International Journal of Farm Sciences **6(4):** 53-60, 2016

Assessment of genetic variability and identification of transgressive segregants for pod yield and its component traits in F_2 segregating generation of groundnut (*Arachis hypogea* L)

P SHASHIKUMARA, BG SANJEEV and P VENKATARAVANA*

Department of Genetics and Plant Breeding
University of agricultural Sciences, GKVK, Bangalore 560065 Karnataka, India
***AICRP on Groundnut, Agricultural Research Station**
Chintamani 563125 Karnataka, India
Email for correspondnece: venkatgpb@rediffmail.com

ABSTRACT

Three F_2 populations derived from three crosses viz KCG-6 × ICGV-91114, KCG-6 × TG-69 and TMV-2 × ICGV-00350 were assessed to estimate the nature and magnitude of genetic variability for pod yield and its component characters during Kharif 2014. The estimates of phenotypic (PCV) and genotypic (GCV) coefficients variances were high for pod yield, kernel yield, total pods, matured pods and oil yield per plant in all the crosses indicating wide range of variability. The difference between PCV and GCV was narrow signifying the lesser influence of environment on these characters. High heritability coupled with high genetic advance of mean (GAM) was noticed for matured pods, kernel yield, oil yield and pod yield per plant and harvest index and shelling per cent in all the three crosses which indicated the involvement of additive gene action in controlling these traits. Good number of transgressive segregants was observed over better parent for pod yield, oil content and matured pods per plant.

Keywords: Groundnut; heritability; genetic variability; genetic advance; transgressive segregants

INTRODUCTION

Groundnut (*Arachis hypogaea* L) is gaining more importance as food crop due to its high content of digestible proteins, vitamins, minerals, antioxidants, biologically active polyphenols, flavonoids and isoflavones. It covers 24 Mha area worldwide with a total production of 38 MT (Anon 2010).

Genetic variability is the basic requirement for crop improvement as this provides wider scope for selection. Thus effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability present in material and the extent to which it is heritable. The variability in the population is largely due to genetic cause with least environmental effect; the possibility of selecting superior genotype is a prerequisite for obtaining higher yield which is the ultimate expression of various yield contributing characters. Therefore direct selection for yield could be misleading (Islam and Rasul 1998). It is difficult to judge what proportion of observed variability is heritable and non-heritable ie environmental. The process of breeding in such population is primarily conditioned by magnitude and nature of interactions of genotypic and environmental variations in plant characters. Therefore in the present study the components of variance such as phenotypic (PCV) and genotypic (GCV) coefficient of variances, heritability in broad sense (h^2bs) and predicted genetic advance as per cent mean were computed for water use efficiency, pod yield and its component traits.The study will help in understanding the pattern of variability present in segregating populations.

MATERIAL and METHODS

The experimental material comprised F_2 population derived from three crosses viz KCG-6 × ICGV-91114, KCG-6 × TG-69 and TMV-2 × ICGV-00350. Each cross consisted 156 F_2 populations belonging to Spanish habit groups. The present investigation was carried out at Agricultural Research Station, Chintamani, Karnataka. The F_2 plants of three crosses and their parents were grown with a spacing of 30 x 20 cm during Kharif 2014. The observations on days to first flowering, plant height (cm), specific leaf area (cm^2/g), SPAD chlorophyll meter reading (mg/g), number of primary branches, number of matured pods, total number of pods, pod yield (g) and kernel yield (g) per plant, sound mature kernel (SMK) (%), shelling (%), harvest index (%), oil content (%) and oil yield (g) per plant were recorded on all the F_2 plants along with ten randomly selected plants in the parental population grown along with F_2 generation in each cross. The PCV and GCV were computed according to Burton and DeVane (1953). Heritability in broad sense for all the characters was computed by the formula suggested by Lush (1945). The predicted genetic advance as per cent mean was estimated according to the formula given by Johnson et al (1955).

RESULTS and DISCUSSION

Since F_2 generation is a segregating population the range of variability present in all the three crosses was quite high for most of the traits suggesting the application of individual plant selection for high yield and water use efficiency. Among all the three crosses studied the cross KCG-6 × ICGV-91114 showed high mean value with respect to kernel yield, pod yield, matured pods and total number of pods per plant and SPAD chlorophyll meter reading

(SCMR). Simultaneously cross KCG-6 × ICGV-91114 recorded lowest SLA among all the three crosses followed by KCG-6 × TG-69. It is evident from the above performance that the parents KCG-6 and ICGV-91114 were highly diverse in nature and they resulted in good recombination of important traits. Other crosses also showed good pod yield and physiological performance suggesting the presence of high genetic variability in the F_2 generation.

