Legume Research, , 40(4) 2017 : 773-777
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.legumeresearch.in

Studies on variability, heritability and genetic advance as per cent of mean in Spanish bunch groundnut genotypes (*Arachis hypogaea* L.)

G. Bhargavi*, V. Satyanarayana Rao and D. Ratna Babu

Department of Genetics and Plant Breeding,
Agricultural College, Bapatla -522 101, Andhra Pradesh, India.
Received: 08-09-2015 Accepted: 05-11-2016 DOI:10.18805/lr.v0i0.7848

ABSTRACT

Twenty Spanish bunch groundnut genotypes were collected from Agriculture Research Station, Kadiri, Andhra Pradesh, along with the check TMV 2 were used to study their variability, heritability and genetic advance as per cent of mean for nineteen characters *viz.*, days to 50% flowering, SPAD chlorophyll meter reading (SCMR) at 40, 50, 60, 70 DAS and at maturity, days to maturity, number of mature pods per plant, biological yield per plant (g), pod yield per plant (g), biological yield per hectare (q), pod yield per hectare (q), harvest index, 100 kernel weight (g), shelling percentage, kernel yield per plant (g), kernel yield per hectare (q), oil content (%) and oil yield per hectare (q) during summer 2013 at Agricultural College farm, Bapatla. The results revealed that the highest PCV and GCV were observed for number of mature pods per plant. High heritability accompanied with high genetic advance as per cent of mean was recorded for number of mature pods per plant, biological yield per plant (g), pod yield per plant (g), biological yield per hectare (q), pod yield per hectare (q), kernel yield per plant (g), kernel yield per hectare (q), 100 kernel weight (g) and oil yield per hectare (q) indicating the preponderance of additive gene action which might be exploited through simple selection procedures. The study revealed that the genotypes Abhaya and JCG 88 were better for further breeding from yield point of view.

Key words: Genetic advance, Groundnut, Heritability, Mean value, Variability.

The cultivated groundnut (*Arachis hypogaea* L.) is one of the most important legume cash crop grown for its oil. Though a native of South America, the crop is cultivated in more than 90 countries around the world in an area of 23.95 M.ha with a production of 36.45 M.t and an average productivity of 1520 kg ha^{-1} (FAOSTAT, 2014). Around 90 per cent of the total production is from developing countries located in the semi arid tropics. India and China together contribute 50 per cent of the global pool. Groundnut is one of the most nourishing foods available in the world with 40-50 per cent oil content, 25-28 per cent protein content with high biological value and enriched with vitamin B and E. Globally, India ranks second in groundnut production with 6.96 M.t produced from an area of 5.34 M.ha with productivity of 1307 kg ha^{-1} during 2013-14. (Ministry of Agriculture, Government of India *http:// www.indiastat.com*). With the increasing demand for groundnut cultivation for its nutritive purpose, there is a need to identify superior genotypes and the genetic variability present among the genotypes. The basic key to bring about the genetic upgradation in a crop is to utilize the available genetic variability. The variability in the population is largely due to genetic cause with least environment effect, the possibility of selecting superior genotype is a prerequisite for obtaining higher yield, which is ultimate expression of various yield contributing characters. It is imperative to partition the observed variability into its heritable and non heritable components and to have an understanding of parameters like genetic co-efficient of variation, heritability and genetic advance. This study was undertaken to estimate variability for pod yield and yield contributing traits in groundnut genotypes covering heritability and genetic advance of pod yield components, so that it would be possible to establish suitable selection criteria for higher pod yield.

