Received: 31 Oct 2025 | Accepted: 21 Jan 2026 | Online: 05 Feb 2026

Electronic Journal of Plant Breeding

Research Article

Genetic diversity studies on oil content and its fatty acid composition of groundnut

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Abstract
Groundnut is an important oilseed crop of the world. The oil quality plays an important role in the nutritional composition and trade. In the present study, 50 groundnut genotypes were evaluated at ICRISAT, Hyderabad, during rainy season, 2023 using alpha lattice design in three replications. The analysis of variance showed significant difference among the genotypes for all the recorded traits. The variability, heritability and genetic advance as per cent of mean estimates were high for major fatty acids, oleic acid, linoleic acid and palmitic acid, indicating the predominance of additive gene action in governing the inheritance of these traits, for which simple selection may be sufficient in achieving potential genetic gain of oil quality. This high variability for palmitic acid, oleic acid and linoleic acid was also confirmed from PCA as they have high scores in PC1. Correlation analysis disclosed that, selecting for stearic acid reveals less contribution to genetic improvement of oil content in groundnut while, oleic acid, linoleic acid and palmitic acid may not affect the oil content in groundnut. The correlation among the fatty acids revealed that, oleic acid which has significant nutritional and market value showed significant negative correlation with all other fatty acids. Thus, to increase both nutritional quality and quantity of oil, selection of genotypes need to be carefully planned. These findings were also confirmed from PCA biplot. The highest oil content and stearic acid was recorded by ICGV 06420 and ICGV 99247, respectively. For palmitic acid, the highest value was present in GPBD 4 and for oleic and linoleic acid, it was in ICGV 181045 and Chico, respectively. Through PCA and genetic divergence analysis, 21 genotypes were identified with high O/L which serves as candidates for future studies in groundnut breeding aiming for increasing its nutritional quality and quantity of groundnut oil.

Keywords: Groundnut, variability, oil content, oleic acid

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) or peanut is a self-pollinated crop belonging to the family Fabaceae and believed to have originated at Bolivia (Krapovickas, 1968). Groundnut kernels are a rich source of oil (40-60 %), protein (20-40%) and carbohydrate (10-20%) thus, it is considered as "King of oilseeds". Further, groundnut kernels also contain mineral elements (phosphorus, calcium, magnesium and potassium), vitamins (E, K and B group), phytosterols, phenolics and antioxidants (Janila *et al.,* 2013; Arya *et al.,* 2016). It is predominantly used as edible oil contributing to 25 per cent of vegetable oil. The global production of groundnut was about 54.27 million metric tonnes from a cultivated area of 30.92 million hectares with productivity of 1.76 tonnes/ ha (FAOSTAT, 2023). India is the second leading country after China in groundnut production, spread over an area of 4.96 million hectares with a production of 10.3 million metric tons (FAOSTAT, 2023). Apart from physical attributes such as seed mass, shape and testa integrity, sensory qualities, including seed color, texture, and flavor, nutritional aspects like oil and protein content, as well as fatty acid and amino acid composition also play a crucial role in the food trade (Dwivedi *et al.,* 1996). Chemically, groundnut oil is composed of 50% monounsaturated fatty acids (MUFAs), 33% polyunsaturated fatty acid (PUFAs) and 14% saturated fatty acids (Ory *et al.*, 1992; Feldman, 1999). Oleic (OA) and linoleic (LA) fatty acids together make 75-80% of the total fatty acids in groundnut oil (Treadwell *et al.,* 1983; Dwivedi *et al.,* 1993). Groundnut oil also consists of minor fatty acids such as stearic acid (saturated fatty acid), arachidic acid, behenic acid, lignoceric acid, eicosenoic acid and gadoleic acid which constitutes for 1 to 3% of the total fatty acid composition (Akcura *et al.,* 2021). Oleic acid (MUFA), linoleic acid (PUFA) and palmitic acid (saturated fatty acid) alone constitute for 90% of the total fatty acid composition in groundnut oil (Abadya *et al.,* 2021).

