Electronic Journal of Plant Breeding, 9(4): 1436-1442 (Dec 2018) DOI: 10.5958/0975-928X.2018.00178.3
ISSN 0975-928X

Research Article

Genetic variability studies for pod yield and component traits in groundnut

[1]Mohammad Raza, [1]M.Reddi Sekhar, [1]M.Shanthi Priya,[2]T.N.V.K.V. Prasad and [3]V.Rajarajeswari
[1]Dept. of Genetics and Plant Breeding, S.V.Ag. College, Tirupati
[2]Dept. of soil Science and Agricultural Chemistry, IFT, RARS, Tirupati
[3]Dept. of Crop Physiology, S.V.Ag. College, Tirupati
E-Mail: rmohammad296@gmail.com

(Received:12 Jul 2018; Revised: 16 Dec 2018; Accepted:20 Dec 2018)

Abstract
Genetic variability studies for pod yield and component traits in groundnut were carried out for 40 accessions for 13 characters. The analysis of variance revealed the existence of significant differences among the genotypes for all the traits studied. The genotypes *viz*.,K-6, K-1696, TCGS-1157 and Dharani showed high mean performance for pod yield and its component traits *viz*., number of primary branches per plant, hundred seed weight (g) and kernel yield per plant (g).High heritability coupled with high genetic advance as per cent of mean was recorded by kernel yield per plant, hundred seed weight, pod yield per plant, number of primary branches per plant, number of pods per plant, shelling percent, harvest index, plant height and number of seeds per pod indicating that these characters are under additive genetic control and selection of these traits for improvement will be worthwhile and may rapidly contribute to increased pod yield in groundnut cultivars.

Key words
Genetic Variability, Heritability, Coefficient of Variation Genetic Advance as percent of mean and Pod yield.

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the foremost important oilseed crops which is a major source of vegetable oil and plant protein. It is the World's fourth most important source of edible oil and the third most important source of vegetable protein (Encyclopedia of Agricultural Science, 1994). It is grown throughout the tropics and some sub-tropical regions. Like other legumes, groundnut is considered by the farmers to stabilize the crop yields, as it is intercropped with some cereals and serves as a source of income and protein for their families. So, selection of superior genotypes is of paramount importance to improve the yield and to limit the gap of uncertainty in economic yield, which is possible only through the genetic studies of pod yield and component traits.Genetic variability is an essential prerequisite for crop improvement programmes for obtaining high yielding varieties, through the estimation of different genetic parameters like components of variances, genotype and phenotype coefficients of variability, heritability and genetic advance. In genetic studies, characters with high genotypic coefficient of variation indicate the potential for effective selection. Heritability provides an idea to the extent of genetic control for expression of a particular character and the reliability of phenotype in predicting its breeding value. High heritability indicates less environmental influence in the observed variation. Heritability value alone cannot provide information on amount of genetic progress that would result from selection of best individuals. Johnson *et al*. (1955) reported that heritability estimates along with genetic advance would be more successful in predicting the effectiveness of selecting the best individuals. High heritability and high genetic advance for a given trait indicates that it is governed by additive gene action and therefore, provides the most effective condition for selection. For breeding programmes to improve pod yield in groundnut, it is essential that plant characters that determine productivity has to be identified. Therefore, the information on the nature and extent of genetic variability and transmission of traits is of paramount importance in enhancing the efficiency of selection for seed and pod yield. This study was undertaken to estimate the extent of genetic variability and heritability in groundnut.

Material and Methods

The present investigation on genetic variability for pod yield and its attributes in groundnut (*Arachis hypogaea* L.)was carried out during *kharif*2015 at Dryland Farm of S. V. Agricultural College, Tirupati. The experimental material consisted of forty genotypes of groundnut. The experiment was laid out in a Randomized Block Design with three replications having each genotype sown in a row length of 5 meters with a spacing of 30 cm × 10 cm. Recommended dose of 20:40:50 N: P: K (kg ha^{-1})as basal dose and gypsum @ 500 kg ha^{-1} at peak flowering stage were applied. All recommended agronomic practices and plant protection measures were adopted in order to exploit the full potential of genotypes. Observations were recorded on

randomly chosen five competitive plants in each genotype in each replication for all the 13 characters (days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pods per plant, number of seeds per pod, hundred seed weight, pod yield per plant, kernel yield per plant, shelling per cent, harvest index, protein percent and oil percent) except for days to 50% flowering and days to maturity. The data for the latter two characters were recorded on per plot basis. The values of five competitive plants were averaged and expressed as mean of the respective character for that replication. The analysis of variance was done based on the model proposed by Panse and Sukhatme (1961) and the estimates of range, variance, phenotypic and genotypic co-efficients of variation (PCV, GCV), heritability in broad sense, genetic advance and genetic advance as percent of mean for 13 characters of forty genotypes of groundnut were estimated using INDOSTAT software.