The experimental material comprised of twenty Spanish bunch groundnut genotypes obtained from Agriculture Research Station, Kadiri, Andhra Pradesh. The experiment was laid out in randomized block design with three replications at Agriculture College farm, Bapatla during summer, 2013. The experiment plots were prepared properly with basal dose of fertilizers *i.e* 20:40:20 kg NPK ha^{-1}. Each entry was accommodated in three rows of 5.0 m length with a spacing of 30 × 10 cm. In case of characters like days to 50 per cent flowering, days to maturity, shelling percentage, 100 kernel weight (g), harvest index, SPAD chlorophyll meter reading at 40, 50, 60, 70 DAS and at maturity, kernel yield per hectare (q), biological yield per hectare (q), pod yield per hectare (q), oil yield per hectare (q) and oil content (%), the observations were recorded on plot basis. The chlorophyll content was measured with SPAD chlorophyll meter on 5th or 6th leaf from the top of each representative plant between 10 A.M and 12 noon of the

*Corresponding author's e-mail: bharu0713@gmail.com

day. Oil content was estimated by using Soxhlet method as described by Sadasivam and Manickam (1992). The amount of oil present in the sample was calculated by using the following formula,

$$\text{Oil in ground sample (\%)} = \frac{\text{Weight of oil (g)}}{\text{Weight of sample (g)}} \times 100$$

Where as observations such as kernel yield per plant (g), number of mature pods per plant, biological yield per plant (g) and pod yield per plant (g) were recorded on 10 randomly selected plants per entry per replication. The data were subjected to statistical analysis and genetic parameters such as phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as per cent of mean were worked out as per Johnson *et al.* (1955) and Hanson (1963).

The analysis of variance revealed significant differences among all the 20 genotypes for all the characters studied, indicating a high degree of variability in the material (Table 1). The mean value (Table 2) exhibited that genotypes Vemana and Tirupati required the highest days to flowering (35 days) and the lowest days was required by Abhaya (29 days). Similarly the SCMR at 40 DAS was the highest for genotype K- 1622 (44.43) and lowest for genotype Narayani (38.13) (Table 2). For the character SCMR at 50 days genotype K 1622 recorded the highest value (45.80) and the genotype Kadiri 5 recorded the least value (38.00). The highest SCMR at 60 DAS and SCMR at 70 DAS were exhibited by the genotype K 1622 (45.80, 46.77) respectively and the lowest by the genotype Tirupati 4 (37.73,39.53) respectively. The character SCMR at maturity exhibited the highest value in Vemana (47.53) and the lowest in genotype Kadiri 9 (41.20). The character days to maturity, the genotype Vemana required more days to mature (119) and the genotype Kadiri 9 took less days to mature (105). Considering the character number of mature pods per plant, the check TMV 2 produced maximum number (11.81) and the genotype Kadiri 6 produced the minimum number (4.67). The character biological yield per plant exhibited the highest value in TAG 24 (32.71) and the lowest in genotype Kadiri 6 (13.21). Pod yield per plant was maximum in genotype JCG 88 (8.60) and minimum in genotype Kadiri 6 (3.72). The genotype TAG 24 exhibited the maximum biological yield per hectare (104.26) and minimum was exhibited by the genotype Kadiri 6 (42.08). The maximum pod yield per hectare was found in JCG 88 (27.34) and minimum was found in Kadiri 6 (11.85). The character harvest index was the highest in Tirupati (0.33) and the lowest in TAG 24 (0.20). Shelling percentage was the highest in Narayani (75.60) and the lowest in Kadiriharithandhra (67.37). Similarly maximum kernel yield per plant and kernel yield per hectare were observed in JCG 88 (6.01,19.10) and minimum were

Table 1: ANOVA for various yield and yield contributing characters of Spanish bunch groundnut in *Summer* 2013

Source of variation	df	Days to 50% flowering	SCMR at 40 DAS (No.)	SCMR at 50 DAS (No.)	SCMR at 60 DAS (No.)	SCMR at 70 DAS (No.)	SCMR at maturity (No.)	Days to maturity	No. of mature pod/plant	Biological yield/plant (g)	Pod yield/ plant (g)
		1	2	3	4	5	6	7	8	9	10
Replication	2	1.316	5.671	0.036	3.718	3.730	9.804	0.616	0.572	0.843	0.611
Treatments	1										
	9	7.385**	11.199**	9.757 **	10.316**	11.77 **	12.972**	36.329**	11.244**	52.638**	4.549 **
Error	3										
	8	1.264	4.458	4.699	4.693	5.034	5.477	1.721	0.472	2.168	0.435