The strong market advantages associated with oleic acid are directing breeding programs toward producing high-oleic peanut lines. Polyunsaturated fatty acids are highly prone to oxidation, which increases the risk of developing off-flavors. The oxidation rates of linoleic and linolenic acids are approximately 10 and 25 times greater, respectively, than that of oleic acid (Frankel, 1991). Oleic acid, a monounsaturated fatty acid, exhibits approximately tenfold greater auto-oxidative stability than linoleic acid (O'Keefe *et al.,* 1993). Consequently, peanuts with a high oleic/linoleic (O/L) ratio have a substantially longer shelf life compared to normal O/L peanuts. Additionally, dietary oleic acid has been reported to lower low-density lipoprotein (LDL) levels, inhibit tumorigenesis, and alleviate inflammatory conditions (Mesa-Garcia *et al.*, 2006). Therefore, the fatty acid composition of groundnut oil plays a crucial role in determining its overall quality.

The previous studies focusing on variability and trait association analysis among fatty acids composition of groundnut oil was limited. Therefore, the objective of this study was to evaluate the variability, trait association and genetic diversity analysis of groundnut genotypes for fatty acids composition of groundnut oil.

MATERIALS AND METHODS

The present investigation was carried out with 47 groundnut genotypes along with three checks, Sunoleic 95-R (high oleic acid), ICGV03043 (high oil content) and ICGV 15083 (high oleic acid), comprised of both advanced breeding lines of ICRISAT and released varieties of groundnut. The experiment was carried out at 17°50'N, 78°27'E, International Crops Research Institute for Semi-arid Tropics (ICRISAT), Patancheru, Hyderabad, India during rainy 2023 season in alfisols. These genotypes were evaluated using alpha lattice design in three replications and five blocks per replication. Seeds of each genotype were sown in four metre long rows with 30 cm between rows and 10 cm between plants by practicing broad bed and furrow system. Standard crop management practices were followed as per guidelines by Janila *et al.* (2018).

Data was collected on oil content (OC) of dry, matured groundnut kernels and fatty acid composition of groundnut oil like palmitic acid (PA), stearic acid (SA), oleic acid (OA), and linoleic acid (LA) contents were assessed using a Near Infrared Spectroscopy (NIRS; XDS monochromator, FOSS Analytical AB, Hillerod, Sweden, Deshmukh *et al.,* 2020). Near infrared reflectance spectroscopy (NIRS) is a rapid non-destructive technique for screening of large number of seed samples for analysis. A sample of 100 g of well matured dried kernels were used for oil and fatty acids estimation in NIRS using WinISI II project manager software version 4.3 (Infrasoft International, Port Matilda, PA, USA). Seed sample was loaded in a round cup which was filled up sufficiently to allow good absorption of the incident light and the percentage of oil and fatty acids was recorded. Data was subjected to analysis of variance (ANOVA), variability parameters such as, PCV and GCV (Burton, 1952 and Sivasubramanian and Menon, 1973), heritability (Hanson *et al.,* 1956 and Johnson *et al.,* 1955), genetic advance as per cent of mean (Johnson *et al.,* 1955) and Pearson correlation coefficients using SAS version 9.4 Software. In addition to these estimates, PCA and hierarchical cluster analysis was also determined. Principal component analysis (PCA) was done as per the procedure outlined by Massey (1965) and Jolliffe (1986) using R software. Hierarchical cluster analysis based on average linkage method was computed by the method reported by Xu *et al.* (2021) using R software.

RESULTS AND DISCUSSION

Genetic variability for oil content and fatty acids in groundnut: The analysis of variance showed significant differences ($p < 0.05$) (**Table 1**) among the genotypes for all the traits *viz.*, oil content, palmitic acid, stearic acid,

Table 1. Analysis of variance (ANOVA) for oil content and its fatty acid composition of groundnut

Source of variation	Degrees of freedom	Oil content	Stearic acid	Palmitic acid	Oleic acid	Linoleic acid
Replications	2	0	0	0.0002	0	0
Block within Replication	12	0.32	0.006**	0	0.26	0
Genotypes	49	1.04*	0.022***	3.5***	214.6***	170.25***
Residual	86	3.9	0.02	0.42	15	12.1

Note**:** *p< 0.05;   ** p< 0.01; ***p < 0.001;

