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Estimates of Genetic Parameters for Morphological, Yield and Yield Traits in Groundnut (A*rachis hypogaea* L)

K John, P Raghava Reddy, P Hariprasad Reddy, P Sudhakar and N P Eswar Reddy
Regional Agricultural Research Station, Tirupati 517 502, Anadhra Pradesh

ABSTRACT

Twenty eight F_1 crosses were evaluated for genetic parameters of 15 characters of morphological, yield and yield attributes during *kharif* 2009. JL-220 recorded the highest *per se* performance for number of well-filled and mature pods per plant, 100-kernel weight, harvest index and protein per cent. TPT-4 showed the highest *per se* performance for shelling per cent. ICGV-99029 recorded the maximum *per se* performance for number of secondary branches per plant, kernel yield per plant and pod yield per plant. Among the F_1s, TPT-4 x ICGV-99029 was distinct for its highest mean values for number of primary branches per plant, number of mature pods per plant, shelling per cent, dry haulms yield per plant, kernel yield per plant and pod yield per plant. It is evident that number of secondary branches per plant had high heritability coupled with high genetic advance as per cent of mean and is least influenced by environment, therefore selection for this character would be effective. Moderate heritability and high genetic advance as per cent of mean was observed for number of well-filled and mature pods per plant and dry haulms yield per plant indicating importance of both additive and non-additive gene action in the inheritance of these traits. Low heritability and moderate GAM was noticed for kernel yield per plant and pod yield per plant indicating the importance of both additive and non additive gene effects for this traits.

Key words : Genetic advance, Groundnut, Heritability, Morphological, Variability.

Crop improvement is a continuous process which takes care of the changing needs and new problems arising in crop productivity. Groundnut is the important oilseed crop of India. Though it leads in area and production in the world its productivity is low due to various abiotic and biotic stresses. Further, pod yield besides physiological traits in groundnut are quantitatively inherited complex traits and is highly influenced by environment. The genetic variability has to be looked into for planning suitable measures for the crop improvement. This necessitates a through knowledge of variability owing to genetic factors, actual genetic variation heritable in the progeny and the genetic advance that can be achieved through selection. The present study is aimed at evaluating the genetic parameters for morphological, yield and yield attributes for efficient selection in segregating generations.

MATERIAL AND METHODS

The experimental material comprised of 28 F_1s. The present investigation was carried out at Regional Agricultural Research Station Farm, Tirupati during *kharif* 2009. The 28 F_1s and their parents were grown in randomized block design with three replications. Each entry was sown in three rows of 3 m length by adopting spacing of 30 x 10 cm. Observations were recorded on ten competitive plants in F_1 generation and twenty plants in parents were selected at random for 13 characters *viz.,* plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of well-filled and mature pods per plant, shelling per cent, sound mature kernel per cent, 100-kernel weight (g), dry haulm weight per plant (g), harvest index (%), oil per cent, protein per cent, kernel yield per plant (g) and pod yield per plant (g). Days to 50 per cent flowering and days to maturity were recorded on plot basis. The phenotypic and genotypic coefficients of variations were computed according to Burton (1952). The heritability in broad sense was computed as suggested by Allard (1960) and genetic advance as percentage of mean as per Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance for 15 characters in parents and F_1generation revealed that significant differences were observed for all the characters indicating presence of a high degree of variability (Table 1).

Table 1. Analysis of variance (Mean squares) for 23 quantitative characters among 8 parents and 28 F_1s of groundnut.

Character	Replications d.f. = 2	Treatments d.f. = 35	Error d.f. = 70
Days to 50 per cent flowering	0.2322	11.8117**	0.7838
Days to maturity	2.5069	25.2417**	1.7950
Plant height	2.0955	40.3926**	10.6697
Number of primary branches per plant	0.1021	0.8676*	0.4501
Number of secondary branches per plant	0.0162	24.6748**	2.3279
Number of well-filled and mature pods per plant	21.6498	45.9631**	10.6478
Shelling per cent	38.8160	123.5518**	74.7767
Sound mature kernel per cent	24.1563	33.1185*	19.9238
100-kernel weight	18.7925	47.0647**	22.5097
Dry haulm weight per plant	140.9358	299.0510**	73.0272
Harvest index	40.4974	74.7647**	21.2815
Oil per cent	0.1285	0.9304**	0.3995
Protein content	0.2782	0.1891*	0.1145
Kernel yield per plant	23.0448	22.9125**	8.0801
Pod yield per plant	17.8025	36.0775**	12.4283

