

## Genetic Spectrum of Variability Studies for Quantitative Traits in F<sub>3</sub> Generation of Groundnut (*Arachis hypogaea* L.)

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### ABSTRACT

*In the present investigation, estimates of genetic variability, heritability and genetic advance were assessed for thirteen different characters in the F<sub>3</sub> population derived from nine groundnut crosses viz., TLG 45 x ICGV-05155, JL – 501 x KDG-128, K-1641 x ALR-3, SG-99 x R-8808, ALG-234 x ICGV-00350, AG-24 x ICGV-6110, JSSP-LS-58 x CS-19, TPG-41 x GG-16 and J-89 x ISK-I-16-13. The mean sums of squares due to genotypes and parents were significant for all the characters except shelling outturn (%) and mean sums of squares due to F<sub>3</sub>s were significant for all the characters except 100-matured kernel weight, oil content (%) and biological yield per plant and mean sum of square due to parents vs crosses were significant for all the characters except shelling outturn, kernel yield, 100-matured kernel weight, oil content (%) and harvest index indicating there by sufficient amount of variability was present in the material studied. The estimates of GCV were quite close to the PCV were moderate to high in most of the crosses for all the characters except in days to appearance of first flower, days to maturity, oil content and biological yield per plant. High heritability coupled with high genetic advance and high value of GCV and PCV for number of matured pods per plant in Cross 7 (JSSP-LS-58 x CS-19). Thus, it can be concluded that this Cross 7 for number of matured pods per plant was mainly under the influence of additive gene action and selection would be effective for improving these traits.*

**Keywords** Groundnut, GCV, PCV, Heritability, Genetic advance.

### INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a highly self-pollinated crop and can be grown successfully in tropical and subtropical areas. The crop has narrow genetic base therefore, it

is essential to create more variability in the segregating materials. Genetic variability is the basic requirement for crop improvement as it provides wider scope for selection.

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Thus, effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability present in the material and the extent to which it is heritable. Hence, in present investigation an attempt was made to assess the variability of important pod yield and yield contributing traits, along with the indices of variability *i.e.* genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability ( $h^2$ ) and genetic advance as percentage of mean (GA as % mean). This study will facilitate the expression of the character and role of environment therein.

### MATERIALS AND METHODS

The experiment on nine  $F_3$ s crosses along with their eighteen parents of groundnut was laid out in Randomized Block Design (RBD) with two replications during *summer* 2019. The observations were taken from randomly selected 5 plants from parents and 10 plants from each of fifteen sown rows of every cross were recorded for thirteen characters, *viz.*, days to appearance of first flower, days to maturity, number of primary branches per plant, plant height, number of matured pods per plant, number of immature pods per plant, pod yield per plant, shelling outturn, kernel yield per plant, 100-mature kernel weight, oil content, biological yield per plant and harvest index. Except, days to appearance of first flower and days to maturity, where data recorded on plot basis. Average value was used for the statistical analysis. The data subjected to different statistical analysis *viz.*, analysis of variance and magnitude of genetic variability were performed following the standard procedures, phenotypic and genotypic coefficients of variation and heritability as suggested by Mahmud and Kramer (1951), genetic advance as followed by Allard (1960).

### RESULTS AND DISCUSSION

#### Analysis of Variance

The mean sums of squares due to genotypes and parents were highly significant for all the characters except significant for biological yield per plant and non-significant for shelling

outturn (%) and mean sums of squares due to  $F_3$ s were highly significant for all the characters except significant for days to maturity and non-significant for 100-matured kernel weight, oil content (%) and biological yield per plant and mean sum of square due to parents *vs* crosses were highly significant for all the characters except significant for number of matured pods per plant and non-significant for shelling outturn, kernel yield, 100-matured kernel weight, oil content (%) and harvest index indicating (Table 1) there by sufficient amount of variability was present in the material studied. According to Jayalakshmi et al. (2001) the crosses showing higher mean would be relatively effective in identifying the superior segregates. Ramana et al. (2015) also found highly significant differences among the  $F_3$  populations.

#### Mean performance of Parents and Crosses

Mean performance is the important criteria to select an individual. The perusal of data indicated the significant differences were observed among the parents for all the characters except shelling outturn (%). The parental values indicated that parent ICGV-00350 was early for first flowering and TLG-45 was early maturing. ALG-234 had highest matured pods per plant and ICGV-05155 had highest kernel yield per plant. TAG-45 had highest pod yield per plant with early maturity is highly desirable for further selection programme.

The perusal of data indicated the significant differences among the generations of all the crosses for rest all the characters except 100-mature kernel weight, oil content (%) and biological yield per plant. The results indicated that crosses under this study were exceeded the range of their respective parents either in negative or positive directions indicating transgressive segregation in characters, should be exploited to select for individual superior to the parents.

