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RESEARCH ARTICLE

Genetic variability and correlation among different nutritional traits in an intra-varietal cross of GPBD-4 and a mutant GM4-3 derived RILs in groundnut (*Arachis hypogeae* L.)

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SUMMARY

Groundnut is the world's third most important source of oil and fourth most important source of vegetable protein. Considering the importance of quality parameters, an experiment was carried out at the Main Agricultural research station, University of Agricultural sciences, Dharwad during both 2011 and 2012 *Kharif* seasons for the estimation of genetic variability, genetic parameters and correlation co-efficients of different quality traits in a Randomized Block Design with two replications for 816 RIL's. Highly significant variations were observed for all quality traits *viz.,*oil content, protein content and fatty acid profiles. Oleic acid (6.68%, 8.30% and 6.41%, 7.96%) arachidic acid (9.08%, 9.40% and 7.63%, 8.35%) and linoleic acid (16.53%, 13.73% and 13.11%, 11.38%) recorded low to moderate phenotypic and genotypic co-efficient of variability and O/L ratio (39.27%, 29.82% and 38.01%, 27.07%) recorded high GCV and PCV for 2011 and 2012 *Kharif* seasons, respectively. The highest heritability and genetic advance were recorded for the parameters *viz*., linoleic acid (90.68%, 91.22%; 25.80%, 20.30%) and O/L ratio (89.56%, 93.67%; 49.96%, 75.78%) for 2011 and 2012 *Kharif* seasons which indicates that these characters are under influence of additive gene action, therefore, further improvement of these traits are possible. Oleic acid in the present study shown significantly negative association with linoleic acid, palmitic acid, behenic acid and total saturated fatty acid percentage in both 2011 and 2012 *Kharif* seasons and a significant positive association is seen with eicosenoic acid, lignoceric acid, O/L ratio and total saturated fatty acids. Therefore, improvement in the O/L ratio is possible with increase in the oleic acid which is required for the maintenance of oil stability for longer period and improves shelf-life of the oil.

Key Words : Genetic variability, Genetic advance, Groundnut, Heritability, O/L ratio, Oleic acid

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The annual production of groundnut (*Arachis hypogaea* L.) in the country is 9.67 m t from 5.53 m ha of land during 2014-15. As groundnut is mainly preferred by consumers as a bakery food in our country and in western countries especially for groundnut butter, roasted groundnut and salted groundnut (Ahmed and Young, 1982). Ground nut oil contains 46 and 32 per cent of monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA), respectively (USDA, 2015). At present, about 47 per cent of the produce is crushed from edible oil (Wang, 2009). In the developing countries, the proportion of the oil is generally higher than 50 per cent. It is estimated that each 1 per cent increase in the oil content would raise the processor benefit by 7 per cent (Liao and Holbrook, 2005). So there is increasing needs for high protein and low oil groundnut, as these traits add to the confectionary quality of groundnut.

In the present study one of the important quality parameter to be considered is O/L ratio as high oleate to linoleate (O/L) ratio has been associated with prolonged groundnut shelf-life and decreased tendency towards rancidity (Braddock *et al.*, 1995). High oleate groundnut diet lowers total cholesterol and decreases bad low density cholesterol (LDL) and maintains high density lipoprotein cholesterol (HDL) and maintains good flavour of oil (O'Byrne *et al.,* 1997).

Oil content and protein content are polygenically controlled and highly influenced by environment, direct selection of these traits often gives misleading results (Alam *et al.*, 1985) and fatty acids are monogenically or oligogenically controlled. Therefore, direct selection can be done for fatty acids. The knowledge of existing variability and degree of association between quality traits is essential for developing high quality genotypes in groundnut. The observed variability is a combined measure of genetic and environmental causes and the genetic variability is heritable from generation to generation. Heritability and genetic advance is a useful tool for breeders in determining the direction and magnitude of selection. Correlation studies provide an opportunity to study the magnitude and direction of association between different quality parameters. Considering the above points, the present study was undertaken to evaluate the genotypes for quality parameters *viz*., different fatty acids, oil content and protein content and to estimate the inter-relationship among the these quality traits in groundnut.