Table 2. Mean values of oil content and its fatty acid composition of groundnut

S.No.	Genotypes	Oil content (%)	Stearic acid (%)	Palmitic acid (%)	Oleic acid (%)	Linoleic acid (%)
1	GG20	46.20	2.89	13.31	49.96	26.68
2	GJG9	46.04	2.81	14.22	41.83	35.49
3	GJGHPS-1	46.93	2.82	13.26	50.76	27.13
4	GPBD4	47.95	3.05	15.72	35.52	42.67
5	ICGV00308	44.87	2.90	14.67	38.37	38.15
6	ICGV00350	48.19	2.84	14.77	39.05	38.51
7	ICGV00351	48.37	2.88	14.91	39.00	38.03
8	ICGV00362	46.40	3.04	13.93	48.52	29.99
9	ICGV00371	46.08	2.87	14.42	45.75	32.12
10	ICGV00440	46.84	2.77	13.46	49.64	28.32
11	ICGV01258	46.56	3.01	14.66	42.51	34.38
12	ICGV02022	46.65	2.78	15.40	34.64	42.11
13	ICGV02144	45.73	2.72	14.03	45.82	33.48
14	ICGV02266	47.05	2.88	13.49	50.69	26.55
15	ICGV03169	46.35	2.82	14.94	37.70	38.47
16	ICGV03207	47.61	3.00	14.77	37.57	38.77
17	ICGV06040	47.08	2.92	14.91	44.46	32.48
18	ICGV06420	49.01	2.88	13.84	46.15	31.23
19	ICGV07220	47.07	2.79	14.08	45.87	32.22
20	ICGV13189	46.73	2.90	14.89	33.55	41.24
21	ICGV14421	47.02	2.76	12.83	56.51	22.16
22	ICGV15074	46.91	2.82	10.87	73.05	7.50
23	ICGV15083	46.41	2.80	11.08	70.66	9.06
24	ICGV15090	47.76	2.84	11.07	71.06	8.95
25	ICGV16668	46.41	2.85	10.64	72.02	8.57
26	ICGV16688	47.59	2.78	10.69	71.77	8.65
27	ICGV16690	47.48	2.78	10.57	73.37	7.28
28	ICGV16697	47.47	2.81	10.95	71.28	8.77
29	ICGV16700	46.08	2.67	10.84	70.71	10.23
30	ICGV171002	47.71	2.88	10.77	73.41	7.33
31	ICGV171008	46.57	2.73	10.74	69.89	9.87
32	ICGV171015	44.93	2.61	10.95	67.50	13.66
33	ICGV171021	45.37	2.72	10.88	70.78	9.78
34	ICGV171024	47.75	2.91	11.36	68.64	11.00
35	ICGV171357	46.51	2.87	13.94	49.27	29.32
36	ICGV181025	46.48	2.87	11.12	69.65	10.56
37	ICGV181045	45.73	2.44	10.15	74.16	7.26
38	ICGV181068	47.24	2.62	9.99	71.73	7.95
39	ICGV181075	47.54	2.89	10.45	72.18	7.45
40	ICGV191033	47.89	2.78	10.43	70.44	8.84
41	ICGV191039	47.73	2.71	10.92	67.45	10.55
42	ICGV201090	45.83	2.86	10.65	73.35	7.68
43	ICGV93468	47.30	2.55	13.20	54.20	24.87
44	ICGV99240	48.00	2.85	14.24	42.80	34.52
45	ICGV99247	47.73	3.05	14.36	46.49	30.70
46	JL24	45.99	2.87	14.40	40.56	37.03
47	Sunoleic95-R	45.58	2.69	10.53	70.98	9.39
48	Chico (check)	46.44	2.80	15.37	33.46	43.15
49	ICGV03043 (check)	47.23	2.85	14.39	49.86	28.65
50	ICGV91114 (check)	46.44	2.70	14.39	40.44	37.25
	Mean	46.92	2.82	12.80	55.35	23.39
	Maximum	49.01	3.05	15.72	74.16	43.15
	Minimum	44.87	2.44	9.99	33.46	7.26
	SE	0.85	0.08	0.37	2.26	1.99