#### Variability Parameters

The estimates of genotypic coefficient of variances (GCV) were quite close to the phenotypic coefficient of variances (PCV) were moderate to high in magnitude in most of

the crosses for all the characters except in days to appearance of first flower, days to maturity, oil content and biological yield per plant. This suggested that phenotypic variation can be used reliably to judge genetic variation. Moderate heritability values were noticed for most of the characters. Genetic advance expressed as percent of mean was high for number of primary branches per plant, plant height, number matured pods per plant, number immature pods per plant, pod yield per plant, shelling outturn, kernel yield per plant, 100-mature kernel weight and harvest index. High heritability coupled with high genetic advance and high value of GCV and PCV for number of matured pods per plant in Cross 7 (JSSP-LS-58 × CS-19). Thus, it can be concluded that this Cross 7 for number of matured pods per plant was mainly under the influence of additive gene action and selection would be effective for improving these traits. Our findings are in accordance with the result moderate GCV (%) and PCV (%) by Vishnuvardhan et al. (2012), John et al. (2007) and high GCV (%) and PCV (%) by Vekariya et al. (2011) and high heritability by John et al. (2011) for matured pods per plant. The genetic parameters studies for various traits in F<sub>2</sub> generations (Table 3) are narrated below.

#### **Days to appearance of first flowering**

The minimum value of GCV=1.13% and maximum PCV= 4.87% were estimated in the Cross 8 with high heritability, which clearly indicated that variability present in this cross is due to environmental effects only. The magnitude of genetic advance expressed as percentage of mean for this trait was low in all the crosses. Magnitudes of GCV, PCV and genetic advance expressed as percentage of mean were low in all the crosses indicated that direct selection for this character is not effective. Vekariya et al. (2011) also found same results for this character.

#### **Days to maturity**

The magnitude of GCV and PCV for this trait was low in all the crosses. GCV varied from the value of 2.95% (Cross 6) to 4.96% (Cross 5) and PCV values ranged from 3.78% (Cross 4) to 5.57% (Cross 6). Our results are akin to

those obtained by Chauhan and Shukla (1985) and Padmaja et al. (2013). The magnitude of heritability for days to maturity (Table 4.3) was high in all the crosses except Cross 6, which has moderate heritability. Singh and Chaubey (2003) also reported high heritability for this trait. The low genetic advance along with high heritability and low GCV and PCV as observed in all the crosses indicated that direct selection for this character is not effective.

#### **Number of primary branches per plant**

Both high GCV and PCV found in Cross 9. The GCV ranged from 6.27% (Cross 6) to 24.85% (Cross 9) and PCV values varied from 8.89% (Cross 6) to 25.02% (Cross 9). Shukla and Rai (2014) also reported moderate to high GCV and PCV (%) for primary branches per plant in groundnut. In fact, we found high GCV(%), PCV (%), h<sup>2</sup>(%) as well as GA as (%) of mean in Cross 9 suggested that branches per plant in the present material was under the influence of additive type of gene action and the improvement in branches per plant through selection would be possible by using progeny of this cross. Chauhan and Shukla (1985) and Singh and Chaubey (2003) reports same results for this character.

#### **Plant height (cm)**

The scrutiny of data indicated the significant differences among the genotypes except Cross 1, Cross 6 and Cross 9. The value of GCV varied from 5.35% (Cross 2) to 15.50% (Cross 3) and PCV from 7.46% (Cross 8) to 15.56% (Cross 3). Low to moderate magnitudes of GCV and PCV in all the crosses indicated the existence of moderate amount of variability for plant height in the material studied. Vishnuvardhan et al. (2012) and Patil et al. (2014) found moderate GCV and PCV for this character. Magnitude of heritability was low in Cross 2, moderate in Cross 8 and high heritability found in rest of all the crosses. Thakur et al. (2011) found moderate heritability and Raut et al. (2010) found high heritability for this character. Magnitude of genetic advance expressed as percentage of mean was low to high. Singh and Chaubey (2003) found low genetic advance. In fact, we

found high GCV(%), PCV (%),  $h^2$ (%) as well as GA as (%) of mean in Cross 3 suggested that plant height in the present material was under the influence of additive type of gene action in Cross 3 and the improvement in plant height through selection would be possible by using progeny of this cross.

#### **Number of matured pods per plant**

The GCV estimates ranged from the value of 3.54% (Cross 8) to 23.20% (Cross 7) and PCV varied from 4.16% (Cross 8) to 23.53% (Cross 7). In fact, the values of GCV and PCV were low in magnitude in most of the crosses except Cross 1 found moderate and Cross 7 found high GCV (%) and PCV (%). Our findings are in accordance with the results moderate GCV (%) and PCV (%) by Vishnuvardhan et al. (2012), John et al. (2007) and high GCV (%) and PCV (%) by Vekariya et al. (2011) for this character. Magnitude of heritability was high in all the crosses except low in Cross 3 and moderate in Cross 4. Bhargavi et al. (2016) found high and John et al. (2013) found moderate heritability for this character. In fact, we found high GCV (%), PCV (%),  $h^2$  (%) as well as GA as (%) of mean in Cross 7 suggested that character number of matured pods per plant in the present material was under the influence of additive type of gene action in Cross 7 and the improvement in number of matured pods per plant through selection would be possible by using progeny of this cross. John et al. (2011) reported moderate heritability and high GAM was showed for matured pods per plant.

