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RESEARCH ARTICLE

Profiling of Groundnut (*Arachis hypogaea* L.) Genotypes for Seed Quality Traits

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The study analyzed seed quality traits in 58 groundnut germplasm accessions of elite breeding material obtained from ICRISAT, Hyderabad along with three checks in 2016-17. A wide variation was obtained in case of hundred kernel weight (HKW), fatty acids and total soluble sugars (TSS). Some of the lines viz. ICGV15001, ICGV15003, ICGV15004, ICGV15036, ICGV15037, ICGV15039, ICGV15041, ICGV15042 and ICGV15050 had oleic acid above 80% which also contributes to high oleic to linoleic acid ratio (O/L ratio) that imparts longer shelf life to the oil. Palmitic and linoleic acid was positively correlated with oil, however, negatively correlated with oleic (r= -0.339*) and O/L ratio (r = -0.335*) which indicates their antagonistic nature. Cluster analysis based on the studied traits, divided 61 genotypes into two main clusters. The differentiation in clusters is based on oleic acid content which was above 80% in lines falling under cluster I and 37-68% in lines under cluster II. The study helped in the identification of lines viz, ICGV15003, ICGV15039 and ICGV15050 with high O/L ratio and comparable oil and TSS content to checks. These genotypes may further be used for studying genetics of quality traits in groundnut breeding programmes.

Key Words: Breeding, Fatty acids, Oil, O/L ratio, Total soluble sugars

Introduction

Groundnut is an important oilseed crop that stands next to soybean in acreage and production in India. The area, production and productivity of groundnut in India during 2015-16 were 5.8 mha, 6.8 mt and 1.18 tonnes/ha respectively (FAO, 2016). It accounts for 45% of the area, 55% of the production of total oilseeds in the country and 43% of total oil production in the country (Aher, 2014). In fact, it plays a significant role in supporting the oilseed economy of India. Almost every part of the crop is useful. Oil is used for cooking purpose, in preparations of soaps, ointments, medicated emulsions, fuel, cosmetics, leather dressings, furniture cream and lubricants, etc; whole kernels for table purpose snacks; cake as a feed for animals and poultry, whereas, shells for making particle boards or as a fuel or filler in cattle feed (Janila *et al.*, 2013). On an average, globally, 50% of total groundnut production is used for oil purpose, 37% for use in confectionery and 12% as seed (Taru *et al.*, 2010). The projected demand of groundnut in Asia alone by 2020 is expected to move 1.6 times higher than its production level in 2000 (Sai *et al.*, 2016). In order to meet this demand, there is need to increase the production of the crop at a much faster rate than the existing one.

Groundnut is a nutritious source of fats, protein, carbohydrates, vitamins and minerals. Groundnut seeds contain 40-50% fats, 20-28% protein and 10-20 % carbohydrates (Belamkar *et al.*, 2011) and also rich source of vitamin E and other minerals for human health including niacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. High nutritional profile of groundnut has encouraged its consumption and thus, processing in many forms (Mattes *et al.*, 2008). Groundnut and its products may be promoted as nutritional foods to fight energy, protein, and micronutrient malnutrition among the poor.

Since about 50 % of total groundnut production in India is used for oil extraction, improvement in oil content and its quality is of major interest to plant breeders and millers. Oil quality of a crop is determined by its fatty acid profile. In groundnut, there are mainly eight fatty acids viz, palmitic (16:0), stearic (18:0), oleic (18:1), linoleic (18:2), arachidic (20:0), eicosenoic (20:1), behenic (22:0) and lignoceric (24:0). Among them, oleic acid (18:1), a monounsaturated fatty acid (MUFA) and linoleic acid, a polyunsaturated fatty acid (PUFA) together accounts for 75-80 % and remaining 20% is contributed by rest of the fatty acids, among which palmitic acid (10%) shares the largest proportion