Note: SE=Standard error

oleic acid, and linoleic acid indicating that these genotypes can be selected in breeding programme for increasing nutritional quality and quantity of groundnut oil. These conclusions are in accordance with the results reported by Cholin *et al.* (2010) in groundnut. The mean for oil content, present in the dry groundnut kernels was 46.92 %. The mean value for oleic acid was 55.35 % while for linoleic acid the value was 23.39 %, for palmitic acid it was 12.80 % and for stearic acid it was 2.82 % (**Table 2**). The mean performance of the studied genotypes disclosed that the oleic acid occupies the major composition of total fatty acids in groundnut oil followed by linoleic acid and palmitic acid while, stearic acid occupies the minor composition of total fatty acids.

The results of variability parameters revealed that, phenotypic coefficient of variance was slightly higher in magnitude than that of genotypic coefficient of variance for all the traits indicates the little influence of environment in inheritance of these traits therefore, phenotypic selection will be rewarding (**Table 3**). High GCV and PCV was recorded in oleic acid (26.47 %, 26.77 %) and linoleic acid (55.79 %, 56.44 %). While, moderate GCV and PCV was reported in palmitic acid (14.62 %, 14.90 %) and low PCV and GCV was present in stearic acid (5.31 %, 6.04 %) and oil content (2.17 %, 3.25 %). It implies that the high variability was exhibited by oleic acid and linoleic acid while palmitic acid showed moderate variability and low variability was expressed by stearic acid and oil content. Similar results of low variability for oil content and stearic acid were reported earlier by Cholin *et al.* (2010), Kumar *et al.* (2019), Zekeria *et al.* (2019) and Deepti *et al.* (2022) in groundnut.

In the present study, high heritability was expressed by stearic acid (74.62 %), palmitic acid (96.15 %), oleic acid (97.59 %) and linoleic acid (97.64 %) while, low heritability was observed in oil content (34.23 %) (**Table 3**). High genetic advance as per cent of mean was reported for palmitic acid (29.47 %), oleic acid (53.72 %) and linoleic acid (113.30 %). The low estimates of genetic advance as per cent of mean was exhibited by oil content (2.29 %) and stearic acid (9.27 %) (**Table 3**). High heritability coupled with high genetic advance as per cent of mean was observed for palmitic acid, oleic acid and linoleic acid, indicating preponderance of additive gene action in governing the inheritance of these characters, for which simple selection may be sufficient in improving these traits. Stearic acid expresses high heritability in conjunction with low genetic advance as per cent of mean, indicating predominace of both additive and non-additive gene action in governing the inheritance of this character, and desired results may not be obtained by simple selection. The results of heritability of fatty acid composition of groundnut oil are in accordance with the results of Cholin *et al.* (2010), Zekeria *et al.* (2019) and Deepthi *et al.* (2022) in groundnut. The oil content showed moderate heritability coupled with low genetic advance, indicating the operation of non-additive gene action for inheritance of this trait hence, simple selection may not be rewarding. These findings were in tune with the results of Cholin *et al.* (2010), John *et al.* (2012), Zekeria *et al.* (2019) and Kumar *et al.* (2019) in groundnut. The estimates of variability, heritability and genetic advance as per cent of mean revealed that the traits, palmitic acid, oleic acid and linoleic acid predict potential genetic gain under selection.

Estimation of association of oil content with its fatty acid composition of groundnut by correlation analysis: Correlation studies play a vital role in selection programmes, as they reveal the degree and direction of relationships among two or more component traits. Oil content is a complex character resulting from multiplicative interaction of its fatty acids and this quantitative character is also highly influenced by environment. Positive correlation of fatty acids with the oil content is rewarding as the positive selection for fatty acids *i.e.,* increase in nutritional quality of oil may lead to simultaneous improvement of oil content in groundnut kernels. On the other hand, the negative correlation of fatty acids with oil content will hinder the genetic advance of oil content in groundnut kernels on selecting for fatty acids. It means, this negative correlation causes decrease in oil content in groundnut kernels on increase in nutritional quality of groundnut oil. Oil content reported significant positive correlation with stearic acid (0.31*) (**Table 4**). Oleic acid showed significant high negative correlation with palmitic acid (-0.99*), stearic acid (0.42*) and linoleic acid (-1*). Likewise, linoleic acid had significant high positive correlation with palmitic acid (0.99*) and stearic acid (0.41*). While, stearic acid reported positive correlation