Source of variation	df	Biological yield/ hectare(q)	pod yield/ hectare(q)	Harvest index	Shelling (%)	Kernel yield/ plant(g)	Kernel yield/ hectare(q)	100 Kernel weight(g)	Oil content (%)	Oil yield/ hectare(q)
		11	12	13	14	15	16	17	18	19
Replication	2	7.541	6.835	0.0006	4.097	0.484	5.208	7.454	0.994	8117.58
Treatments	19	531.398 **	45.625**	0.0042**	13.609**	2.315**	23.250**	52.156**	10.830**	38032.20**
Error	38	23.687	4.382	0.0011	3.868	0.235	2.294	2.340	2.209	4500.727

*= significant at 0.05 level
**= significant at 0.01 level

Table 2 : Mean performance of 20 Spanish bunch genotypes for 19 characters during summer 2013

Character	Days to 50% flowering	SCMR at 40 DAS	SCMR at 50 DAS	SCMR ar 60 DAS	SCMR at 70 DAS	SCMR at 80 DAS	Days to Maturity	No. of maturity pods per Plant	Biological Yield per plant (g)	Pod yield per plant (g)	Biological yield per hectare (q)	Pod yield/ hectare (q)	Harvest index	Shelling (%)	Kernel yield per plant (g)	Kernel yield per hectare (q)	100 kernel weight (g)	Oil content (%)	Oil yield per hactare (q)
Vemana	35.00	40.43	42.80	44.53	46.67	47.53	119.00	8.39	24.57	6.32	78.09	20.09	0.26	68.58	4.34	13.77	22.87	43.43	600.44
Kadiri 4	32.00	43.47	44.23	45.67	45.53	45.70	114.00	7.59	23.64	5.61	75.55	17.91	0.24	73.91	4.15	13.23	25.35	44.67	593.02
Kadiri 5	34.00	38.50	38.00	41.30	42.53	43.60	113.00	7.90	19.44	5.92	61.80	18.80	0.31	71.89	4.25	13.50	24.15	43.67	589.61
Tirupati 4	34.00	40.53	41.30	37.73	39.53	42.43	108.00	5.47	24.71	5.56	78.73	17.70	0.23	71.46	3.97	12.67	32.34	45.70	578.54
Kadiriharithandra	32.33	42.83	41.80	42.67	43.57	42.60	108.33	8.14	26.53	6.49	84.80	20.74	0.24	67.37	4.38	14.00	28.72	42.90	601.21
Kadiri 9	30.00	40.50	40.67	41.63	42.63	41.20	105.00	7.00	22.91	5.51	72.97	17.55	0.24	71.96	3.96	12.60	30.45	44.67	563.66
Anantha	32.00	41.60	41.73	42.77	44.77	42.57	109.00	8.47	22.21	5.60	70.94	17.90	0.25	70.27	3.93	12.57	32.57	45.23	568.06
Tirupati 1	35.00	39.43	41.60	43.50	46.57	47.90	113.00	6.54	22.59	4.92	71.67	15.58	0.22	74.84	3.67	11.63	26.34	42.13	489.80
Tirupati 2	31.00	39.53	41.63	42.43	43.77	43.60	110.00	9.29	24.34	6.25	77.29	19.89	0.26	71.03	4.44	14.13	25.64	41.43	585.47
Tirupati 3	33.00	41.10	41.57	42.63	40.53	41.63	112.00	9.49	22.42	7.52	71.09	23.84	0.33	73.52	5.52	17.47	27.45	42.20	739.37
Kadiri 6	32.67	39.13	42.53	43.40	43.83	44.13	113.67	4.67	13.21	3.72	42.08	11.85	0.28	73.23	2.72	8.67	28.16	41.23	357.54
Narayani	31.00	38.13	38.50	43.93	42.80	45.27	111.33	6.06	28.05	6.04	89.56	19.31	0.22	75.60	4.57	14.60	37.45	41.37	604.18
Greeshma	32.00	38.33	40.23	43.63	44.20	43.60	111.00	10.40	25.99	7.62	82.60	24.24	0.29	71.93	5.48	17.43	27.00	41.53	723.35
Abhaya	29.00	39.80	41.27	42.63	43.73	42.47	112.33	10.37	25.76	8.05	82.31	25.71	0.31	72.76	5.85	18.67	28.98	41.13	768.38
JCG 88	33.00	39.50	42.67	43.50	43.63	44.67	116.00	11.33	27.58	8.60	87.69	27.34	0.31	69.81	6.01	19.10	29.63	42.47	810.89
TAG 24	31.00	42.43	43.63	44.37	45.77	46.30	113.33	8.61	32.71	6.54	104.26	20.83	0.20	74.58	4.88	15.53	29.77	43.43	675.40
K 1535	34.00	38.50	39.73	41.63	42.73	43.30	116.00	6.26	28.77	7.70	91.22	24.43	0.27	73.60	5.66	17.97	38.15	42.37	759.98
JL 24	31.67	42.57	41.37	45.70	46.73	46.83	108.67	9.12	21.21	6.67	67.76	21.28	0.31	69.86	4.66	14.87	28.51	37.03	549.41
K 1622	31.67	44.43	45.80	45.80	46.77	47.30	116.00	9.73	27.39	7.72	86.91	24.49	0.28	71.14	5.50	17.43	35.42	42.57	741.38
TMV 2 (check)	32.00	43.47	42.40	44.63	43.60	42.20	107.67	11.81	29.94	8.05	94.97	25.51	0.27	72.63	5.85	18.57	26.16	41.37	766.23
Mean	32.31	40.71	41.67	43.20	43.99	44.24	111.86	8.33	24.69	6.51	78.61	20.74	0.26	71.99	4.68	14.92	29.25	42.52	633.29
C.D (at 5%)	1.85	3.49	3.58	3.58	3.70	3.86	2.16	1.13	2.43	1.09	8.04	3.46	0.05	3.25	0.80	2.50	2.52	2.45	110.88
C.V (%)	3.47	5.18	5.20	5.01	5.10	5.28	1.17	8.24	5.96	10.12	6.19	10.08	12.61	2.73	10.33	10.15	5.22	3.49	10.59