#### **Number of immature pods per plant**

It is undesirable character that we found lowest GCV (%),  $h^2$  (%) as well as GA as (%) of mean in Cross 2 suggested that character number of immature pods per plant in the present material was least heritable in Cross 2 and the improvement in selection for lowest number of immature pods per plant through selection would be possible by using progeny of this cross. Our results are akin to those obtained by Raut et al. (2010) for high and Rudraswamy et al. (1999) for moderate genetic advance.

#### **Pod yield per plant (g)**

The GCV was observed from the value of 1.32% (Cross 8) to 30.04% (Cross 9) and PCV varied from 6.02% (Cross 4) to 30.14% (Cross 9). The values of GCV were low in magnitude in most of all the crosses except Cross 5, which possess moderate and Cross 9 possess high GCV and value of PCV was low in most of the crosses except Cross 5 possessed moderate and Cross 9 possessed high PCV. Our results are akin to those reported high GCV and PCV by Bhargavi et al. (2016) and Chauhan and Shukla (1985), moderate by Kumar et al. (2014) and high to moderate by Maurya et al. (2014) and Patidar et al. (2014). The magnitude of heritability was found high except Cross 8 (1.94%), which possessed low heritability. Similar observations were also reported by Prabhu et al. (2017a). In fact, we found least GCV(%),  $h^2$ (%) as well as GA as (%) of mean in Cross 8 and highest GCV(%), PCV (%),  $h^2$ (%) as well as GA as (%) of mean in Cross 9 suggested that pod yield per plant in the present material was under the influence of additive type of gene action in cross 9 and the improvement in pod yield per plant through selection would be possible by using progeny of this cross.

#### **Shelling outturn (%)**

The GCV values were observed to vary from 6.06% (Cross 1) to 16.37% (Cross 9). Magnitudinally, low GCV was recorded in all the crosses except Cross 4, Cross 5, Cross 8 and Cross 9 possessed moderate GCV. The values of PCV varied from 8.08% (Cross 1) to 16.94% (Cross 9), which were moderate in magnitude for this character in all the crosses except Cross 1, which possessed low PCV. Such result was earlier obtained by Dandu et al. (2012) and Kumar and Rajamani (2004). The character exhibiting high predicted genetic advance with high heritability is the Cross 9 indication of presence of additive effect as observed for shelling outturn (%) in present investigation. High genetic gain can be anticipated by applying selection pressure on this trait.

**Kernel yield per plant (g)**

The GCV estimates ranged from the value of 4.03% (Cross 1) to 23.92% (Cross 9) and PCV varied from 9.03% (Cross 4) to 24.56% (Cross 9). The values of GCV were low in most of the crosses except Cross 9. PCV were found low in Cross 1, Cross 4 and Cross 7, moderate in Cross 3, Cross 5 and Cross 8 and high in Cross 9. Our findings are in accordance with the results by Ramana et al. (2015) and John et al. (2007). Low to high heritability along with low to high genetic advance and moderate to high PCV as observed in the all the Crosses indicated that the character was least influenced by the environmental effects. In fact, we found highest GCV(%), PCV(%),  $h^2$ (%) as well as GA as (%) of mean in Cross 9 suggested that kernel yield per plant in the present material was under the influence of additive type of gene action in Cross 9 and the improvement in kernel yield per plant through selection would be possible by using progeny of this cross.

**100–mature kernel weight (g)**

Magnitudinally, moderate GCV was recorded in all the crosses except Cross 8, which possessed high GCV. The values of PCV varied from 14.27% (Cross 3) to 22.54% (Cross 1), which was high in magnitude for this character in all the crosses except Cross 3 and Cross 4, which possessed moderate PCV. Such result was earlier obtained by Gupta et al. (2015) and Bhagat et al. (1986). The magnitude of heritability for this trait was high in all the crosses except Cross 5, which possessed moderate heritability. The estimates of genetic advance expressed as percent of mean varied from 13.14% (Cross 5) to 41.14% (Cross 8). The magnitude of genetic advance expressed as percent of mean for this trait was high in the all crosses except Cross 5, which possessed moderate GA. Nadaf and Habib (1987) also found high heritability and Yadav et al. (1998) found high genetic advance expressed as percentage of mean. Prabhu et al. (2015) reported moderate heritability and genetic advance, indicated that direct selection for this character is effective.