Table 3. Estimation of variance components for oil content and its fatty acid composition of groundnut

Characters	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	heritability in broad sense (%)	Genetic advance	Genetic advance as per cent of mean
Oil content	2.17	3.25	34.23	1.07	2.29
Stearic acid	5.31	6.04	74.62	0.26	9.27
Palmitic acid	14.62	14.90	96.15	3.77	29.47
Oleic acid	26.47	26.77	97.59	29.73	53.72
Linoleic acid	55.79	56.44	97.64	26.50	113.30

https://doi.org/10.37992/2026.1701.001

Table 4. Correlation among fatty acid composition of groundnut

Trait	Oil content	Stearic acid	Palmitic acid	Oleic acid	Linoleic acid
Oil content	1				
Stearic acid	0.31*	1			
Palmitic acid	0.08	0.48**	1		
Oleic acid	-0.05	-0.42**	-0.99**	1	
Linoleic acid	0.04	0.41**	0.99**	-1**	1

Note**:** *p< 0.05; ** p< 0.01

with palmitic acid (0.48*). The current study had revealed that, selecting for minor fatty acid, stearic acid may lead to the genetic improvement of oil content in groundnut kernels but was in less magnitude. It is due to less association (r<0.5) between stearic acid and oil content. It was in agreement with previous study reported by Yol *et al.* (2017) in groundnut. Furthermore, on selecting for oleic acid which has significant market value and nutritional quality, will lead to decrease of other fatty acids of groundnut oil. These results are in accordance with the results of Bandyopadhyay and Desi (2000), Cholin *et al.* (2010) and Yol *et al.* (2017) in groundnut. The association between unsaturated fatty acids, oleic acid and linoleic acid was inversely related and is high of -1 is due to, oleic acid is completely converted into linoleic acid by enzymatic desaturation via *AhFAD2* enzyme (Deshmukh *et al.,* 2020). The major fatty acids, oleic acid, linoleic acid and palmitic acid showed no or very less association with oil content in groundnut. Thus, increase in the nutritional quality may not affect the oil quantity in groundnut. Therefore, for increasing both oil quality and quantity in groundnut, selection of genotypes need to be carefully done.

Principal component analysis :Principal component analysis of the evaluated traits across 50 groundnut genotypes identified two principal components (PC1 and PC2) among five principal components (PCs) having eigenvalues greater than one (**Table 5 and Fig. 1**). PC1 and PC2 together accounts for 88.15 % of total variation. The principal component 1 (PC1) and principal component 2 (PC2) showed the variability of 64.96 % and 23.19 % respectively, of the total variability. The first principal component captures the maximum possible proportion of total variability, while each subsequent component explains a progressively smaller portion of the remaining variation.

In PC1, palmitic acid, oleic acid and linoleic acid expressed high component scores while in PC2, oil content showed high component score followed by stearic acid (**Fig. 2**). These findings were also confirmed from the PCA biplot that, the traits having high component scores exhibited long vectors. It indicates that, palmitic acid, oleic acid and linoleic acid contribute for much variability followed by oil content and stearic acid.

Smaller angles (<90^0) were present among dimension vectors of stearic acid, palmitic acid and linoleic acid while, large angles (>90^0) were observed for oleic acid with stearic acid, palmitic acid and linoleic acid. Oil content showed right angle (=90^0) with oleic acid, linoleic acid and palmitic acid. Smaller angles between dimension vectors revealed positive corelation among stearic acid, palmitic acid and linoleic acid and large angles exhibits negative correlation of oleic acid with stearic acid, palmitic acid and linoleic acid. The right angle expresses zero correlation of oil content with oleic acid, linoleic acid and palmitic acid.