MATERIAL AND METHODS

An experiment comprising of 816 RILs ($F_{7:8}$) developed from a cross GPBD4 x GM4-3 of groundnut was conducted in a Randomized Block Design with two replications at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during 15 June 2011 and July 2012 *Kharif* seasons. The unit of plot size was one row of 1.5 meters length for both seasons. Row to row and plant to plant spacing were maintained at 30 cm and 10 cm. Recommended cultural practices were followed to ensure a good crop. The data on 13 parameters namely palmitic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, eicosenoic acid, behenic acid, lignoceric acid, O/L ratio, total saturated fatty acid and total unsaturated fatty acid, oil content and protein content were recorded. All the traits were estimated using near infrared spectroscopy (NIRS) at seed quality testing and research lab. Oil stability indices *viz.*, oleic/linoleic acid ratio, unsaturated/saturated (U/S) fatty acid ratio and per cent of saturated fatty acids (%) were computed using the formula (Mozingo *et al.*, 1988).

Oleic/linoleic acid (O/L) ratio: % of oleic acid (C18:1)/ % of linoleic acid (C18:2)

Unsaturated/saturated fatty acid (U/S): % (Oleic + Linoleic + Eicosenoic) / % (Palmitic + Stearic + Arachidic + Behenic + Lignoceric)

The replicated data were subjected to statistical analysis using WINDOSTAT software. Components of genetic parameters like mean, genotypic and phenotypic variance, genotypic and phenotypic co-efficient of variation, heritability, geneticadvance, genotypic and phenotypic correlation co-efficient were estimated.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes for all the characters indicating the prevalence of genetic variability. The mean, range, co-efficients of genotypic and phenotypic variation, heritability and genetic advance for various characters are given in the Table 1. Co-efficient of variation at phenotypic and genotypic levels was relatively high in only oleic acid to linoleic acid ratio, an important indicator of oil stability and nutritional quality (Kavera *et al*., 2008) in groundnut. Further this study revealed that PCV was slightly higher than GCV indicating that these quality traits are less influenced by environment (Alam *et al.*, 1985). However, RILs lacked variability for palmitic acid, eicosenoic acid, behenic acid and lignoceric that are minor fatty acids present in low quantity in groundnut. The magnitude of PCV was higher than GCV for oil content (7.05%, 2.73% and 6.96%, 0.99%) and protein content (5.85%, 5.46% and 5.26%, 4.91%) indicating the influence of environment upon these traits. The high heritability values coupled with high genetic advance as per cent mean were recorded for linoleic acid (90.68%, 91.22% and 25.8%, 20.3%) and O/L ratio (89.58%, 93.67% and 49.96%, 75.78%). This indicates that these characters are under the influence of additive gene action and prediction of high genetic advance supports better improvement for these traits.

Heritability estimates along with genetic advance would be more useful in predicting polygenically controlled traits for selection rather than heritability estimate alone (Johanson *et al.*, 1955). In the present study, high heritability with high genetic advance was observed for linoleic acid (91.22%, 73.04% and 25.8%, 20.3%) and oleic/linoleic acid ratio (89.56%, 93.67% and 49.96%, 75.78%) and high heritability with moderate genetic advance as per cent mean for oleic acid (92.18%, 92.04% and 12.69%, 15.75%), arachidic acid (70.67%, 78.35% and 13.22%, 15.22%) in both 2011 and 2012 *Kharif* seasons, respectively, indicating that direct selection for these parameters are appropriate for genetic improvement as these are governed by additive generation (Zaman *et al*., 2011). But protein content (80.73 %, 80.73% and 9.08%, 9.73%), oil content (91.21 %, 87.58% and 7.392%, 0.042%), palmitic acid (83.75%, 78.98% and 9.75%, 9.51%),