observed in kadiri 6 (2.72,8.67) respectively. The character 100 kernel weight exhibited the highest value in genotype K 1535 (38.15) and the lowest in genotype Vemana (22.87). Maximum oil content was observed in genotype Tirupati 4 (45.70) and minimum was observed in JL 24 (37.03). The genotype JCG 88 exhibited highest oil yield per hectare (810.89) and the lowest was seen in genotype Kadiri-6 (357.54)

In the present study, the variation was also estimated character wise in terms of phenotypic and genotypic coefficients of variation (Table 3). Less difference between phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) indicated the low influence of environment on expression of these traits. High PCV (24.19) and GCV (22.74) exhibited by number of mature pods per plant indicated the greater variability and the scope for improvement of high yielding genotypes with desirable character. These results were in accordance with the findings of John *et al.* (2009). Moderate PCV and GCV were recorded for biological yield per plant (17.64, 16.60), biological yield per hectare (17.66, 16.54), harvest index (17.46, 12.07), 100 kernel weight (14.87, 13.92) and oil yield per hectare (19.77, 16.69) respectively, indicating the greater role of environment interaction with genetic factors in their variability expression. These results were in accordance with the findings of Korat *et al*. (2009), Sudhir *et al*. (2008) and Zaman *et al*. (2011). Low PCV and GCV were exhibited by days to 50 per cent flowering (5.62,4.42), SCMR at 40 DAS (6.36,3.68), SCMR at 50 DAS (6.06,3.11), SCMR at 60 DAS (5.93,3.16), SCMR at 70 DAS (6.13,3.40), SCMR at maturity (6.38, 3.57), days to maturity (3.25, 3.03), shelling percentage (3.70, 2.50) and oil content (5.30,3.98) respectively indicating the presence of low variability for these traits among the tested genotypes. Similar results were reported by John *et al*. (2009), John *et al*. (2011), Nandini *et al.* (2011), Zaman *et al.* (2011) and Thirumala *et al*. (2012).