Table 5. Principal component scores, eigen values and variances for oil and fatty acid composition of groundnut oil

Traits	PC1	PC2	PC3	PC4	PC5
Oil content	-0.09	**-0.83**	-0.55	-0.009	0.009
Stearic acid	-0.33	**-0.49**	0.80	-0.06	0.01
Palmitic acid	**-0.55**	0.11	-0.09	0.82	-0.09
Oleic acid	**0.54**	-0.15	0.15	0.47	0.66
Linoleic acid	**-0.54**	0.17	-0.15	-0.32	0.74
Eigen values	3.25	1.16	0.58	0.014	0.001
Proportion of variation %	64.96	23.19	11.53	0.29	0.02
Cumulative variation %	64.96	88.15	99.69	99.98	100.00

Note: PC- Principal component

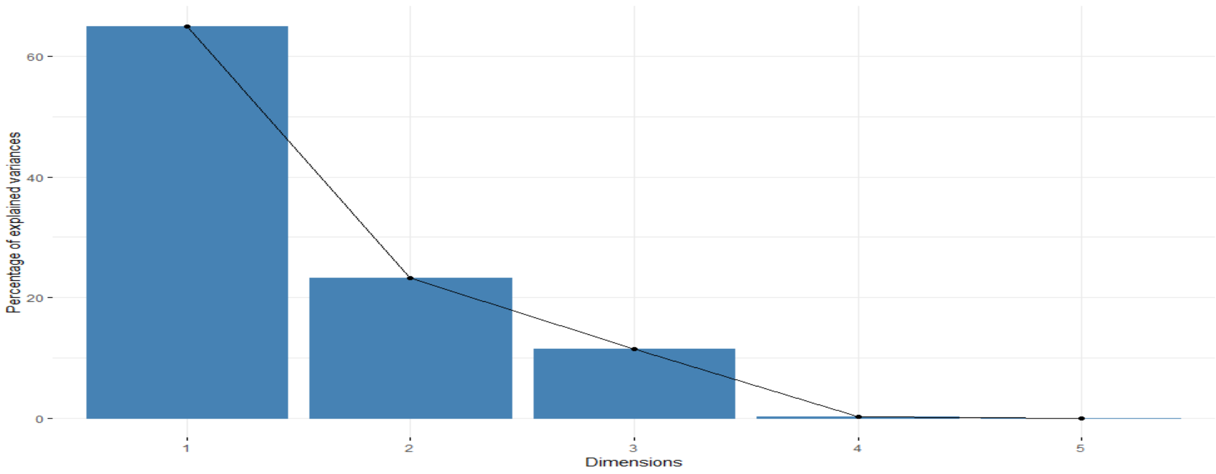

Fig. 1. Scree plot of groundnut genotypes between principal components and its proportion of variation