The PCV and GCV estimates were relatively high for pod yield, kernel yield, pods and number of branches, matured pods and oil yield per plant, plant height and harvest index in all the three crosses. This indicated higher magnitude of variability present in all three populations. These observations are in accordance with the findings of Lal et al (2003), Golakia et al (2005) and Veeramani et al (2005) for pod and kernel yield. Low to moderate variability was observed for traits days to 50 per cent flowering, shelling per cent and sound mature kernel per cent in all three populations and there was narrow difference between PCV and GCV that indicated that available variability present in population was mainly expressed by genotypic constitution.

Among the traits related to water use efficiency SCMR registered low PCV and GCV in two crosses KCG-6 × ICGV-91114 and KCG-6 × TG-69 whereas moderate PCV and GCV was recorded in the cross TMV-2 × ICGV-00350. Similarly for SLA, low PCV and GCV were observed in the cross KCG-6 × TG-69 and moderate in the cross TMV-2 × ICGV-00350 whereas the cross KCG-6 × ICGV-91114 resulted in moderate PCV and low GCV for SLA. This indicated low variability for these traits.The difference between PCV and GCV was observed to be low which indicated that available variability was controlled by genotypes of the population. Lower PCV and GCV were reported for oil content in all the three populations. These observations are in accordance with the findings of Gowda et al (1996), Venkataramana (2001) and John et al (2008).

Heritability was high for pod yield coupled with high genetic advance as per cent mean in all the populations which indicated that direct selection could be applied for pod yield more effectively in all the populations. These results are in accordance with earlier results obtained by Golakia et al (2005) and John et al (2013). Yield related characters like shelling per cent, harvest index, matured pods, oil yield, and kernel yield per plant showed high heritability with high genetic advance as per cent mean in all the three populations. Narasimhulu et al (2012) came out with similar findings of high heritability along with the genetic advance as per cent mean (GAM) for pod yield and kernel yield per plant and shelling per cent. Veeramani et al

Table 1. Estimates of mean, range, GCV, PCV, heritability and GAM for pod yield and its attributing traits in F_2 population of the crosses of groundnut