Heritability estimates were high for days to 50 per cent flowering (61.75), days to maturity (87.01), no. of mature pods per plant (88.37), biological yield per plant (88.58), pod yield per plant (75.90), biological yield per hectare (87.72), pod yield per hectare (75.83), kernel yield per plant (74.68), kernel yield per hectare (75.28), 100 kernel weight (87.65) and oil yield per hectare (71.29) indicating little influence of environment on the inheritance of these characters. Similar results were obtained by John *et al.* (2009), John *et al*. (2011), Zaman *et al.* (2011) and Nandini *et al.* (2011).

Heritability estimate along with genetic advance as per cent of mean is more helpful in predicting the gain under selection than heritability estimate alone. The estimates of heritability and genetic advance as per cent of mean were high for number of mature pods per plant, biological yield per plant, pod yield per plant, biological yield per hectare, pod yield per hectare, kernel yield per plant, kernel yield per hectare and oil yield per hectare indicating that these characters were less influenced by environment and governed by additive gene action which might be exploited through simple selection procedures. They could be further improved

Table 3: Estimation of mean, range, genotypic and phenotypic coefficients of variation, heritability, genetic advance and genetic advance as percent of mean in 20 Spanish bunch groundnut genotypes in *Summer* 2013

Character	Mean	Range		GCV (%)	PCV (%)	Heritability (%)	Genetic advance	GA as % of mean
		Min.	Max.					
Days to 50% flowering	32.31	29.00	35.00	4.42	5.62	61.75	2.31	7.15
SCMR at 40 DAS (No.)	40.71	38.13	44.43	3.68	6.36	33.51	1.78	4.39
SCMR at 50 DAS (No.)	41.67	38.00	45.80	3.11	6.06	26.4	1.37	3.29
SCMR at 60 DAS (No.)	43.20	37.73	45.80	3.16	5.93	28.54	1.50	3.48
SCMR at 70 DAS (No.)	43.99	39.53	46.76	3.40	6.13	30.87	1.71	3.90
SCMR at 80 DAS (No.)	44.24	41.20	47.90	3.57	6.38	31.33	1.82	4.11
Days to maturity	111.86	105.00	119.00	3.03	3.25	87.01	6.52	5.83
No. of mature pods per plant	8.33	4.67	11.81	22.74	24.19	88.37	3.66	44.03
Biological yield per plant (g)	24.69	13.20	32.71	16.60	17.64	88.58	7.95	32.19
Pod yield per plant (g)	6.51	3.72	8.59	17.96	20.61	75.90	2.10	32.23
Biological yield per hectare (q)	78.61	42.07	104.25	16.54	17.66	87.72	25.09	31.92
Pod yield per hectare (q)	20.74	11.85	27.34	17.87	20.52	75.83	6.65	32.05
Harvest index (%)	0.26	0.20	0.33	12.07	17.46	47.79	0.04	17.19
Shelling (%)	71.99	67.36	75.60	2.50	3.70	45.63	2.50	3.48
Kernel yield per plant (g)	4.68	2.72	6.01	17.75	20.54	74.68	1.48	31.61
Kernel yield per hectare (q)	14.92	8.66	19.10	17.71	20.41	75.28	4.72	31.66
100 kernel weight (g)	29.25	22.86	38.15	13.92	14.87	87.65	7.85	26.86
Oil content (%)	42.52	37.03	45.70	3.98	5.30	56.53	2.62	6.17
Oil yield per hectare (q)	633.29	357.53	810.89	16.69	19.77	71.29	183.88	29.03

GCV= Genotypic coefficients of variation PCV= Phenotypic coefficients of variation GA = Genetic advance

through individual plant selection. These findings were in agreement with Sudhir *et al.* (2008), Shoba *et al.* (2009), John *et al*. (2011) and Zaman *et al*. (2011).