Results and Discussion

The analysis of variance (Table 1) for pod yield and other agronomic characters showed significant genotypic effects for agronomic characters, thus indicated that the groundnut accessions were highly variable in performance for agronomic characters. The presence of variability among genotypes is important for genetic studies and consequently for improvement and selection. The significant difference in yield and agronomic characters among the accessions gives room for selection of superior ones. Mean pod yield per plant among the accessions ranged between 11.21 and 30.53 g (Table 2). From the mean performance, K-6, K-1696, TCGS-1157 and Dharani showed clear superiority in terms of pod yield per plant and yield component attributes. The genotype K-6 registered the highest pod yield by recording higher number of primary branches and kernel yield per plant. The genotype ICGV-03128 registered the highest number of pods per plant. Similarly, K-7 had the highest number of primary branches per plant, while Bheema and JSSP-49 had the highest number of seeds per pod. The genotype Bheema also had the highest hundred seed weight. Similarly, the genotype K-1648 recorded the highest days to 50 % flowering, shelling percent and protein percent while, TCGS-1157 registered highest the harvest index. The genotype JCG-3005 registered the highest oil percent, while genotype Dharani recorded the highest kernel yield per plant. The highest estimate of range was registered for shelling percent followed by hundred seed weight, harvest index and plant height. The highest estimate of variance was registered for shelling percent. The highest estimate of co-efficient of variation was registered for kernel yield per plant followed by hundred seed weight and pod yield per plant. The estimate of genetic advance was highest for shelling percent. Estimates of high heritability were observed for all the characters under study. Genetic advance as per cent of mean was recorded as the highest for kernel yield per plant followed by hundred seed weight, pod yield per plant, number of primary branches per plant, number of pods per plant, shelling percent, harvest index, plant height and number of seeds per pod while moderate genetic advance as per cent of mean was recorded for days to 50% flowering. On contrary, low genetic advance as per cent of mean was recorded for protein per cent, days to maturity, and oil per cent. Table 3 shows the mean performance, range, variance, genotypic and phenotypic coefficient of variation, estimates of broad sense heritability (HB), genetic advance and genetic advance as percent of mean for pod yield and related characters. Phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for almost all the traits, indicating the influence of genotype x environment interaction in the expression of these characters (Uguru, 1995). The relatively small difference observed between the PCV and GCV may be associated with genetic difference for these characters. The genetic variability for most of the characters in the accessions was lower than the phenotypic variance (Table 3). This indicated that the environment influenced all the characters at different magnitudes. Broad sense heritability (HB) was high for all the characters studied. High GCV and PCV values were observed for kernel yield per plant, hundred seed weight, pod yield per plant and number of primary branches per plant which provide scope of selection of variation for genetic improvement of these traits.

Similar kind of high variability for kernel yield per plant was reported by Patil *et al*. (2015).The high estimates of variability obtained for pod yield per plant were similar to the reports of Kadam *et al*. (2016). The high variability estimates recorded for number of primary branches per plant was in conformity with the findings of Vange and Maga (2014). On contrary, moderate co-efficient of variation was recorded for number of pods per plant, shelling percent, harvest index, plant height and number of seeds per pod. Similar kind of moderate estimates for shelling percent were reported by Narasimhulu *et al*. (2012).

Low estimates of variability were observed for characters *viz*., days to 50% flowering, protein per cent, days to maturity and oil per cent indicated limited scope of selection in these traits for further genetic improvement. The findings of Shukla *et al*.

(2014) are in accordance with the present results of low estimates of variability for days to maturity. The low estimate of variability recorded by oil per cent was in concurrence with report of Parameshwarappa *et al*. (2005).