**Oil content (%)**

Magnitudinally, low GCV was recorded in all the crosses. The values of PCV varied from

2.17% (Cross 7) to 4.69% (Cross 8), which were low in magnitude for this character in all the crosses. Such result was earlier reported by Bhagat et al. (1986). The magnitude of GCV(%),  $h^2$ (%) as well as GA as (%) of mean in Cross 1 found least and GCV(%), PCV (%),  $h^2$ (%) as well as GA as (%) of mean in Cross 3 found highest type of gene action in Cross 3 and the improvement in oil content (%) through selection would be possible by using progeny of this cross and selection may be successfully practiced to develop high oil content having varieties from this material.

**Biological yield per plant (g)**

The GCV estimates ranged from value of 0.42% (Cross 1) to 5.44% (Cross 5) and PCV varied from 4.75% (Cross 9) to 5.50% (Cross 5). In fact, the values of GCV and PCV were low in all the crosses, indicating that there would be a no scope for selecting better segregates in the population based on phenotypic performance. Our findings are in accordance with the result by Singh et al. (1982). Low to high range of heritability and genetic advance expressed as per cent of mean for biological yield per plant showed the value of 0.07% in the Cross 1 to 11.08% in the Cross 5, which were low in magnitude except Cross 5 and Cross 8, which possessed moderate genetic advance as per cent of mean. Similar observations were also reported by Bhargavi et al. (2016).

**Harvest index (%)**

The values of GCV were low in magnitude of all the crosses except Cross 5 possess moderate and Cross 9 possessed high GCV. The PCV were found low in Cross 1 (7.27%) and Cross 4 (8.13%), moderate in Cross 5 (12.77%) and Cross 8 (11.10%) and high in Cross 9 (29.74%). Our results are akin to those reported by Bhargavi et al. (2016) and Ramana et al. (2015). The magnitude of heritability was found high except Cross 1 and Cross 8 possessed low heritability suggested that extreme differences among the  $F_3$  plants within the cross. The estimates of genetic advance expressed as percentage of mean for harvest index per cent showed the value of 0.03% in Cross 8 to 61.23% in Cross 9, which

was low in Cross 1 and Cross 8, moderate in Cross 4 and high in magnitude in Cross 5 and

Cross 9. Similar observations were also reported by Bhargavi et al. (2016).

**Table 1: Analysis of variance showing mean square for thirteen characters in parents and F<sub>3</sub> generation of nine groundnut crosses**

Source	Replication	Genotypes	Parents	Crosses	Parents vs Crosses	Error
<b>Df</b>	1	26	17	8	1	26
<b>Days to appearance of first flower</b>	0.10	4.45**	6.48**	0.32**	2.82**	0.07
<b>Days to maturity</b>	2.76	16.36**	20.76**	4.71*	34.83**	3.08
<b>No. of primary branches/plant</b>	0.31	1.57**	2.13**	0.34**	1.81**	0.06
<b>Plant height(cm)</b>	0.83	4.92**	5.80**	3.26**	3.29**	0.10
<b>No. of matured pods/plant</b>	3.00	5.68**	7.35**	2.72**	0.79*	0.18
<b>No. of immature pods/plant</b>	1.39	3.37**	3.73**	2.70**	2.69**	0.14
<b>Pod yield/plant (g)</b>	0.60	4.05**	4.12**	4.11**	2.33**	0.05
<b>Shelling outturn (%)</b>	89.44	54.45	60.20	32.80**	129.95	36.68
<b>Kernel yield/plant (g)</b>	0.50	2.22**	3.21**	0.39**	0.03	0.78
<b>100-mature kernel weight(g)</b>	0.21	256.34**	383.48**	14.49	29.66	7.92
<b>Oil content (%)</b>	1.10	2.57*	3.27**	1.37	0.25	1.59
<b>Biological yield/plant (g)</b>	0.00	4.76*	5.70*	0.10	26.06**	2.69
<b>Harvest index (%)</b>	1.39	32.45**	37.12**	26.49**	0.79	2.16

\*\*\*Significant at p=0.05 and 0.01 levels, respectively.