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(Orsavova *et al.*, 2015). As a source of edible oil, the important quality requirements of groundnut are high oil content in seed, high oleic acid and high oleic/linoleic acid (O/L) ratio. The O/L ratio determines the shelf life of the seed, the higher the ratio the longer the shelf life (Braddock *et al.*, 1995). Oleic acid also lowers the bad cholesterol (LDL) (Kris-Etherton *et al.*, 2001) which is desirable for healthy heart. Higher proportion of oleic acid in oil leads to high smoking point, faster cooking and less absorption of oil (Miller *et al.*, 1987). Groundnut oil is relatively more stable and has longer shelf life than safflower and sunflower oil, which have higher content of PUFAs. Moreover, due to increasing health awareness among the consumers and for decreased tendency towards rancidity of the products imparted by high O/L ratio, the groundnut varieties with low oil content, high O/L ratio, high protein and sugar content are being preferred for confectionery purpose (Dwivedi and Nigam, 1995). Sweetness of the groundnut is a heritable trait (Pattee *et al.*, 2000). It has been also observed that sweetness in groundnut is mainly due to the presence of large amount of free sucrose (Mason *et al.*, 1969). In comparison to abundant information on groundnut protein, oil and fatty acid contents, there are only few reports related on sugars.

The assured irrigation facilities and strong marketing policies have led to expansion in area under rice and wheat; leaving less area under other crops particularly oilseeds and pulses. The availability of other cheap oils like palm oil in India led to severe decline in area under available edible oils like mustard and groundnut. However, rich nutritional profile and mounting demand for table purpose groundnut seeks imperative steps for the revival of this crop. Development of high yielding groundnut varieties coupled with improved quality traits may help in meeting the raising nutritional demands. The present study was meant to evaluate 58 groundnut lines received from ICRISAT, Hyderabad along with three checks for confectionery traits viz., hundred kernel weight (HKW), oil content, fatty acid profile and total soluble sugar (TSS) content so as to identify donor lines for utilization by plant breeders, nutritionists and health advisors to make best use of it.

Materials and Methods

Seed samples of 61 groundnut genotypes were procured from ICRISAT, Hyderabad along with three checks viz, SG99, M522, TG 37A and were sown in *kharif* season during 2016-17. The germplasm was evaluated in alpha design having two replications along with three checks (SG99, M522, TG 37A) and selection of germplasm was based on confectionery traits having high sugar contents, bold seeded and low fatty acids. At maturity seed samples were evaluated for HKW, oil, fatty acid profile, and TSS content. The groundnut seed samples were analyzed for the oil content using Nuclear Magnetic Resonance (MQC23, Oxford Instruments, UK) which is a non-destructive, quick, easy to perform and simple to calibrate. Standard samples containing 5 g seeds of groundnut with known oil content were set to calibrate the instrument. The fatty acid composition was determined by gas chromatography of fatty acid methyl esters. These were prepared as per the procedure developed by (Appelqvist, 1968) and analyzed on Agilent technologies Gas Chromatography model 7820A series equipped with flame ionization detector with CP-Sil 88 (25m × 0.25mm × 0.20mm) FAME column. Temperatures of oven, detector, and injector were maintained at 210, 240, and 230°C, respectively. Two µl of sample was injected at a split rate of 10:1. Individual fatty acids were expressed as percentages of the total fatty acids. The TSS extraction was performed according to an adapted methodology from Garcia *et al.* (2006), using three replicates with 0.2 g of grounded defatted meal and estimation was done colorimetrically by phenol-sulphuric method (Dubois *et al.*, 1956), using glucose (100 µg ml-1) as a standard.

The range, mean, standard error of mean, coefficient of variability for different characters and simple correlation coefficients among quality characters were worked out following standard statistical methods. Cluster analysis was carried out based on HKW and eleven seed quality traits using neighbor-joining method of Paleontological statistics software package for education and data analysis (PAST).

Results and Discussion

The range of variation, mean, standard deviation and coefficient of variation (CV) of HKW, oil, fatty acid composition, O/L ratio and TSS content in 61 germplasm accessions are listed in Table 1. The HKW covers a wide range of 26.00 (ICGV15050) to 102.60 g (ICGV06229). Oil content exhibited low variability and ranged from 48.06% in ICGV15050, ICGV15054 genotypes to 51.04% in ICGV05174 genotype. Sixteen genotypes namely, ICGV05174, ICGV05182,

Table 1. Range, mean and coefficients of variation (CV) for hundred kernel weight (HKW) and different quality parameters in 61 groundnut genotypes