Character	Cross	Mean	Range		PCV (%)	GCV (%)	h^2 (bs) (%)	GAM (%)
			Lowest	Highest				
X_1	C1	30.01 ± 0.35	27.00	36.00	10.66	7.42	48.53	10.66
	C2	28.91 ± 0.37	23.00	39.00	11.76	10.23	63.86	17.61
	C3	29.77 ± 0.35	25.00	44.00	9.41	7.15	58.12	11.18
X_2	C1	32.30 ± 0.58	20.00	52.80	28.00	21.30	58.00	9.16
	C2	33.14 ± 0.57	22.60	48.20	24.20	20.50	71.25	22.83
	C3	30.35 ± 0.63	13.00	49.30	19.77	16.98	73.00	38.36
X_3	C1	4.43 ± 0.15	2.00	7.00	24.30	15.80	36.69	18.74
	C2	4.55 ± 0.14	2.00	7.00	26.30	19.90	55.18	29.40
	C3	3.57 ± 0.16	2.00	7.00	22.90	19.77	68.20	31.91
X_4	C1	147.00 ± 1.04	96.30	178.00	10.67	7.66	69.00	10.50
	C2	152.15 ± 0.98	116.30	188.21	8.89	6.36	65.30	15.57
	C3	169.42 ± 2.12	139.40	211.20	15.60	11.25	52.40	16.71
X_5	C1	41.40 ± 0.64	31.20	51.34	6.91	4.20	47.54	16.40
	C2	39.23 ± 0.58	36.32	48.15	9.20	6.40	58.00	19.40
	C3	38.77 ± 0.68	28.20	48.15	13.80	10.38	64.50	26.35
X_6	C1	32.40 ± 0.37	5.00	56.00	47.10	40.90	58.13	53.40
	C2	31.45 ± 0.27	6.00	57.00	27.70	23.67	62.78	32.35
	C3	31.48 ± 0.36	7.00	49.00	34.60	30.63	55.80	39.18
X_7	C1	24.69 ± 0.59	2.50	43.00	48.11	42.23	64.52	42.94
	C2	23.09 ± 0.52	3.00	36.00	37.77	34.05	72.00	56.02
	C3	22.54 ± 0.65	2.00	31.00	46.59	41.53	67.56	41.56
X_8	C1	52.32 ± 0.60	45.65	75.24	17.29	14.16	87.41	49.84
	C2	58.13 ± 0.52	56.39	77.80	21.64	18.41	65.87	31.72
	C3	55.35 ± 0.54	42.40	68.43	23.57	20.71	82.00	38.09
X_9	C1	10.12 ± 0.66	1.72	24.34	53.60	49.20	84.38	92.80
	C2	7.88 ± 0.69	0.80	18.37	38.58	36.04	77.89	54.83
	C3	6.17 ± 0.69	1.10	16.43	47.27	42.52	63.38	61.34
X_{10}	C1	32.46 ± 0.01	15.34	47.30	17.12	14.12	68.16	27.87
	C2	31.00 ± 0.01	11.00	47.64	25.14	22.76	82.27	42.46
	C3	26.70 ± 0.01	10.24	43.87	27.16	23.74	74.00	61.08
X_{11}	C1	43.60 ± 0.29	39.60	49.40	8.55	7.46	85.46	13.39
	C2	42.30 ± 0.33	38.50	49.20	10.24	8.70	75.00	15.52
	C3	38.85 ± 0.31	38.70	49.30	9.55	8.27	71.00	14.75
X_{12}	C1	4.41 ± 0.09	0.54	9.20	35.14	32.02	78.57	91.29
	C2	3.33 ± 0.08	0.42	8.80	42.24	39.07	82.39	87.00
	C3	2.71 ± 0.07	0.30	6.90	44.49	39.04	77.30	70.57
X_{13}	C1	78.40 ± 0.36	65.00	87.00	5.66	4.49	63.38	7.34
	C2	81.30 ± 0.31	68.00	87.00	6.96	4.52	83.27	28.49
	C3	76.95 ± 0.39	67.00	82.00	6.20	5.10	69.00	8.30
X_{14}	C1	15.38 ± 1.05	1.20	39.45	54.89	49.20	89.75	66.70
	C2	12.70 ± 1.04	3.35	31.15	48.24	45.36	73.52	72.54
	C3	9.30 ± 1.04	2.40	22.42	48.24	42.36	64.70	59.62

C1= KCG -6 × ICGV-91114, C2= KCG-6 × TG-69, C3= TMV-2 × ICGV-00350, X_1= Days to first flowering, X_2= Plant height (cm), X_3= # branches/plant, X_4= SLA (cm^2/g), X_5= SCMR, X_6= Total pods/plant, X_7= Matured pods/plant, X_8= Shelling (%), X_9= Kernel yield/plant, X_{10}= Harvest index (%), X_{11}= Oil content (%), X_{12}= Oil yield/plant (g), X_{13}= Sound mature kernel (%), X_{14}= Pod yield/plant

Table 2. Comparative statement based on estimates of different genetic parameters for 14 characters in F_2 generation of groundnut