**Table 2: Mean performance of parents for various traits in F<sub>3</sub> generation of groundnut**

Sr. No.	Parents	Days to appearance of first flower	Days to maturity	No of primary branches per plant	Plant height (cm)	No. of matured pods per plant	No. of immature pods per plant	Pod yield per plant (g)	Shelling out turn (%)	Kernel yield per plant (g)	100 mature kernel weight (g)	Oil content (%)	Biological yield per plant (g)	Harvest index (%)
1	TLG-45	39.2	93	5.5	12.5	12.6	4.1	17.7	73.48	13	88	48.32	39.4	45.1
2	ICGV-05155	38.9	99	8.3	14.9	12.6	4	15.9	84.93	13.5	107	50.78	39.2	40.56
3	JL-501	37.8	103	4.8	16.9	12.3	3.5	14.4	69.55	10	88.5	47.48	41.7	34.54
4	KDG-128	37.2	99	5	14.6	12.2	3.7	16.2	80.25	13	113.5	50.67	38.4	42.19
5	K-1641	36.7	99	6.5	14.1	7.6	2	15.5	67.77	10.5	87.5	49.7	41.9	37.02
6	ALR-3	36.8	98	4.7	14.4	8.7	1.8	12.9	77.46	10	89.5	49.54	40.2	32.12
7	SG-99	36.8	102.5	4.6	14.4	11.4	5.1	14.3	70.11	10	93.5	46.96	41.4	34.56
8	R-8808	37.2	101.5	5.3	14.3	10.4	4.6	14.5	79.27	11.5	95.5	48.93	39.3	37.07
9	ALG-234	36.2	102.5	4.9	16.9	15.6	3.3	16.6	69.32	11.5	107.5	51.19	40.9	40.61
10	ICGV-00350	33.1	104.5	4.6	17.4	12.2	3.2	16.7	74.84	12.5	84	48.92	41.3	40.72
11	TAG-24	37.6	106.5	4.3	12.3	13.1	5.6	12.1	78.66	9.5	88.5	49.19	41.1	29.45
12	ICGV-6110	35.6	99.5	4.8	14.6	12.7	5.3	16.1	80.71	13	110.5	48.26	44.3	36.35
13	JSSP-LS-58	33.9	100.5	5	16.3	13	4.9	15.1	82.81	12.5	76.5	50.14	40.5	37.3
14	CS-19	39.8	100.5	4.8	15.2	13.8	6.3	16	81.18	13	109.5	50.69	37.2	43.02
15	TPG-41	38.9	102.5	4.3	13.4	14.2	5.7	13.8	79.78	11	117.5	48.86	39.9	34.58
16	GG-16	36.3	106.5	3.7	14.7	13.8	5.9	15.9	69.15	11	114	50.29	38.5	41.44
17	J-89	39.3	102	4.2	16	13.9	6.5	16.5	69.78	11.5	113	51.23	38.8	42.54
18	ISK-I-16-13	38.2	99	4.1	18.9	12.6	4.3	16.2	74.12	12	74.5	48.06	38.1	42.52
	S.Em. ±	0.19	1.24	0.17	0.22	0.3	0.27	0.16	4.28	0.63	1.99	0.89	1.33	1.22