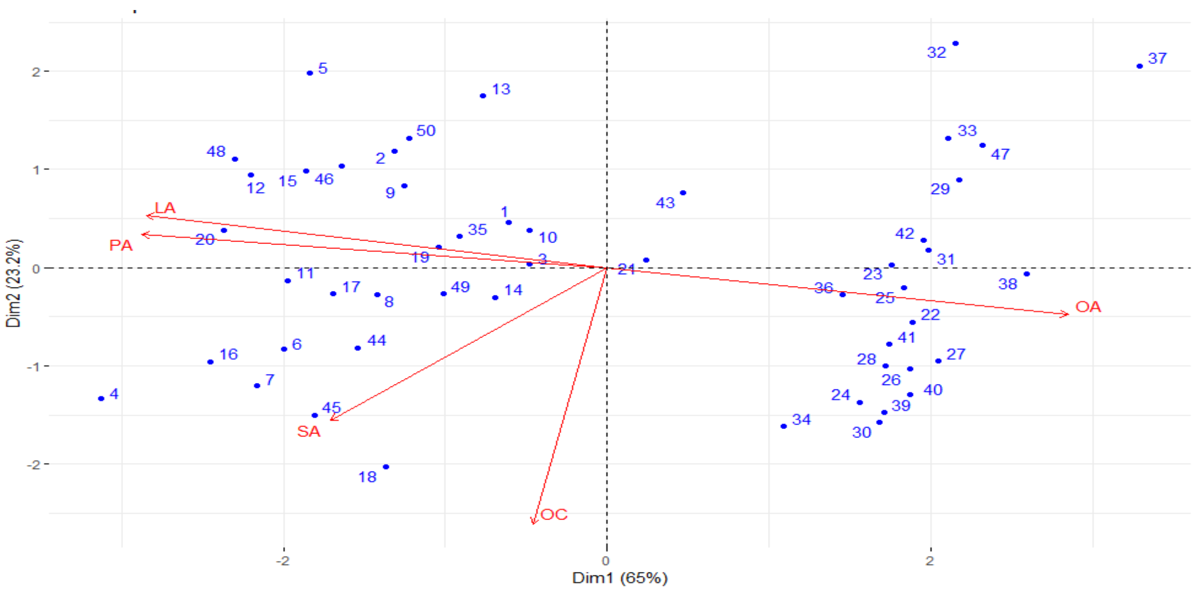

Fig. 2. Two dimensional biplot of principal component analysis

Genotypes that are best for a particular trait were plotted closer and furthest to the vector line. Thus, highest oil content was recorded by ICGV 06420 (49.01%) and highest stearic acid was reported in ICGV 99247 (3.05%). For palmitic acid, the highest value was present in GPBD 4 (15.72 %) and for linoleic acid, highest value was recorded by Chico (43.15 %). The highest oleic acid was expressed by ICGV 181045 (74.16%). In PCA biplot, the genotypes, ICGV 181045, ICGV 181068, Sunoleic 95-R, ICGV 16690, ICGV 15074, ICGV 201090, ICGV 171002, ICGV 191033, ICGV 171021, ICGV 181075, ICGV 16668, ICGV 16697, ICGV 16688, ICGV 171008, ICGV 16700, ICGV 171015, ICGV 191039, ICGV 15083, ICGV 15090, ICGV 181025 and ICGV 171024 were grouped based on high oleic acid. It indicates that, these 21 genotypes contribute for high variability and showed distinct grouping when compared with other traits *viz.,* oil content, stearic acid, palmitic acid and linoleic acid, as the oleic acid showed negative or no correlation with these traits.

Cluster analysis or Genetic divergence analysis: In the present study, 50 genotypes were grouped into 7 clusters based on divergence analysis at the genetic distance of 10.3 (**Table 6, Fig. 3**). Cluster I is the largest among all other clusters comprising 21 genotypes. While clusters II, III, IV, V, VI and VII has 3, 5, 1, 9, 2 and 9 genotypes, respectively.

Table 6. Distribution of groundnut genotypes into different clusters

Name of cluster	Number of genotypes	Genotypes
I	21	ICGV 181045, ICGV 181068, Sunoleic 95-R, ICGV 16690, ICGV 15074, ICGV 201090, ICGV 171002, ICGV 191033, ICGV 171021, ICGV 181075, ICGV 16668, ICGV 16697, ICGV 16688, ICGV 171008, ICGV 16700, ICGV 171015, ICGV 191039, ICGV 15083, ICGV 15090, ICGV 181025, ICGV 171024
II	3	ICGV 171357, ICGV 93468, ICGV 03043
III	5	Chico, JL 24, ICGV 91114, ICGV 99240, ICGV 99247
IV	1	ICGV 14421
V	9	ICGV 13189, ICGV 02022, ICGV 03169, ICGV 03207, GPBD 4, GJG 9, ICGV 00308, ICGV 00350, ICGV 00351,
VI	2	GG 20, GJG HPS-1
VII	9	ICGV 02266, ICGV 06420, ICGV 00440, ICGV 06040, ICGV 00362, ICGV 07220, ICGV 00371, ICGV 01258, ICGV 02144

