotypes, grown in a Randomised block design with three replications at Sri Venkateswara Agricultural College dry land farm, Tirupati during *kharif,* 2014. Each genotype was sown in single row of 3 m length by adopting a spacing of 30 × 10 cm. Observations were recorded on randomly chosen ten competitive plants for fourteen characters viz., number of primary branches per plant, number of pods per plant, number of seeds per pod, number sound mature kernels per plant, dry matter per plant (g), pod yield per plant (g), kernel yield per plant (g), shelling per cent, Specific Leaf Area (SLA) at 60 Days After Sowing (DAS), SLA at 80 DAS, SPAD chlorophyll meter (SCMR) at 60 DAS, SCMR at 80 DAS, leaf nitrogen (%) content at 60 DAS and leaf nitrogen (%) content at 80 DAS. The characters viz., days to 50% flowering and days to maturity were recorded on per plot basis. Leaf nitrogen (%) content values were transformed using arc-sine transformation. Analysis of variance was

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carried out as per the method suggested by Panse and Sukhatme (1961). The phenotypic and genotypic co-efficient of variation (Burton, 1952), heritability in broad sense (Allard, 1960) and genetic advance as per cent of mean (Johnson *et al.,* 1955) were also computed as per the standard procedure.

RESULTS AND DISCUSSION

The success of any crop improvement programme essentially depends upon the nature and magnitude of the genetic variability present in the gene pool of the crop. The knowledge of nature and magnitude of genetic variability in the breeding population is of immense value for planning efficient breeding programme to improve the yield potential of genotypes under rainfed conditions as mild to severe moisture stress conditions would always co-exist in the crop environment. The analysis of variance for 16 characters in 50 genotypes revealed that the genotypes differed significantly for all the characters indicating the existence of sufficient variability in the material studied (Table 1). The estimates of genetic parameters for sixteen characters are furnished in Table 2. A wider range of mean variation was noted for specific leaf area at 60 days after sowing from 122.09 to 255.34 ($cm^2 g^{-1}$), whereas the range was found to be least for leaf nitrogen (%) content at 80 days after sowing (3.2 to 3.9). The highest magnitude of genotypic and phenotypic variance were observed for specific leaf area at 60 days after sowing while least estimates were recorded for leaf nitrogen (%) content at 80 days after sowing. The phenotypic co-efficient of variation was of high magnitude than the genotypic co-efficient of variation for all the characters indicating the influence of environment in the expression of these traits (Table 2). Similar kind of observations were reported by Korat *et al.* (2009), Prasanna Rajesh *et al.* (2012) which corroborated the findings of present study.

High magnitude of PCV and GCV of about 31.50 per cent and 30.92 per cent, respectively for dry matter per plant followed by number of sound mature kernels per plant (24.76 and 24.11), kernel yield per plant (23.81 and 23.44), pod yield per plant (22.87 and 22.44) and number of primaries per plant (22.78 and 22.10) indicated that most of the characters had sufficient variability to effect selection for improvement of these characters. Further, moderate values of PCV and GCV were registered for number of pods per plant (20.35 and 18.84), SLA at 60 DAS (14.21 and 14.15), number of seeds per plant (14.13 and 13.95), shelling percentage (13.51 and 13.18) and SLA at 80 DAS (10.79 and 10.77). On contrary, low estimates of PCV and GCV were recorded for days to 50% flowering (9.02 and 8.97), days to maturity (8.00 and 7.99), SCMR at 60 DAS (8.35 and 7.90), SCMR at 80 DAS (7.11 and 6.75), leaf nitrogen content at 60 DAS (2.22 and 1.99) and leaf nitrogen content at 80 DAS (1.80 and 1.71). Reports of high GCV and PCV by Kumar and Rajamani (2004) for number of sound mature kernels per plant and John *et al.* (2008), Nandini *et al.* (2011), Srivalli *et al.* (2013), Shukla and Rai (2014) and Ramana *et al.* (2015) for kernel yield per plant were in conformity with findings of the present study.

High heritability was recorded for all the traits ranging from 99.7% for days to maturity and specific leaf area at 80 days after sowing to 80.7% for leaf leaf nitrogen content at 60 days after sowing indicating least influence of environment on the genetic expression of the characters under study.

The estimates of heritability alone will not be of much value for selection and genetic gain should be considered in conjunction with heritability estimates (Johnson *et al.,* 1955) to estimate realized genetic improvement possible in the character through simple selection methods. High heritability and high genetic advance estimates were registered for dry matter per plant ($h^2(b)$ = 96.3%, GAM = 62.51%), number of sound mature kernels per plant (94.9%, 48.38%), pod yield per plant (96.3%, 45.36%), number of primary branches per plant (94.1%, 44.16%), number of pods per plant (85.7%, 35.49%), SLA at 60 DAS (99.2%, 29.04%), number of seeds per pod (97.5%, 28.39%), shelling percentage (95.2%, 26.51%) and SLA at 80 DAS (99.7%, 22.6%) indicating additive gene effects in inheritance of these characters and simple selection would be effective to augument further genetic improvement of these traits. The reports of high heritability coupled with high GAM for number of sound mature kernels per plant by Kumar and Rajamani (2004), Venkateswarlu (2007) and Hiremath *et al. (*2011) were in conformity with findings of the present study.