**Table 3: Estimate of genetic parameters in F<sub>3</sub> population of groundnut**

Sr. No.	Characters	Cross	Mean	GCV (%)	PCV (%)	Heritability (h <sup>2</sup> )	GA as % of mean (GAM)
1	Days to appearance of first flower	1	36.91	4.07	4.11	98.26	8.32
		2	37.36	2.82	3.04	86.01	5.38
		3	37.59	2.57	2.63	95.9	5.19
		4	37.68	2.69	2.74	96.25	5.44
		5	37.58	-	-	-	-
		6	37.8	1.99	4.22	22.2	1.93
		7	38.02	-	-	-	-
		8	38.34	1.13	4.87	5.35	0.54
		9	37.83	3.15	3.64	74.68	5.6
2	Days to maturity	1	100.47	-	-	-	-
		2	103.6	3.36	4.33	60.22	5.37
		3	100.77	3.88	3.94	96.83	7.86
		4	103.9	3.72	3.78	96.75	7.53
		5	101.97	4.96	5.15	92.74	9.83
		6	104.73	2.95	5.57	28.08	3.22
		7	102	4.61	4.77	93.66	9.2
		8	103.1	4.7	5.44	74.58	8.36
		9	104.3	5.15	5.53	86.49	4.99
3	No. of primary branches/plant	1	5.38	-	-	-	-
		2	4.68	12.69	13.04	94.64	25.43
		3	4.59	-	-	-	-
		4	4.67	-	-	-	-
		5	4.16	9.95	11.05	81.08	18.46
		6	4.49	6.27	8.89	49.73	9.11
		7	4.17	14.2	14.6	94.6	28.44
		8	4.11	7.62	12.83	35.29	9.33
		9	4.95	24.85	25.02	98.7	50.87
4	Plant height (cm)	1	13.93	-	-	-	-
		2	13.5	5.35	13.17	16.5	4.48
		3	15.77	15.5	15.56	99.34	31.83
		4	16.44	12.53	12.59	99.07	25.69
		5	15.56	7.66	7.97	92.21	15.15
		6	15.05	-	-	-	-
		7	17.31	9.83	10.62	85.79	18.76
		8	16.8	5.5	7.46	54.21	8.34
		9	16.26	-	-	-	-
5	No. of matured pods/plant	1	11.52	10.77	11.38	89.54	21
		2	11.81	7.22	7.41	94.78	14.47
		3	9.88	5.08	9.34	29.58	5.69
		4	11.32	5.21	7.74	45.25	7.21
		5	12.12	-	-	-	-
		6	12.66	4.81	5.18	86.05	9.18
		7	13.93	23.2	23.53	97.21	47.12
		8	12.9	3.54	4.16	72.28	6.2
		9	12.89	-	-	-	-
6	No. of immature pods/plant	1	4.44	15.09	18.69	65.15	25.09
		2	3.28	5.21	21.76	5.74	2.57
		3	2.97	35.54	35.85	98.24	72.56
		4	4.63	21.53	22.79	89.24	41.9
		5	5.28	11.93	13.62	76.76	21.53
		6	5.68	6.7	7.57	78.36	12.21
		7	5.85	-	-	-	-
		8	5.85	7.77	8.82	77.5	14.09
		9	6.17	-	-	-	-
7	Pod yield/plant (g)	1	15.15	-	-	-	-
		2	14.22	-	-	-	-
		3	13.94	-	-	-	-
		4	14.61	5.95	6.02	97.42	12.09
		5	14.23	13.33	13.33	100	27.45
8	Shelling outturn (%)	1	79.64	6.06	8.08	56.35	9.38
		2	81.08	-	-	-	-
		3	83.23	7.98	11.08	51.86	11.84
		4	79.29	10.8	11.57	87.21	20.78
		5	79.62	13.13	13.45	95.42	26.43
		6	82.12	6.14	11.73	27.38	6.62
		7	81.33	7.44	10.76	47.73	10.58
		8	74.3	10.35	14.07	54.04	15.67
		9	70.58	16.37	16.94	93.46	32.61
9	Kernel yield/plant (g)	1	12.07	4.03	9.22	19.14	3.63
		2	11.53	-	-	-	-
		3	11.6	9.7	11.45	71.68	16.91
		4	11.53	9.03	9.03	100	18.61
		5	11.23	9.97	13.37	55.63	15.32
		6	11.47	-	-	-	-
		7	11.5	4.71	9.89	22.67	4.62
		8	11.33	9.85	11.66	71.38	17.15
		9	12.67	23.92	24.56	94.83	47.98
10	100 mature kernel weight (g)	1	96.83	17.77	22.54	62.12	28.85
		2	98.07	-	-	-	-
		3	100.6	14.2	14.27	99.03	29.11
		4	100.9	18.35	18.4	99.42	37.69
		5	97.57	11.43	20.48	31.15	13.14
		6	103.43	-	-	-	-
		7	101.43	-	-	-	-
		8	99.87	20.12	20.27	98.54	41.14
		9	94.7	-	-	-	-
11	Oil content (%)	1	50.74	1.45	3.14	21.29	1.38
		2	48.39	-	-	-	-
		3	49.65	4.3	4.3	99.94	8.85
		4	49.18	2.2	3.55	38.51	2.81
		5	50.04	3.65	4.66	61.4	5.89
		6	48.14	3.37	3.48	93.86	6.73
		7	48.67	1.65	2.17	57.67	2.58
		8	49.5	4.24	4.69	81.59	7.88
		9	48.98	-	-	-	-
12	Biological yield/plant (g)	1	38.78	0.42	5.11	0.66	0.07
		2	38.62	-	-	-	-
		3	38.29	3.83	4.92	60.61	6.15
		4	38.27	4.56	5.3	73.79	8.06
		5	38.6	5.44	5.5	97.78	11.08
		6	38.46	-	-	-	-
		7	38.98	-	-	-	-
		8	38.53	5.06	5.23	93.59	10.08
		9	38.74	3.09	4.75	42.22	4.13
13	Harvest index (%)	1	39.19	3	7.27	16.98	2.54
		2	36.89	-	-	-	-
		3	36.47	-	-	-	-
		4	38.28	7.28	8.13	80.1	13.42
		5	36.89	12.73	12.77	99.31	26.13
		6	36.53	-	-	-	-
		7	36.46	-	-	-	-
		8	40.03	0.38	11.1	0.12	0.03
		9	47.79	29.73	29.74	99.94	61.23
7	Pod yield/plant (g)	6	14.01	-	-	-	-
		7	14.19	6.35	7.76	67.01	10.71
		8	15.38	1.32	9.47	1.94	0.38
		9	18.5	30.04	30.14	99.36	61.69

Cross 1 = TLG 45 x ICGV-05155  
 Cross 4 = SG-99 x R-8808  
 Cross 7 = JSSP-LS-58 x CS-19

Cross 2 = JL – 501 x KDG-128  
 Cross 5 = ALG-234 x ICGV-00350  
 Cross 8 = TPG-41 x GG-16