Table 1 : Mean, range and genetic parameters of quality traits for 2011, 2012 *Kharif* seasons

Sr. No.	Traits	Season	Mean	Range	GCV%	PCV%	h^2_{bs} (%)	Genetic advance	Genetic advance as per cent mean
1.	Palmitic acid (%)	2011	9.69	7.7-11.7	5.17	5.65	83.75	0.94	9.75
		2012	10.43	7.4-12.2	5.2	5.85	78.98	0.99	9.51
2.	Stearic acid (%)	2011	3.65	2.5-6.3	7.68	9.57	64	0.46	12.65
		2012	3.48	2.5-6.3	6.88	9.19	56.08	0.37	10.63
3.	Oleic acid (%)	2011	56.86	43-73	6.41	6.68	92.18	7.21	12.69
		2012	52.07	40-76	7.96	8.3	92.04	8.19	15.74
4.	Linoleic acid (%)	2011	20.75	6.7-33	15.74	16.53	90.68	6.4	30.89
		2012	25.3	5.5-35	13.11	13.73	91.22	6.53	25.8
5.	Arachidic acid (%)	2011	1.73	1.2-2.8	7.63	9.08	70.67	0.22	13.22
		2012	1.67	1.1-2.8	8.35	9.4	78.35	0.255	15.22
6.	Eicosenoic acid (%)	2011	1.05	0.7-1.2	5.2	5.71	82.8	0.1	9.75
		2012	0.95	0.7-1.2	4.98	6.07	67.36	0.08	8.41
7.	Behenic acid (%)	2011	3.67	2.8-4.3	4.19	4.9	73.06	0.27	7.38
		2012	3.8	2.7-4.6	5.81	6.97	69.47	0.379	9.97
8.	Lignoceric acid (%)	2011	1.41	0.7-1.5	4.72	5.34	77.97	0.12	8.59
		2012	1.3	0.7-1.6	5.06	6.27	65.13	0.11	8.41
9.	Oleic /linoleic ratio	2011	2.87	1.3-11	25.63	27.08	89.56	1.43	49.96
		2012	2.16	1.2-14	38.01	39.27	93.67	1.63	75.78
10.	Total saturated fatty acid	2011	20.14	18-22	2.87	3.15	83.3	1.09	5.41
		2012	20.7	18-22	3.46	3.77	84.6	1.36	6.57
11.	Total unsaturated fatty	2011	78.63	74-82	1.31	1.49	77.34	1.86	2.37
	acid	2012	78.34	74-83	1.56	1.56	80.46	2.03	2.59
12.	Protein (%)	2011	34.47	23-38	4.91	5.46	80.73	3.132	9.088
		2012	32.17	25-36	5.26	5.85	80.73	3.13	9.73
13.	Oil content (%)	2011	47.5	40-50	6.96	7.05	87.58	3.51	7.395
		2012	46.6	39-49.6	0.99	2.73	83.43	2	0.042

Eicosenoic acid (67.36%, 71.54% and 9.75%, 8.41%), behenic acid (73.06%, 69.47% and 7.38%, 9.97%) lignoceric acid (77.97%, 65.13% and 8.59%, 8.41%), total saturated fatty acid (83.3%, 84.6% and 5.41%, 6.57%) and total unsaturated fatty acids (77.34%, 80.46% and 2.37%, 2.59%) shown high heritability with low genetic advance as per cent mean in both 2011 and 2012 *Kharif* seasons. Selecting for these parameters directly is often misleading as they are governed by non-additive gene action (Kavera *et al*., 2008) in groundnut.