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

Out of the eight parents used in the study, TCGS-584 and JL-220 showed the lowest *per se* performance for 50% flowering and days to maturity. These two genotypes were early maturing. TCGS-584 was found to be shortest in height. JL-220 recorded the highest *per se* performance for number of well-filled and mature pods per plant, 100-kernel weight, harvest index and protein per cent. TPT-4 showed the highest *per se* performance for shelling per cent (Table 2). The parental genotype, K-1375 exhibited the highest *per se* performance for number of primary branches per plant, sound mature kernel per cent and oil per cent. The other parent *viz*., ICGV-99029 recorded the maximum *per se* performance for number of secondary branches per plant, kernel yield per plant and pod yield per plant. The highest *per se* performance for dry haulms yield per plant was registered by TIR-25.

Among the F_1, TPT-4 x ICGV-99029 was distinct for its highest mean value for number of primary branches per plant, number of mature pods per plant, shelling per cent, dry haulms yield per plant, kernel yield per plant and pod yield per plant (Table 2). Other F1s, involving TPT-4 as one of parents showing lowest *per se* performance is TPT-4 x TCGS-584 for days to 50 per cent flowering and highest *per se* performance was recorded by the F_1, TPT-4 x JL-220 for SMK per cent. The F1 s involving ICGV-99029 as one of the parents *viz*., ICGV-91114 x ICGV-99029 for number of secondary branches per plant, and TCGS-584 x ICGV-99029 for both leaf area index and protein per cent showed the highest *per se* performance. The F_1 crosses, TIR-25 x ICGV-91114 and K-1375 x TCGS-647 recorded the lowest *per se* performance for days to 50 per cent flowering for plant height respectively. The other F_1s, *viz*., JL-220 x TCGS-647 for 100-kernel weight, TIR-25 x JL-220 for harvest index and ICGV-91114 x K-1375 for oil per cent showed the highest *per se* performance.

In the present study high PCV recorded for number of primary branches per plant and moderate values for number of mature pods per plant, dry haulms yield per plant, kernel yield per plant and pod yield per plant and the all other characters showed low PCV values.The study of genotypic coefficient of variation revealed that except number of secondary branches per plant, number of well-filled and mature pods per plant and dry haulms yield per plant all the characters showed narrow genetic variability and thereby offering a limited opportunity to improve further these characters (Table 3). Similar results were obtained by Quadri and Khunti (1982), Mishra and Yadava (1992), Nisar Ahmed

Table 2. *Per se* performance of 8 parents and 28 F_1s for 23 quantitative characters in groundnut.