High heritability coupled with high genetic advance as per cent of mean recorded by pod yield per plant is in agreement with the reports of Nandini *et al*. (2011) and Shukla *et al*. (2014). Number of primary branches per plant displayed high heritability with high GAM, which is similar to the reports of John *et al*. (2008). Number of pods per plant also recorded high heritability coupled with high genetic advance, which is in accordance with the findings of Nandini *et al*. (2011). High heritability coupled with high GAM revealed for shelling percent in the present study is similar to the reports of John *et al*. (2009), Nandin i*et al*. (2011) and Shukla *et al*. (2014).

In the present study, the display of high heritability coupled with high genetic advance as per cent of mean by above characters indicates additive gene effects, hence, selection for these traits would be very effective. However, the character days to 50% flowering registered high heritability coupled with moderate genetic advance as per cent of mean. Similar estimates of high heritability coupled with moderate genetic advance as per cent of mean as recorded by days to 50% flowering is in conformity with the reports of Venkataramana (2001). In this case, the high heritability was attributed to both additive and non-additive gene effects and hence simple selection for these characters in the later generations may be suggested for further improvement.

On contrary to the above characters, protein percent, days to maturity and oil percent registered high heritability estimates coupled with low genetic advance as per cent of mean. Similar estimates of high heritability coupled with low genetic advance as per cent of mean recorded by days to maturity is in conformity with the report of Zaman *et al*. (2011).Similarly, estimates of high heritability coupled with low genetic advance as per cent of mean recorded by protein per cent and oil per cent is in accordance with the findings of Noubissie *et al*. (2012). These estimates with respect to protein per cent, days to maturity and oil per cent revealed the presence of non-additive gene action, elucidating the effect of favourable environment rather than the inherent performance of the genotypes. These findings obviate simple selection and necessitate intermating of the selects followed by single plant selection for genetic improvement of protein per cent, days to maturity and oil per cent.

From the study, it was concluded that number of primary branches per plant, hundred seed weight, pod yield per plant and kernel yield per plant recorded high PCV, GCV, heritability (broad sense) and genetic advance as percent of mean indicating that these characters were governed by additive gene action and simple selection could be used for their improvement. On the other hand, days to 50% flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, shelling %, harvest index, protein per cent, and oil per cent, exhibited moderate to low GCV, PCV, high heritability and moderate to low genetic advance. Hence, inter mating of selected genotypes could be suggested to generate variability followed by selection in later generations for superior segregants for these characters.

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Table1. Analysis of variance for thirteen quantitative characters in 40 genotypes of groundnut

Sl. No.	Character	Mean sum of squares		
		Replications (df:2)	Genotypes (df:39)	Error (df:78)
1.	Days to 50% flowering	0.06	16.18**	0.65
2.	Days to maturity	0.08	24.26**	0.70
3.	Plant height (cm)	0.55	126.91**	11.30
4.	No. of primary branches per plant	0.78	3.73**	0.46
5.	No. of pods per plant	1.08	62.06**	7.13
6.	No. of seeds per pod	0.06	0.19**	0.03
7.	Hundred seed weight (g)	0.06	230.62**	4.47
8.	Pod yield per plant (g)	0.01	66.44**	1.92
9.	Kernel yield per plant (g)	0.32	40.69**	0.86
10.	Shelling percentage	1.63	315.15**	13.53
11.	Harvest index (%)	0.97	219.40**	8.02
12.	Protein (%)	0.18	1.77**	0.14
13.	Oil (%)	0.36	2.56**	0.20

Electronic Journal of Plant Breeding, 9(4): 1436-1442 (Dec 2018) DOI: 10.5958/0975-928X.2018.00178.3
ISSN 0975-928X

Table 2. Mean performance of 40 genotypes of groundnut for pod yield and its component traits