Cross 3 = K-1641 x ALR-3  
 Cross 6 = TAG-24 x ICGV-6110  
 Cross 9 = J-89 x ISK-I-16-13

**CONCLUSION**

The mean sums of squares due to genotypes and parents were highly significant for all the characters except significant for biological yield per plant and non-significant for shelling outturn (%) and mean sums of squares due to F<sub>3</sub>s were highly significant for all the characters except significant for days to maturity and non-significant for 100-matured

kernel weight, oil content (%) and biological yield per plant and mean sum of square due to parents vs crosses were highly significant for all the characters except significant for number of matured pods per plant and non-significant for shelling outturn, kernel yield, 100-matured kernel weight, oil content (%) and harvest index indicating there by sufficient amount of variability was present in the material studied.

The results indicated that crosses under this study were exceeded the range of their respective parents either in negative or positive directions indicating transgressive segregation in characters, should be exploited to select for individual superior to the parents.

The estimates of genotypic coefficient of variances were quite close to the phenotypic coefficient of variances and moderate to high in magnitude in most of the crosses for all the characters except in days to appearance of first flower, days to maturity, oil content and biological yield per plant. Moderate heritability values were noticed for most of the characters. Genetic advance expressed as percent of mean was high for number of primary branches per plant, plant height, number matured pods per plant, number immature pods per plant, pod yield per plant, shelling outturn, kernel yield per plant, 100-mature kernel weight and harvest index. High heritability coupled with high genetic advance and high value of GCV and PCV for number of matured pods per plant in Cross 7 (JSSP-LS-58 × CS-19). Thus, it can be concluded that this Cross 7 for number of matured pods per plant was mainly under the influence of additive gene action and selection would be effective for improving these traits.

### REFERENCES

- Allard, R. W. (1960). *Principles of Plant Breeding*. John Willey and Sons, New York.
- Bhagat, N. R., Ahmad, T., Lalwani, H. B., & Nagraj, G. (1986). Variation, character association and path analysis in improved groundnut varieties. *Indian J. agric. Sci.*, 56, 300-302.
- Bhargavi, G., Satyanarayana Rao, V. R., & Narasimha Rao, K. L. (2016). Genetic variability, heritability and genetic advance of yield and related traits of Spanish bunch groundnut (*Arachis hypogaea* L.). *Agric. Sci. Digest*, 36(1), 60-62.
- Chauhan, R. M., & Shukla, P. T. (1985). Variability, heritability and genetic advance in bunch and spreading types of groundnut. *Indian J. agric. Sci.*, 55, 71-74.
- Dandu, S. J., Vasanthi, R. P., Reddy, K. R., & Sudhakar, P. (2012). Variability, heritability and genetic advances in F<sub>2</sub> generation of 15 crosses involving bold-seeded genotypes in groundnut (*Arachis hypogaea* L.). *Int. J. Appl. Biol. Pharm. Technol.*, 3(1), 368-372.
- Gupta, R. P., Vachhani, J. H., Kachhadia, V. H., Vaddoria, M. A., & Reddy, P. (2015). Genetic variability and heritability studies in Virginia groundnut (*Arachis hypogaea* L.). *Electron. J. Plant Breed.*, 6(1), 253-256.
- Jayalakshmi, V., Reddy, P. V., Reddy, G., & Haritha, S. (2001). Heritability and genetic advance in segregating populations of groundnut (*Arachis hypogaea* L.). *Legume Res.*, 24, 141-147.
- John, K., Raghava, P. R., Hariprasad, P. R., Sudhakar, P., & Eswar, N. P. (2011). Genetic variability for morphological, physiological, yield and yield traits in F<sub>2</sub> populations of groundnut (*Arachis hypogaea* L.). *Int. J. Appl. Biol. Pharm. Technol.*, 2(4), 463-469.
- John, K., Vasanthi, R. P., Sireesha, K., & Giridharakrishna, T. (2013). Genetic variability studies in different advanced breeding genotypes of Spanish bunch groundnut (*Arachis hypogaea* L.). *Int. J. Appl. Biol. Pharm. Technol.*, 4(2), 185-187.
- John, K., Vasanthi, R. P., & Venkateswarlu, O. (2007). Variability and correlation studies for pod yield and its attributes in F<sub>2</sub> generation of six Virginia x Spanish crosses of groundnut (*Arachis hypogaea* L.). *Legume Res.*, 30(4), 292-296.
- Kumar, K., Prashant, K. R., Arvind, K., Bazil, A. S., & Chaurasia, A. K. (2014). Study on the performance of groundnut (*Arachis hypogaea* L.) genotypes for quantitative traits in Allahabad region. *Carib. J. Sci. Tech.*, 2, 564-569.
- Kumar, P. R., & Rajamani, S. (2004). Genetic variability and heritability in groundnut (*Arachis hypogaea* L.). *Indian J. agric. Res.*, 16, 61-64.
- Maurya, M. K., Rai, P. K., Kumar, A., Bazil, A., & Singh & Chaurasia, A. K. (2014). Study on genetic variability