The genotypic and phenotypic correlations were calculated for all pairs of characters for both seasons mentioned in Table 2. The genotypic correlation co-efficients were higher than the corresponding phenotypic correlation co-efficient means, indicating that both environmental and genotypic correlation in those cases act in same direction and finally maximize their expression at phenotypic level. As important parameter in the present steady is oleic acid, we try to associate the correlation strategy with all other parameters. Oleic acid was significantly and negatively associated with linoleic acid (-0.96** and -0.98**), palmitic acid (-0.93** and -0.92**), behenic acid (-0.47** and -0.52**) and total saturated fatty acid percentage (-0.78** and-0.87**) were recorded in both seasons but its association with eicosenoic acid (0.43** and 0.45**), lignoceric acid (0.43** and 0.41**), O/L ratio (0.90** and 0.82**) and total unsaturated fatty acid (0.51** and 0.82**) were significantly positive. The inverse relationships between oleic acid with palmitic acid and linoleic acid was also evident from various earlier studies (Anderson *et al*., 1998). The negative relationship between palmitic acid and oleic acid was likely due to an increased rate of palmitic acid elongation to stearic acid with rapid

Table 2 : Correlation among different nutritional traits in 2011 and 2012 *Kharif* seasons

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1	2011	1	-0.27**	0.95**	-0.54**	-0.41**	0.22**	-0.40**	-0.88**	0.63**	-0.29**	-0.93	0.26**	-0.07
	2012	1	-0.18**	0.94**	-0.15**	-0.44**	0.23**	-0.42**	-0.7**	0.73**	-0.6**	0.92**	0.28**	-0.09
X_2	2011		1	0.21**	0.74**	-0.40**	0.47**	-0.40**	0.21**	0.52**	-0.46**	-0.8	0.06	-0.4*
	2012		1	0.06	0.48**	-0.57**	0.55**	-0.45**	0.05	0.49**	-0.47**	-0.16**	0.07	-0.45*
X_3	2011			1	-0.45**	-0.44**	0.27**	-0.46**	-0.91**	0.64**	-0.26**	-0.96**	0.32**	-0.31**
	2012			1	-0.08**	-0.41**	0.39**	-0.41**	-0.85**	0.80**	-0.70**	-0.98**	0.31**	-0.36**
X_4	2011				1	-0.14**	0.47**	-0.05	0.40**	0.32**	-0.38**	0.29**	-0.11	-0.2
	2012				1	-0.30**	0.48**	-0.12**	0.14**	0.39**	-0.28**	0.003	-0.1	-0.21**
X_5	2011					1	-0.22**	0.89**	0.26**	-0.53**	0.18**	0.43**	-0.22*	0.45**
	2012					1	-0.18**	0.80**	0.21**	-0.56**	0.51**	0.45**	-0.21*	0.47**
X_6	2011						1	0.11**	-0.31**	0.78**	-0.83**	-0.47**	-0.05	-0.28**
	2012						1	0.05**	-0.35**	0.76**	-0.77**	-0.52**	-0.03	-0.30**
X_7	2011							1	0.27**	-0.46**	0.11**	0.43**	-0.21**	-0.47**
	2012							1	0.21**	-0.35**	0.32**	0.41**	-0.19**	- 0.50**
X_8	2011								1	-0.63**	0.33**	0.91**	-0.38**	0.29**
	2012								1	-0.64**	0.55**	0.82**	-0.35**	0.30**
X_9	2011									1	-0.77	-0.79**	-0.14*	0.38**
	2012									1	-0.90**	-0.87**	-0.12*	0.40**
X_{10}	2011										1	0.52**	-0.26*	0.49**
	2012										1	0.82**	-0.24*	0.50**
X_{11}	2011											1	-0.31**	0.33
	2012											1	-0.30**	0.40**
X_{12}	2011												1	-0.19**
	2012												1	-0.20**
X_{13}	2011													1
	2012													1