Parents/crosses	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of well-filled and mature pods per plant	Shelling per cent
Parents							
TPT-4	22.33	106.33	45.37	4.33	2.53	12.47	81.83
TIR-25	25.00	108.33	49.67	4.43	1.97	16.10	73.42
ICGV-91114	21.00	100.33	48.40	4.13	0.87	17.63	79.48
TCGS-584	25.33	101.00	43.77	4.57	1.37	19.07	70.01
JL-220	20.67	101.33	44.13	4.57	1.37	20.90	73.87
ICGV-99029	29.00	115.00	50.47	4.70	5.53	12.33	74.63
K-1375	24.33	108.67	48.47	5.17	2.97	14.97	80.18
TCGS-647	28.67	109.00	45.73	4.30	3.13	10.23	65.72
Crosses							
TPT-4 x TPT-25	21.33	103.00	41.73	3.87	0.70	14.97	72.74
TPT-4 x ICGV-91114	21.00	103.67	46.03	4.37	0.83	11.67	71.06
TPT-4 x TCGS-584	20.00	104.00	44.97	4.83	2.30	19.80	74.34
TPT-4 x JL-220	20.77	104.00	43.07	4.07	0.97	14.07	79.71
TPT-4 x ICGV-99029	23.67	106.00	47.53	5.73	8.60	23.53	84.48
TPT-4 x K-1375	23.67	103.00	42.40	4.27	1.70	14.67	63.57
TPT-4 x TCGS-647	23.33	103.00	43.10	4.17	1.27	14.10	75.39
TIR-25 x ICGV-91114	21.67	100.33	41.13	4.13	2.03	11.00	82.68
TIR-25 x TCGS-584	21.33	102.67	41.60	4.27	2.10	16.20	82.12
TIR-25 x JL-220	20.67	102.00	40.87	4.50	1.50	19.00	61.64
TIR-25 x ICGV-99029	26.33	112.67	44.37	6.07	6.93	14.73	71.83
TIR-25 x K-1375	21.33	104.00	42.13	4.25	2.57	14.73	75.28
TIR-25 x TCGS-647	21.67	102.00	42.80	5.67	7.27	15.53	77.14
ICGV-91114 X TCGS-584	25.33	101.00	39.23	3.70	1.57	10.00	74.19
ICGV-91114 X JL-220	20.00	103.00	37.97	4.03	0.40	7.80	80.35
ICGV-91114 X ICGV-99029	23.67	103.00	45.33	5.13	11.73	18.63	62.38
ICGV-91114 X K-1375	23.33	106.00	41.07	4.07	1.80	11.33	63.10
ICGV-91114 X TCGS-647	24.67	105.33	39.87	4.57	4.07	12.80	71.23
TCGS-584 X JL-220	25.67	104.00	39.33	4.37	1.20	11.77	71.20
TCGS-584 X ICGV-99029	27.33	106.00	42.80	4.40	7.57	20.60	69.91
TCGS-584 X K-1375	22.67	102.67	36.93	3.80	1.10	9.40	74.11
TCGS-584 X TCGS-647	23.33	103.67	45.30	4.80	3.03	12.00	66.72
JL-220 X ICGV-99029	24.33	112.33	49.80	4.30	7.20	11.40	69.24
JL-220 X K-1375	23.33	103.33	49.53	4.37	6.50	11.47	68.66
JL-220 X TCGS-647	24.00	105.67	46.63	4.93	8.63	14.07	63.16
ICGV-99029 x K-1375	24.33	107.00	44.87	4.43	2.50	15.73	75.31
ICGV-99029 x TCGS-647	24.33	107.00	45.97	4.53	5.63	20.33	73.13
K-1375 x TCGS-647	24.33	110.33	36.20	5.30	5.80	17.03	70.48
Mean of parents	25.54	106.25	47.00	4.53	2.47	15.46	74.83
Range among parents	20.67-29.00	100.33-115.00	43.77-50.47	4.13-5.17	0.87-5.53	10.23-20.90	65.72-81.33
Mean of F_1s	24.03	104.67	42.95	4.53	3.84	14.23	72.33
Range among F_1s	20.00-27.33	100.33-112.67	36.20-49.80	3.80-6.07	0.40-8.63	7.03-23.53	61.64-84.48
CD at 5% level	1.44	2.18	5.320	1.09	2.48	5.31	14.30