Sl.No.	Genotype	Days to 50% flowering	Days to maturity	Plant Height(cm)	No. of primary branches per plant	No. of pods per plant	No. of seeds per pod	Hundred seed weight (g)	Pod yield per plant (g)	Kernel yield per plant (g)	Shelling (%)	Harvest index (%)	Protein (%)	Oil (%)
1.	TPT-3	34.33	103.67	52.53	6.20	18.80	2.00	28.46	15.11	9.60	63.42	43.39	26.23	48.20
2.	BHEEMA	29.33	102.33	46.27	4.53	29.80	2.67	58.14	19.11	11.36	59.39	47.01	25.23	46.27
3.	K-9	28.00	101.00	54.80	5.13	28.67	2.00	28.51	23.71	16.77	75.61	50.71	24.87	45.83
4.	K-1741	28.67	104.67	33.90	4.07	20.53	1.67	46.56	15.76	8.86	55.94	39.11	26.33	46.47
5.	TPT-4	29.67	103.33	47.00	6.00	21.40	2.00	48.88	22.99	14.94	65.90	49.03	23.87	48.60
6.	TPT-1	30.00	101.00	40.40	4.53	27.73	1.67	28.44	19.10	12.27	64.14	56.01	24.57	47.67
7.	AVT(D) -1412	27.33	105.67	42.53	4.20	24.00	2.00	30.78	14.79	7.89	53.57	47.68	25.20	47.07
8.	MLTG (VB)- 2	33.33	107.33	42.00	4.53	21.87	1.87	40.77	22.45	11.77	52.36	49.32	25.97	47.07
9.	GREESHMA	27.33	99.67	45.33	5.27	23.13	1.60	32.77	22.62	12.42	54.87	51.75	25.63	47.97
10.	K-1648	35.33	106.00	35.80	5.27	15.53	1.73	56.07	14.19	10.99	77.52	44.58	26.80	46.60
11.	MLTG (SB)-3	32.00	104.67	46.00	6.73	23.73	1.93	43.63	21.24	15.01	70.73	52.08	25.83	47.00
12.	AVT(D) -1415	29.00	101.67	42.60	5.33	32.80	1.67	38.88	24.38	15.83	67.48	66.79	25.33	47.23
13.	K-1930	31.00	107.67	42.33	4.13	18.87	1.80	37.21	21.85	11.64	53.22	63.85	25.30	47.07
14.	MLTG (SB)- 6	29.67	108.00	36.20	4.47	18.00	1.80	31.03	19.72	9.57	48.43	58.61	26.20	47.03
15.	MLTG (VB)- 11	34.67	104.33	34.27	4.73	21.13	1.80	34.30	19.47	11.60	59.66	48.83	26.23	46.50
16.	CTMG-11	27.67	98.00	45.47	5.27	19.33	1.93	23.53	17.91	10.31	57.56	58.96	25.37	47.90
17.	VG-315	32.67	106.33	31.43	4.00	17.47	1.73	30.07	16.33	7.76	47.24	50.64	25.33	46.50
18.	AVT(D) -1425	30.00	107.33	48.13	4.00	16.47	1.73	31.20	15.54	10.63	68.28	53.03	25.97	48.53
19.	ICGV-03128	28.33	102.00	45.60	6.10	35.27	1.73	28.80	14.22	10.50	73.84	31.72	24.53	47.17
20.	K-1696	32.00	102.33	45.20	6.66	24.60	1.87	32.73	24.75	15.92	61.61	62.86	25.73	46.83
21.	K-7	32.67	100.33	47.27	8.47	24.67	1.93	38.50	17.18	8.73	50.76	40.57	26.47	46.70
22.	K-1814	29.67	105.33	39.40	4.33	22.60	1.93	31.03	17.66	8.03	45.48	54.54	25.23	47.03
23.	J-86	34.00	105.00	38.80	5.47	27.33	2.00	23.07	17.05	8.01	52.77	42.37	23.13	48.87
24.	JCG-3005	30.33	107.67	38.00	4.00	27.40	1.53	32.37	17.17	7.99	46.67	43.03	25.30	49.23
25.	LGN-163	29.33	107.67	43.07	4.57	24.87	1.80	24.10	11.74	5.99	50.97	39.00	24.43	48.80
26.	K-6	28.00	102.33	52.67	7.55	23.60	1.93	32.23	30.53	17.93	58.75	54.13	25.40	48.07
27.	K-1622	31.67	103.67	38.83	4.60	19.60	1.73	43.60	16.42	8.19	50.00	31.96	25.63	46.30
28.	ICGS-76	35.00	110.00	41.20	4.53	21.07	1.80	27.50	13.59	5.21	38.35	41.51	24.70	46.60
29.	HARITHANDHRA	30.33	105.00	39.33	4.27	15.80	1.60	24.53	17.49	9.21	52.50	46.39	25.47	48.14
30.	K-1662	30.00	100.67	47.13	5.80	18.00	1.60	40.13	17.69	7.75	43.74	40.77	24.93	46.63
31.	JSSP-49	32.00	106.00	36.73	4.47	18.07	2.67	25.83	11.21	5.86	52.47	38.32	25.33	47.49
32.	K-1501	30.33	104.33	30.00	4.00	18.47	1.80	37.63	12.55	6.09	48.53	42.57	26.23	45.50
33.	K-1628	28.67	108.00	38.53	4.20	21.33	1.87	20.30	15.49	6.85	44.31	52.76	25.90	46.63
34.	K-1976	30.00	104.33	37.67	4.23	18.80	1.93	23.93	13.92	5.26	38.01	47.60	24.53	49.07
35.	NARAYANI	27.33	103.00	55.00	4.97	22.60	2.00	38.10	24.45	13.30	54.40	44.69	25.93	48.03
36.	ABHAYA	27.67	101.00	49.17	5.47	24.67	2.07	32.02	18.64	14.37	76.96	45.56	24.57	48.27
37.	K-1621	27.33	104.33	38.60	5.17	20.20	1.80	44.13	20.59	14.12	68.80	52.78	25.93	46.80
38.	Dh-235	28.00	102.67	47.07	4.00	22.80	1.80	28.53	22.99	14.35	62.52	56.80	24.33	47.23
39.	TCGS-1157	31.00	99.00	54.53	6.60	25.73	2.53	42.23	28.27	15.75	50.75	68.49	25.83	46.40
40.	DHARANI	28.67	100.67	53.47	7.43	28.00	1.80	36.37	29.13	18.29	63.04	51.24	26.27	48.13
	General Mean	**30.31**	**103.95**	**43.11**	**5.13**	**22.62**	**1.88**	**34.42**	**18.98**	**10.92**	**57.01**	**49.03**	**25.40**	**47.34**
	C.V. (%)	2.66	0.81	7.80	4.19	11.81	9.87	6.14	7.31	8.51	6.45	5.78	1.52	0.95
	C. D. at 5%	1.31	1.37	5.47	0.35	4.34	0.30	3.44	2.26	1.51	5.98	4.60	0.63	0.73
	S. E. ±	0.46	0.49	1.94	0.12	1.54	0.11	1.22	0.80	0.54	2.12	1.64	0.22	0.26