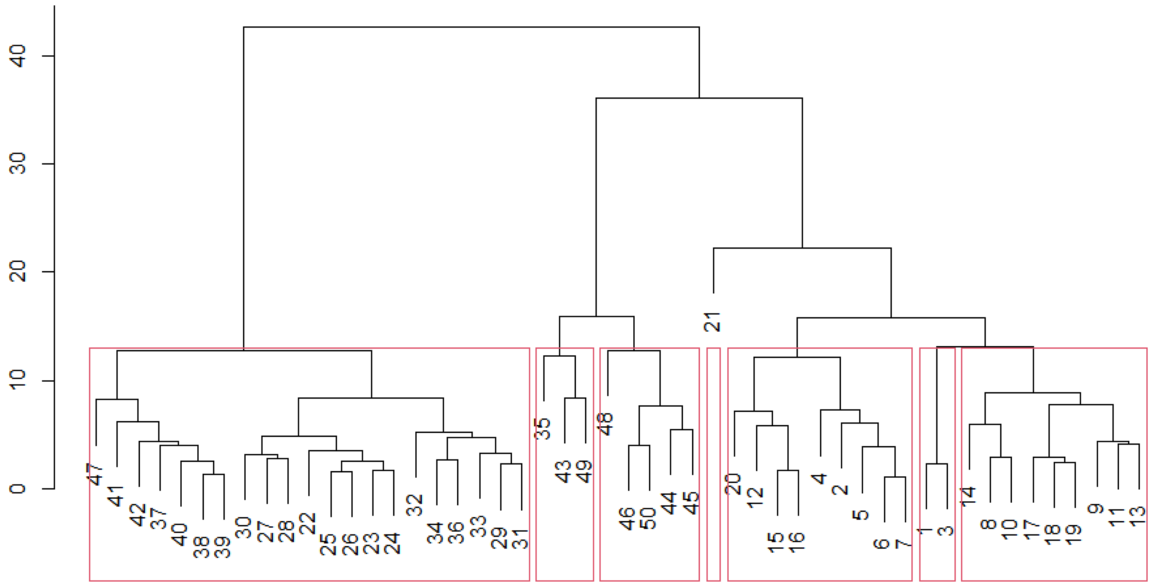

Fig. 3. Distribution of groundnut genotypes into different clusters (Refer table 2 for name of genotypes)

The genotypes present in the cluster I were recorded high mean for oleic acid (71.15 %) and low mean for stearic acid (2.76 %), palmitic acid (10.75 %) and linoleic acid (9.06 %) compared to the genotypes present in other clusters (**Table 7**). Cluster II and IV showed low mean for stearic acid (2.76 %). The genotypes present in the cluster V were recorded high stearic acid (2.89 %), palmitic acid (14.92 %) and linoleic acid (39.27 %) and low mean for oil content (46.46 %) and oleic acid (37.47 %) while, the cluster VI expressed high mean for oil content (47.81%) compared to the genotypes present in the other clusters. In crop improvement programme, the genotypes present in cluster I can be selected as parents in breeding for high oleic acid to linoleic acid ratio (O/L) and cluster V for high stearic acid, palmitic acid and linoleic acid and cluster VI for high oil content.

This study used 50 groundnut genotypes to determine the variability, association and genetic divergence among the groundnut genotypes for oil content and its fatty acid composition. The variability, heritability and genetic advance as per cent of mean estimates were high for major fatty acids, oleic acid, linoleic acid and palmitic acid so, these traits contribute to potential genetic gain under selection. To increase both nutritional quality and quantity of oil, selection should be done with at most care as the fatty acid composition of oil showed less or no association with oil content in groundnut. The genotypes which were present in the cluster I or grouped based on high oleic acid in PCA biplot were considered as best genotypes in terms of having high oleic to linoleic ratio (O/L) and the genotypes present in the cluster VI promote in increasing oil content. The genotypes with high O/L ratio,

Table 7. Cluster mean values for oil content and its fatty acid composition in groundnut genotypes

Character	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI	Cluster VII
Oil content (%)	46.89	47.03	47.01	47.71	46.46	47.81	46.73
Stearic acid (%)	2.76	2.76	2.85	2.76	2.89	2.86	2.88
Palmitic acid (%)	10.75	13.84	14.55	12.83	14.92	13.29	14.09
Oleic acid (%)	71.15	51.11	40.75	56.51	37.47	50.36	46.60
Linoleic acid (%)	9.06	27.61	36.53	22.16	39.27	26.91	31.20

has significant market and nutritional value which serves as candidates for future studies in groundnut breeding aiming for high O/L and oil content.

ACKNOWLEDGMENT

The research was supported by Groundnut Breeding, Accelerated crop improvement programme, International Crops Research Institute for Semi-arid Tropics (ICRISAT), Patancheru, Hyderabad, India.

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