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Parents/ crosses	Sound mature kernel per cent (%)	100-kernel weight (g)	Dry haulm weight per plant (g)	Harvest index (%)	Oil per cent	Protein per cent	Kernel yieldper plant (g)	Pod yield per plant (g)
Parents								
TPT-4	87.93	39.77	23.23	38.35	47.63	26.20	14.07	17.30
TIR-25	83.83	35.63	27.83	36.27	47.67	26.30	11.51	15.70
ICGV-91114	93.50	43.14	16.93	38.29	47.63	26.40	11.51	14.53
TCGS-584	90.17	40.71	25.70	40.57	47.73	26.23	10.27	14.67
JL-220	90.67	45.28	23.77	41.08	47.80	26.27	12.24	16.57
ICGV-99029	89.17	43.03	27.47	32.94	47.60	26.03	14.37	18.53
K-1375	92.40	40.98	26.50	38.87	47.93	26.03	13.55	16.90
TCGS-647	84.57	43.34	24.70	39.10	47.57	26.33	6.92	10.53
Crosses								
TPT-4 x TPT-25	82.17	35.76	22.33	36.39	47.57	25.63	9.04	12.33
TPT-4 x ICGV-91114	89.47	43.25	23.13	35.63	47.93	26.27	9.20	12.80
TPT-4 x TCGS-584	91.47	40.80	22.90	41.59	47.37	25.93	11.29	15.30
TPT-4 x JL-220	92.83	41.99	22.03	39.70	47.97	25.77	11.46	14.57
TPT-4 x ICGV-99029	86.77	42.01	64.43	25.84	47.77	26.47	18.51	21.97
TPT-4 x K-1375	90.90	42.43	37.80	33.02	47.73	26.47	11.81	18.43
TPT-4 x TCGS-647	90.63	41.71	19.90	40.74	47.80	26.20	10.11	13.53
TIR-25 x ICGV-91114	90.47	38.75	18.60	32.81	47.73	26.00	7.67	9.17
TIR-25 x TCGS-584	92.67	42.43	15.13	41.80	47.53	26.33	9.22	11.13
TIR-25 x JL-220	86.30	40.38	25.47	44.56	47.93	26.13	9.61	15.53
TIR-25 x ICGV-99029	87.20	42.57	45.73	29.73	46.87	26.37	11.18	15.63
TIR-25 x K-1375	88.83	39.51	25.23	41.73	47.67	26.33	14.00	18.50
TIR-25 x TCGS-647	85.70	42.49	34.90	34.21	47.43	26.37	13.58	17.67
ICGV-91114 X TCGS-584	89.50	30.29	17.07	35.29	47.50	26.10	6.87	9.27
ICGV-91114 X JL-220	88.73	38.86	12.00	40.91	47.20	26.63	6.78	8.47
ICGV-91114 X ICGV-99029	82.90	37.50	34.30	27.23	47.67	26.27	11.47	18.00
ICGV-91114 X K-1375	85.57	36.82	21.87	35.87	48.07	26.23	7.54	11.90
ICGV-91114 X TCGS-647	83.60	34.73	25.53	32.22	47.00	26.43	8.78	12.17
TCGS-584 X JL-220	79.60	37.91	17.23	37.16	47.90	26.40	7.34	10.23
TCGS-584 X ICGV-99029	86.30	48.64	42.80	32.40	47.53	26.70	13.62	20.20
TCGS-584 X K-1375	84.90	45.74	13.87	42.30	47.63	26.73	7.57	10.13
TCGS-584 X TCGS-647	85.43	45.33	26.10	33.36	47.20	26.60	8.57	12.80
JL-220 X ICGV-99029	87.57	39.75	30.17	27.59	46.83	26.40	7.78	11.20
JL-220 X K-1375	89.93	47.95	33.53	27.27	47.10	26.23	8.16	11.90
JL-220 X TCGS-647	87.43	49.33	34.23	32.73	45.37	26.33	10.33	16.57
ICGV-99029 x K-1375	87.70	36.76	21.63	38.41	46.73	25.80	10.27	13.53
ICGV-99029 x TCGS-647	91.30	40.91	28.53	37.93	46.33	25.93	12.42	17.13
K-1375 x TCGS-647	84.43	41.12	21.83	27.68	46.37	26.43	5.85	8.37
Mean of parents	89.03	41.49	24.52	38.18	47.70	26.22	11.81	15.60
Range among parents	83.83-93.50	35.63-45.28	16.93-27.83	32.94-41.08	47.57-47.93	26.03 -26.40	6.92-14.37	10.53-18.53
Mean of F_1s	87.51	42.05	27.08	35.21	47.35	26.26	10.46	13.87
Range among F_1s	79.60-92.83	30.29-49.33	12.00-64.43	27.27-44.56	45.37-48.07	25.63-26.73	5.85-18.51	8.37-21.97
CD at 5% level	7.24	7.72	13.91	7.51	1.03	0.55	4.63	5.74

Table 3. Estimates of genetic parameters for 15 quantitative characters in eight parents and 28 F_1s in groundnut.