- and seed quality of groundnut (*Arachis hypogaea* L.) genotypes. *Int. J. Emerg. Tech. Adv. Engg.*, 4(6), 818-823.
- Mahmud, I., & Kramer, H. H. (1951). Segregation for yield, height and maturity following a soybean cross. *Agron. J.*, 43, 605-609.
- Nadaf, H. L., & Habib, A. F. (1989). Correlation studies in bunch groundnut. *Agric. Sci. Digest*, 9, 4-6.
- Padmaja, D., Eswari, K. B., Brahmeswara Rao, M. V., & Madhusudhan, R. S. (2013). Genetic variability parameters for yield components and late leaf spot tolerance in BC<sub>1</sub>F<sub>2</sub> population of groundnut (*Arachis hypogaea* L.). *Int. J. Inn. Res. Dev.*, 2(8), 348-354.
- Patidar, S., Rai, P. K., & Kumar, A. (2014). Evaluation of groundnut (*Arachis hypogaea* L.) genotypes for quantitative characters and yield contributing traits. *Int. J. Emerg. Tech. Adv. Engg.*, 4(7), 500-504.
- Patil, A. S., Punewar, A. A., Nandanwar, H. R., & Shah, K. P. (2014). Estimation of variability parameters for yield and its component traits in groundnut (*Arachis hypogaea* L.). *Int. Qua. J. Lif. Sci.*, 9(2), 749-754.
- Prabhu, R., Manivannan, N., Mothilal, A., & Ibrahim, S. M. (2015). Estimates of genetic variability parameters for yield and yield attributes in groundnut (*Arachis hypogaea* L.). *Internat. J. Agric. Environ. Biotech.*, 8(3), 551-559.
- Prabhu, R., Manivannan, N., Mothilal, A., & Ibrahim, S. M. (2017). Variability, correlation and path coefficient analysis in groundnut (*Arachis hypogaea* L.). *Stat. Appr. on Mult. Res.*, 5(1), 55-67.
- Ramana, E. V., Vasanthi, R. P., Reddy, K. H., Bhaskara, R. B. V., & Ravindra, R. B. (2015). Studies on genetic variability for yield, yield components and resistance to kalahasti malady in groundnut (*Arachis hypogaea* L.). *Int. J. Appl. Biol. Pharm. Technol.*, 6(1), 72-74.
- Raut, R. D., Dhaduk, L. K., & Vachhani, J. H. (2010). Studies on genetic variability and direct selections for important traits in segregating materials of groundnut (*Arachis hypogaea* L.). *Internat. J. agri. Sci.*, 6(1), 234-237.
- Rudraswamy, P., Nehru, S. D., Kulkarni, R. S., & Manjunath, A. (1999). Estimation of genetic variability and inbreeding depression in six crosses of groundnut (*Arachis hypogaea* L.). *Mysore J. agric Sci.*, 33, 248-252.
- Shukla, A. K., & Rai, P. K. (2014). Evaluation of groundnut genotypes for yield and quality traits. *Ann. Plant Soil. Res.*, 16(1), 41-44.
- Singh, S. B., & Chaubey, A. K. (2003). Variability and association amongst quantitative traits in peanut (*Arachis hypogaea* L.) genotypes. *J. Res. PAU*, 38, 147-152.
- Singh, H., Yadav, A. K., Yadava, T. P., & Chhabra, M. L. (1982). Genetic variability and heritability for morpho-physiological attributes in groundnut. *Indian J. agric. Sci.*, 52, 432-434.
- Thakur, S. B., Ghimire, S. K., Pandey, M. P., Shrestha, S. M., & Mishra, D. B. (2011). Genetic variability, heritability and genic advance of pod yield component traits of groundnut (*Arachis hypogaea* L.). *J. Inst. Agric. Anim. Sci.*, 32, 133-141.
- Vekariya, H. B., Khanpara, M. D., Vachhani, J. H., Kachhadia, V. H., Madariya, R. B., & Jivani, L. L. (2011). Variability and heritability studies in bunch groundnut (*Arachis hypogaea* L.). *Int. J. agric. Sci.*, 7(1), 32-34.
- Vishnuvardhan, K. M., Vasanthi, R. P., Reddy, K. H., & Reddy, B. V. B. (2012). Genetic variability studies for yield attributes and resistance to foliar diseases in groundnut (*Arachis hypogaea* L.). *Int. J. Appl. Biol. Pharm. Technol.*, 3(1), 390-394.
- Yadav, L. S., Singh, P., & Singh, A. B. (1998). Studied on variability, heritability and genetic advance in Spanish bunch groundnut. *J. Living World*, 5, 18-23.