Character	Cross	Genetic parameter	Gene effect	Influence of environment
Days to first flowering	C1	Moderate h^2 (bs) and moderate GAM	Additive and non-additive	Moderate
	C2	High h^2(bs) and moderate GAM	Additive	Low
	C3	Moderate h^2(bs) and moderate GAM	Additive and non-additive	Moderate
Plant height (cm)	C1	Moderate h^2(bs) and low GAM	Non-additive	High
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low
# branches/plant	C1	Moderate h^2 (bs) and moderate GAM	Additive and non-additive	Moderate
	C2	Moderate h^2 (bs) and high GAM	Additive	Moderate
	C3	High h^2 (bs) and high GAM	Additive	Low
SLA (cm^2/g)	C1	High h^2 (bs) and moderate GAM	Additive	Low
	C2	High h^2 (bs) and moderate GAM	Additive	Low
	C3	Moderate h^2 (bs) and moderate GAM	Additive and non-additive	Moderate
SCMR	C1	Moderate h^2 (bs) and moderate GAM	Additive and non-additive	Moderate
	C2	Moderate h^2 (bs) and moderate GAM	Additive and non-additive	Moderate
	C3	High h^2 (bs) and moderate GAM	Additive	Low
Total pods/plant	C1	Moderate h^2 (bs) and high GAM	Additive	Moderate
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	Moderate h^2 (bs) and high GAM	Additive	Moderate
Matured pods/plant	C1	High h^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low
Shelling (%)	C1	High h^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low
Kernel yield/plant	C1	High h^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2(bs) and high GAM	Additive	Low
Harvest index (%)	C1	High h^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low
Oil content (%)	C1	Highh^2 (bs) and moderate GAM	Additive	Low
	C2	High h^2 (bs) and moderate GAM	Additive	Low
	C3	High h^2 (bs) and moderate GAM	Additive	Low
Oil yield/plant (g)	C1	Highh^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low
Sound mature kernel (%)	C1	High h^2 (bs) and low GAM	Non-additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2(bs) and low GAM	Non-additive	Low
Pod yield/plant (g)	C1	Highh^2 (bs) and high GAM	Additive	Low
	C2	High h^2 (bs) and high GAM	Additive	Low
	C3	High h^2 (bs) and high GAM	Additive	Low

C1= KCG -6 × ICGV-91114, C2= KCG-6 × TG-69, C3= TMV-2 × ICGV-00350

Table 3. Transgressive segregants for matured pods/plant (MPP), oil content (OC, %), and pod yield/plant (PY) identified in F_2 population of the crosses

S/N	Transgressive segregants																	
	KCG-6 × ICGV- 91114						KCG-6 × TG-69						TMV-2 x ICGV-00350					
	Plant #	MP/ plant	Plant #	OC (%)	Plant #	PY/ plant	Plant #	MP/ plant	Plant #	OC (%)	Plant #	PY/ plant	Plant #	MP/ plant	Plant #	OC (%)	Plant #	PY/ plant
1	54	31	44	49.40	54	25.35	47	30	44	48.20	47	27.23	28	24	49	49.30	28	19.18
2	81	30	39	48.30	81	28.78	83	36	79	48.80	83	31.15	92	23	74	46.70	92	17.14
3	46	38	58	47.60	127	36.25	12	28	139	49.20	56	27.42	18	28	134	48.40	56	22.42
4	127	34			48	27.68	119	34	132	47.50	119	30.68	138	27	19	47.84	123	22.21
5	23	46			46	32.45	67	33			67	29.59	86	26	94	45.90	86	18.26
6	35	40			91	37.15	97	32			97	28.90	123	31			138	20.90
7	152	43			152	37.54					136	28.65	56	29			127	16.65
8	76	41			74	39.45					127	26.82	22	25			22	21.13
9	23	38			23	32.15											74	19.67
10	35	39			35	37.05											46	15.90
11	138	33			41	27.50												
12	94	37			138	29.36												
13	114	42			94	27.68												
14					114	36.56												

Parent	MP/plant	OC (%)	PY/plant	Parent	MPP/plant	OC (%)	PY/plant	Parent	MPP/plant	OC (%)	PY/ plant
KCG-6	26.47	47.20	23.54	KCG-6	26.47	47.20	23.54	TMV 2	12.60	40.97	8.28
ICGV-91114	16.40	44.30	13.50	TG 69	23.35	43.84	18.08	ICGV-00350	18.56	47.80	14.68

MP= Matured pods, OC= Oil content, PY= Pod yield

(2005) recorded high broad sense heritability and genetic advance for number of pods per plant and kernel yield characters. John et al (2011) reported high broad sense heritability and genetic advance for harvest index. This indicated that additive gene action played major role in controlling these traits hence individual plant selection would be effective for these traits.

The cross TMV-2 × ICGV-00350 recorded high heritability coupled with high genetic advance as per cent for SCMR whereas it was moderate for remaining two crosses. high heritability and moderate genetic advance as per cent mean were reported for specific leaf area in the population derived from KCG-6 × ICGV-91114 and KCG-6 × TG-69 but cross between TMV-2 × ICGV-00350 recorded moderate heritability and genetic advance as per cent mean. Among these surrogate traits for water use efficiency SLA was found to be better trait for selecting high water use efficient genotypes compared to SPAD chlorophyll meter reading because of additive gene action.