Character	Mean	Co-efficient of variation		Heritability in broad sense (H_{BS})	Genetic advance (GA)	Genetic advance as percent of mean (GAM)
		Phenotypic coefficient of variation	Genotypic coefficient of variation			
Days to 50 per cent flowering	24.03	6.69	5.54	68.53	2.14	8.91
Days to maturity	104.67	1.76	1.39	62.81	2.35	2.25
Plant height (cm)	42.95	9.53	6.59	47.80	4.16	9.69
Number of primary branches per plant	4.53	16.54	8.61	27.07	0.42	9.27
Number of secondary branches per plant	3.84	88.29	78.10	78.26	5.27	137.24
Number of well-filled and mature pods per plant	14.23	30.87	21.68	49.33	4.80	33.73
Shelling per cent	72.33	14.63	5.32	13.23	2.93	4.05
Sound mature kernel per cent	87.51	5.83	0.70	1.44	0.15	0.17
100-kernel weight (g)	42.05	11.81	5.00	17.92	1.84	4.38
Dry haulm weight per plant (g)	27.08	45.86	32.46	50.11	13.30	49.11
Harvest index (%)	35.21	17.46	12.03	47.47	6.20	17.61
Oil per cent	47.35	1.65	0.86	27.06	0.44	0.93
Protein per cent	26.26	1.34	0.48	12.70	0.09	0.34
Kernel yield per plant (g)	10.46	32.53	16.95	27.14	2.04	19.50
Pod yield per plant (g)	13.87	28.26	15.08	28.48	2.53	18.24

(1995), Naik *et al.* (2000), Parameshwarappa *et al.,* (2004) and Korat *et al.* (2009).

Heritability estimates indicate the heritable portion of the variation and the estimation of genetic advance would show the extent of genetic gain that could be expected through selection in the character to be improved upon (Burton, 1952 and Johnson *et al.,* 1955). Heritability in broad sense includes additive and epistatic gene effects, and therefore it will be reliable only if accompanied by high genetic advance as reported by Ramanujam and Thirumalachari (1967). In the present investigation, high heritability estimates were observed for days to 50 per cent flowering, days to maturity and number of secondary branches per plant. Reddy and Gupta (1992) and Seethala devi (2004) reported high heritability for harvest index. Moderate heritability was recorded for plant height, number of well-filled and mature pods per plant, harvest index and dry haulms yield per plant. Naik *et al.* (2000) reported low genotypic coefficient of variation and heritability for sound mature kernel per cent. Seethala Devi (2004) reported high genotypic coefficient of variation and moderate heritability for sound mature kernel per cent.

Low heritability values were obtained for pod yield per plant and number of well-filled and mature pod per plant. Wang *et al.,* (1987) also noticed low heritability values for these characters. Low heritability for pod yield per plant was reported by Reddi *et al.,* (1986a) and Swamy Rao *et al.,* (1988).

The genetic gain that can be expected by selection for a character is given by the estimates of genetic advance. Among the characters, studied, number of secondary branches per plant, number of well-filled and mature pods per plant and dry haulms weight per plant showed high genetic advance as per cent of mean. Reddy and Gupta (1992) reported similar results. Moderate GAM recorded for harvest index, kernel yield per plant and pod yield per plant. However days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, shelling per cent, sound mature kernel per cent, 100-kernel weight, oil per cent and protein per cent exhibited low genetic advance as per cent of mean. Nagabhushanam *et al.* (1982), Vasanthi and Raja Reddy (2002) and Seethala Devi (2004) reported low genetic advance as per cent of mean for pod yield per plant.

From the foregone discussion, it is evident that number of secondary branches per plant had high heritability coupled with high genetic advance as per cent of mean are controlled by additive gene effects and are least influenced by environment (Table 4), therefore selection for these characters would be very effective. Moderate heritability and high genetic advance as per cent of mean was observed for number of well-filled and mature pods per plant and dry haulms yield per plant indicating importance of both additive and non-additive gene action in the inheritance of these traits. Moderate heritability and moderate GAM was recorded for harvest index which might be due to additive gene effects. High heritability and low GAM was observed for days to 50 per cent flowering and days to maturity indicated the importance of non-additive gene action. Low heritability and moderate GAM was noticed for kernel yield per plant and pod yield per plant indicating the importance of additive gene effects, selection for such characters may be rewarding.

Moderate heritability and low GAM was observed for plant height, whereas low heritability and low gain was observed for characters number of primary branches per plant, shelling per cent, sound mature kernel per cent, 100-kernel weight, oil per cent and protein per cent indicating the preponderance of non-additive gene action in inheritance of these characters. Hence, selection for these characters is not effective in early segregating generations and has to be carried in later generations. From the present findings it is evident that number of secondary branches per plant had high heritability coupled with high genetic advance as per cent of mean and is least influenced by environment, therefore selection for this trait would be more effective. Moderate heritability and high genetic advance as per cent of mean was observed for number of well-filled and mature pods per plant and dry haulms weight per plant indicating importance of both additive and non-additive gene action in the inheritance of these traits.

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