High heritability coupled with moderate genetic advance as per cent of mean was observed for the traits days to 50% flowering (99.0%, 18.39%), days to maturity (99.7%, 16.44%), SCMR at 60 DAS (89.5%, 15.40%) and SCMR at 80 DAS (90.2%, 13.22%) indicating the role of both additive and non-additive gene effects in their

Table 1. Analysis of variance for sixteen quantitative characters in 50 genotypes of groundnut

S. No.	Characters	Mean sum of squares		
		Replications (df: 2)	Genotypes (df: 49)	Error (df: 98)
1.	Days to 50% flowering	3.14	23.34**	0.23
2.	Days to maturity	4.28*	232.00**	0.62
3.	No of primary branches per plant	0.54	4.17**	0.24
4.	No of pods per plant	17.16**	36.97**	5.28
5.	No of seeds per pod	0.01	0.20**	0.01
6.	No of sound mature kernels per plant	14.18**	59.76**	3.07
7.	Dry matter per plant (g)	9.22**	97.89**	3.59
8.	Pod yield per plant (g)	0.44	36.15**	1.34
9.	Kernel yield per plant (g)	1.79	17.66**	0.54
10.	Shelling percentage (%)	22.36**	250.83**	11.94
11.	SLA at 60 Days after sowing (cm^2 g^{-1})	17.81**	1387.61**	11.56
12.	SLA at 80 Days after sowing (cm^2 g^{-1})	2.00	672.95**	2.04
13.	SCMR at 60 Days after sowing	0.01	33.27**	3.50
14.	SCMR at 80 Days after sowing	1.95	26.06**	2.54
15.	Leaf Nitrogen (%) content at 60 Days after sowing	0.01	0.17**	0.03
16.	Leaf Nitrogen (%) content at 80 Days after sowing	0.01	0.11**	0.01

* Significant at 5% level; ** Significant at 1% level

genetic control and simple selection methods may not be rewarding to effect further genetic gain in these traits. Hybridization of selects followed by selection in later generations of segregating populations would be effective to capitalize both additive and non-additive gene effects observed in these traits. On contrary, high heritability and low GAM was observed for leaf nitrogen content at 60 DAS (80.7% and 3.69%) and 80 DAS (90.0% and 3.34%) indicating that high heritability was due to favourable influence of environment rather than genotypic effects and selection for such traits may not be rewarding.

From the foregoing discussion, it can be concluded that high GCV, heritability and genetic advance as per cent of mean were observed for dry matter per plant, number of sound mature kernels per plant, pod yield per plant, number of primary branches per plant, number of seeds per pod and shelling percentage indicating that variation in above traits was most-likely due to additive gene effects, hence simple selection may be effective to isolate high yield potential groundnut genotypes with high water use efficiency traits for rainfed conditions.

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Table 2. Mean, coefficients of variation, heritability (broad sense) and genetic advance as percent of mean for sixteen characters in 50 groundnut genotypes

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	30.92	25.67	37.67	7.70	7.78	8.97	9.02	99.0	5.68	18.39
2.	Days to maturity	109.85	91.67	123.67	77.12	77.33	7.99	8.00	99.7	18.06	16.44
3.	No of primary branches per plant	5.18	3.00	7.64	1.31	1.39	22.10	22.78	94.1	2.28	44.16
4.	No of pods per plant	17.25	10.00	30.67	10.56	12.32	18.84	20.35	85.7	6.19	35.94
5.	No of kernels per pod	1.86	1.50	2.91	0.06	0.06	13.95	14.13	97.5	0.52	28.39
6.	No of sound mature kernels per plant	18.03	4.67	26.67	18.89	19.92	24.11	24.76	94.9	8.72	48.38
7.	Dry matter per plant	18.13	8.33	32.17	31.43	32.63	30.92	31.50	96.3	11.33	62.51
8.	Pod yield per plant (g)	17.24	7.10	25.13	11.60	12.05	22.44	22.87	96.3	6.88	45.36
9.	Kernel yield per plant (g)	10.19	3.65	16.92	5.70	5.89	23.44	23.81	96.9	4.84	47.55
10.	Shelling percentage (%)	67.67	44.30	87.58	79.63	83.61	13.18	13.51	95.2	17.94	26.51
11.	SLA at 60 DAS($cm^2 g^{-1}$)	151.27	122.09	255.34	458.68	462.54	14.15	14.21	99.2	43.93	29.04
12.	SLA at 80 DAS ($cm^2 g^{-1}$)	138.80	109.18	195.04	223.63	224.31	10.77	10.79	99.7	30.75	22.16
13.	SCMR at 60 DAS	39.85	34.07	46.93	9.92	11.09	7.90	8.35	89.5	6.13	15.40
14.	SCMR at 80 DAS	41.43	36.02	48.32	7.84	8.68	6.75	7.11	90.2	5.48	13.22
15.	Leaf Nitrogen (%) content at 60 DAS	3.7	3.2	3.9	0.04	0.06	1.99	2.22	80.7	0.40	3.69
16.	Leaf Nitrogen (%) content at 80 DAS	3.7	3.3	3.9	0.03	0.03	1.71	1.80	90.0	0.36	3.34

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