Selection in F_2 transgressive segregants are likely to help the breeder to pick out the favorable segregants. The crosses had thrown a good number of transgressive segregants over better parent for pod yield and matured pods per plant. More number of transgressive segregants were recorded for pod yield per plant in the cross KCG-6 × ICGV-9114 as compared to the crosses TMV-2 × ICGV-00350 and KCG-6 × TG-69. This could be due to the fact that parents used in these two crosses were diverse for the characters studied. The cross TMV-2 × ICGV-00350 gave higher number of transgressive segregants for oil content (%) as compared to crosses KCG- 6 × ICGV-9114 and KCG-6 × TG-69. Similarly crosses KCG-6 × ICGV-91114 and TMV-2 × ICGV-00350 gave higher number of transgressive segregants for mature pods per plant compared to KCG-6 × TG-69. This is in accordance with the reports of Jayalakshmi (2000). This indicated that the crosses KCG-6 × ICGV-91114 and TMV-2 × ICGV-00350 were diverse for this character compared to KCG-6 × TG-69. The findings revealed that the parents involved in the study differed for many genes which resulted in creating large amount of genetic variability for yield and yield related components in segregating generations.

REFERENCES

Anonymous 2010. FAOSTAT. Food and Agriculture Organization, Rome, Italy.

Burton GW and DeVane EH 1953. Estimating heritability in tall fescue (*Festuca arundiaceae*) from replicated clonal material. Agronomy Journal **45(10):** 478-481.

Golakia PR, Makne VG and Monpara BA 2005. Heritable variation and association in Virginia runner and Spanish bunch group of groundnut. National Journal of Plant Improvement **7(1):** 50-53.

Gowda MVC, Prabhu TG and Bhat RS 1996. Variability and association of late leaf spot resistance and production in two crosses of groundnut. Crop Improvement **23(1):** 44-48.

Islam MS and Rasul MG 1998. Genetic parameters, correlations and path coefficeint analysis in groundnut. Bangladesh Journal of Scientific and Industrial Research **33:** 250-254.

Jayalakshmi V 2000. Transgressive segregation of physiological and yield attributes in groundnut (*Arachis hypogaea* L). Journal of Crop Improvement **27(1):** 67-72.

Johanson HW, Robinson HF and Comstock RE 1955. Estimates of genetic and environmental variability in soybeans. Agronomy Journal **47(7):** 314-318.

John K, Reddy PR, Reddy PH, Sudhakar P and Reddy NPE 2011. Genetic variability for morphological, physiological, yield and yield traits in F_2 populations of groundnut (*Arachis hypogaea* L). International Journal of Applied Biology and Pharmaceutical Technology **2(4):** 463-469.

John K, Vasanthi RP, Sireesha K and Giridhara Krishna T 2013. Genetic variability studies in different advanced breeding genotypes of Spanish bunch groundnut (*Arachis hypogaea* L). International Journal of Applied Biology and Pharmaceutical Technology **4(2):** 185-187.

John K, Vasanthi RP, Venkateswarlu O, Muralikrishna T and Naidu PH 2008. Genetic analysis and regression studies for yield and yield attributes in F_2 segregating populations of groundnut crosses. Legume Research **31(1):** 26-30.

Lal M, Roy D and Ojha OP 2003. Genetic variability and selection response for root and other characters in groundnut (*Arachis hypogaea* L). Legume Research **26(2):** 128-130.

Lush JL 1945. Heritability of quantitative characters in farm animals. Proceedings, 8th International Congress on Genetics (Hereditas Supplement), pp 356-375.

Narasimhulu R, Kenchanagoudar PV and Gowda MVC 2012. Study of genetic variability and correlations in selected groundnut genotypes. International Journal of Applied Biology and Pharmaceutical Technology **3(1):** 355-358.

Veeramani BB, Prakash M, Jagdeeshan S, Kavimani S, Saravanan K and Ganeshan J 2005. Variability studies in M_2 generation of groundnut (*Arachis hypogaea* L). Legume Research **28(1):** 68-70.

Venkataramana P 2001. Variability and correlation studies in groundnut. Crop Research **21(1):** 81-83.

Received: 26.8.2016 ***Accepted: 13.10.2016***