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ISSN 0975-928X

Table 3. Variability and genetic parameters for thirteen characters in 40 genotypes of groundnut

Sl. 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	30.31	27.33	35.33	5.17	5.39	7.50	7.66	95.9	4.59	15.15
2.	Days to maturity	103.95	98.00	110.00	7.85	8.08	2.69	2.73	97.0	5.68	5.47
3.	Plant height (cm)	43.11	30.00	55.00	38.53	42.30	14.40	15.08	91.0	12.20	28.31
4.	No. of primary branches per plant	5.13	4.00	8.47	1.23	1.24	21.59	21.72	98.7	2.27	44.20
5.	No. of pods per plant	22.62	15.53	35.27	18.31	20.68	18.91	20.10	88.5	8.29	36.66
6.	No. of seeds per pod	1.88	1.53	2.67	0.05	0.06	12.05	13.33	81.7	0.42	22.45
7.	Hundred seed weight (g)	34.42	20.30	58.14	75.38	76.87	25.22	25.47	98.0	17.71	51.45
8.	Pod yield per plant (g)	18.98	11.21	30.53	21.50	22.14	24.43	24.80	97.1	9.41	49.61
9.	Kernel yield per plant (g)	10.92	5.21	18.29	13.07	13.36	33.10	33.46	97.8	7.36	67.45
10.	Shelling percentage	57.01	38.01	77.52	100.54	105.05	17.58	17.97	95.7	20.20	35.44
11.	Harvest Index (%)	49.03	31.72	68.49	70.46	73.13	17.12	17.44	96.3	16.97	34.61
12.	Protein (%)	25.40	23.13	26.80	0.54	0.59	2.89	3.02	91.5	1.45	5.71
13.	Oil (%)	47.34	45.50	49.23	0.78	0.91	1.87	2.01	86.7	1.70	3.60