Whereas SCMR at 40 DAS, SCMR at 70 DAS, shelling percentage and oil content expressed moderate heritability accompanied with low genetic advance as per cent of mean indicating these traits are governed by non-additive gene action with little influence of environment in its inheritance. The traits controlled by non-additive gene action could be improved by selection and intermating among selected ones in early generation followed by reselection. Similar results were reported by Prasanna *et al.* (2012) and Thirumala *et al.* (2012).

The indicators used for the study were found to be highly significant among the genotypes. The yield parameters, days to 50 per cent flowering, days to maturity, number of mature pods per plant, biological yield per plant, pod yield per plant, biological yield per hectare, pod yield per hectare, kernel yield per plant, kernel yield per hectare, 100 kernel weight and oil yield per hectare were highly heritable. Hence selection of genotypes could be made during breeding programme. These yield parameters of groundnut could be improved through individual plant selection. The results of field experiment clearly indicated that medium duration genotypes JCG 88 (27.34) and Abhaya (25.71) compared to the check TMV 2 (25.51) were better genotypes from yield point of view.

REFERENCES

FAO (Food and Agricultural Organisation). 2014. FAO Database. http://www.fao.org

Hanson, W.O. (1963). In: *Heritability in Statistical Genetics and Plant Breeding,* [Hanson, W.O and Robinson, H.F. (eds.)], 1982. National Academy of Science and National Research Council, Washington D. C. pp. 125-139.

John, K., Reddy, P.R., Reddy, P.H., Sudhakar, P and Reddy, N.P.E.(2011). Genetic analysis for water use efficiency traits, yield and yield attributes in groundnut. *Electronic Journal of Plant Breeding*. **2(3):** 357-366.

John, K., Vasanthi, R.P and Venkateswarlu, O.(2009). Studies on variability and character association in Spanish bunch groundnut (*Arachis hypogaea* L.). *Legume Research.* **32(1)**: 65-69.

Johnson, H.W., Robinson, H.F and Comstock, R.E.(1955). Estimates of genetic and environmental variability in Soybean. *Agronomy Journal.* **47:** 314-318.

Korat, V.P., Pithia, M.S., Savaliya, J.J and Sodavadiya, P.R.(2009). Studies on genetic variability in different genotypes of groundnut. *Legume Research*. **32(3)**: 224-226.

Ministry of Agriculture, Government of India. 2013-14. http://www.indiastat.com.

Nandini, C., Savithramma, D.L and Naresh Babu, N. (2011). Genetic variability analysis for surrogate traits of water use efficiency in F_8 recombinant inbred lines of the cross NRCG 12568 x NRCG 1236 in groundnut. *Electronic Journal of Plant Breeding* **2(4):** 555-558.

Prasanna, R.A., Sekhar, R.M., Raja, R.K and Naik, K.S.S.(2012). Variability and genetic association studies of yield, physiological and confectionery traits in 28 F_2 crosses in groundnut (*Arachis hypogaea* L.). *Journal of Research ANGRAU*. **40(2):** 107-111.

Sadasivam, S and Manickam, A.(1992). *Biochemical Methods for Agricultural Sciences*. Wiley Eastern Limited. New Delhi. 10-11.

Shoba, D., Manivannan, N and Vindhiyavarman, P.(2009). Studies on variability, heritability and genetic advance in groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding.* **1:** 74-77.

Sudhir K.I., Venkataravana, P and Gururaja, M.R.(2008). Evaluation of new germplasm and advanced breeding lines of groundnut under late *kharif* situation. *Legume Research*. **31(4):** 254-258.

Thirumala, R.V., Bhanu, D., Murthy, K.G.K and Bharathi D.(2012). Genetic variability and association among the various characters in groundnut. *International Journal of Applied Biology and Pharmaceutical Technology*. **3**(3): 337- 341.

Zaman, M.A., Tuhina, K.M., Ullah, M.Z., Moniruzzam, M and Alam, K.H.(2011). Genetic variability and path analysis of groundnut. *The Agriculturist*. **9(1):** 29-36