* and ** indicate significance of values at P=0.05 and 0.01, respectively, X_1: Palmitic, X_2: Stearic, X_3: Linoleic, X_4: Lignoceric, X_5: Arachidic, X_6: Eicosenoic, X_7: Behenic, X_8: O/L ratio, X_9: SFA, X_{10}: USFA, X_{11}: Oleic acid, X_{12}: Protein, X_{13}: Oil

desaturation to oleic acid via delta-9 desaturase (Groff *et al*., 1996). The strong negative correlation between oleic acid and linoleic acid results from these being the chief acyl desaturation of oleic acid leads to linoleic acid accumulation in the oil (Mercer *et al*., 1990). From these correlations it can be concluded that breeding for increased oleic acid normally results in reduced palmitic acid and linoleic acid. The correlation between oil and protein content was negative, which is important for developing cultivars for confectionary purpose. Oil content showed positive correlation with oleic, eicosenoic acid, lignoceric acid and O/L ratio and negative correlation with stearic, arachidic and behenic acids (Dwivedi *et al*., 1993).

REFERENCES

Ahmed, E.H. and Young, C.T. (1982). Composition, nutrition, and flavours of peanuts. *Peanut science and technology,* (Pattee HE and Young CT, eds.). Yoakum, TX, USA: APRES: 655–688.

Alam, M.S., Rahman, A.R.M.S. and Khair, A.B.M. A. (1985). Genetic variability and character association in groundnut. *Bangladesh J. Agric*., **10**: 9-16.

Anderson, P.C., Hill, K., Gorbet, D.W. and Brodbeck, B.V. (1998). Fatty acid and amino acid profiles of selected peanut cultivars and breeding lines. *J. Food Compo. Anal*., **11**: 100-111.

Braddock, J.C., Sims, C.A. and O' Keefe, S.K. (1995). Flavour and oxidative stability in roasted high oleic peanuts. *J. Food Sci.*,**60**: 489-493.

Dwivedi, S.L., Nigam, S.N., Jambunathan, R., Sahrawat, K. L., Nagabhushanam, G.V. S. and Raghunath, K. (1993). Effect of genotypes and environment on quality parameters and their correlation in peanut. *Peanut Sci.*,**20**: 84-89.

Groff, J.L., Gropper, S.S. and Hunt, S.M. (1996) Lipids. In: *Advanced nutrition and human metabolism*. West Publishing, Minneapolis/St. Paul, M.N, USA: 113-146pp.

Johanson, H.W., Robinson, H.F. and Comstock, H.F. (1955). Estimates of genetic and environmental variability in soybean. *Agron. J.,* **47**: 314-318.

Kavera, S.B, Nadaf, H.L., Vijayakumar, A.G. and Salimath, P. M. (2008). Fatty acid profile of ground nut (*Arachis hypogaea* L.) cultivars. *Crop Improv*., **35** (1): 61-65.

Liao, B.S. and Holbrook, C.C. (2005). Groundnut in genetic resources, chromosome engineering, and crop improvement.*Oilseed crops* (Singh RJ,ed.). *Boca Raton, FL, USA: CRC.,* **4**: 51–57.

Mercer, L.C., Wynne, T.C. and Young, C.T. (1990). Inheritance of fatty acid content in peanut oil. *Peanut Sci*., **17**: 17-21.

Mozingo, R.W., Coffelt, T.A. and Wynne, J.C. (1988). Quality evaluations of Virginia-type peanut varieties released from 1944-1985. *Southern Co-operative Series Bull. No*. **335** : 1-28.

O'Byrne, D. J., Knauft, D. A. and Shireman, R. B. (1997). How fat monosaturated rich diets containing high oleic peanuts improve serum lipoprotein profiles. *Lipids,* **32**:687–689.

Wang, C. T. (2009). Peanut production, trade and utilization. *Peanut Sci. & Technol. Bull. Nat. Peanut Agri-Indus. Res. Syst.,* **1** (5&6): 8–32.

Zaman, M.A., Tuhina-Khatun, M., Ullah, M.Z., Moniruzzamn, M. and Alam, K. H. (2011). Genetic variability and path analysis of groundnut (*Arachis hypogaea* L.) *A Scientific J. Krishi Found. Agriculturists,* **9** (1&2): 29-36.