Quality traits	Range	Mean±SE	CV (%)
HKW (g)	26.00-102.60	63.70±2.44	5.42
Oil content (%)	48.06-51.04	49.50±0.62	1.78
Palmitic 16:0 (%)	6.73-14.29	10.69±0.25	3.31
Stearic 18:0 (%)	0.98-4.59	2.01±0.09	6.32
Oleic 18:1 (%)	37.39-84.71	58.90±1.64	3.94
Linoleic 18:2 (%)	1.52-38.17	22.60±1.34	8.38
Arachidic 20:0 (%)	0.74-2.33	1.36±0.04	4.16
Eicosenoic 20:1 (%)	0.61-3.59	1.23±0.07	8.05
Behenic 22:0 (%)	0.52-3.89	2.29±0.08	4.94
Lignoceric 24:0 (%)	0.21-1.9	1.06±0.04	5.35
Oleic/Linoleic ratio	0.97-55.67	7.84±1.77	31.88
Total soluble sugars(%)	4.37-7.22	5.94±0.09	21.49

ICGV05198, ICGV06188, ICGV06216, ICGV06188, TG-51, ICGV199, TG-26, Gangapuri, ICGV06217, ICGV06222, ICGV06214, ICGV86504, ICGV06216, TG37A (check) out of 61 showed more than 50% of oil content (Table 2). Such a high content of oil may affect the flavour and shelf life. For commercial production, the oil content in the groundnut cultivars is generally around 50%, while some germplasm accessions have been reported to contain more than 55% oil (Liao and Holbrook, 2005).The results are within the range of oil content obtained in other studies (Wang *et al.*, 2009; Shokunbi *et al.*, 2012; Chowdhury *et al.*, 2015, Rosalva *et al.*, 2015).

Wide variation was observed in the fatty acid profile of the genotypes under study. Oleic (18:1) and linoleic (18:2) acid together constitute 75-86%, palmitic (16:0) upto 14% and rest of the fatty acids viz, stearic (18:0), arachidic (20:0), eicosenoic (20:1), behenic (22:0), lignoceric (24:0) though in smaller amounts, together constitute upto 7% (Table 2). A similar observation was made by Anderson *et al.* (1998) on comparison of fatty acid profile of six high oleic acid peanut genotypes. The range of fatty acids obtained in the present study was also supported by the observations made by Campos-Mondragón *et al.* (2009) and Chowdhury *et al.* (2015). In recent years, focus has been laid on MUFAs which contains only one double bond which imparts susceptibility towards oxidation and thus prevents tissues from oxidative damage. MUFAs (oleic acid, ω9) are highest in olive oil (67.0%) followed by canola oil (26.9-67.6%) and groundnut oil (43.1%). From health point of view, the presence of oleic acid in oil is considered very useful as it is effective in reducing blood pressure (Teres *et al.*, 2008) and bad cholesterol (LDL) level (O'Byrne *et al.*, 1997). Surprisingly, nine of the genotypes viz. ICGV15001, ICGV15003, ICGV15004, ICGV15036, ICGV15037, ICGV15039, ICGV15041, ICGV15042 and ICGV15050 in the studied material were observed to have oleic acid more than 80% as compared to M-522 (check) (62.80%) which also enhances the O/L ratio upto 55%. Remaining genotypes had O/L ratio varying from 0.97-5.02.Thus, a high O/L ratio (≥10:1) in peanut results in an increased shelf life (upto 10 times) and improved flavor when compared to a normal O/L ratio (~1.5:1) (Isleib *et al.*, 2006; Chamberlin *et al.*, 2014). In USA, Norden *et al.* (1987) for the first time identified groundnut lines F435-2--1 and F435-2--2 with O/L ratio of nearly 40. Since then several high oleic acid groundnut cultivars have been released (Kassa *et al.*, 2009). There has been an increasing demand for high oleic peanuts in the peanut industries and hence focus is laid on the development of varieties with high oleic content. Apart from these nine genotypes, in rest of the genotypes, range of linoleic acid was observed from 13.67-38.17%. The results were in agreement to different studies (Dean *et al.*, 2009; Hassan and Ahmed, 2012). Linoleic acid (18:2) is considered as one of the most important PUFA in human food as it prevents heart vascular diseases (Boelhouwer, 1983).

TSS content is another important trait of groundnut seeds. Higher sweetness is more in demand among the consumers. Of all the genotypes tested from germplasm collection, 31 genotypes showed less than 6% TSS, and remaining 30 accessions showed >6%. Two of the genotypes, namely, Gangapuri and ICGV06216 were found to have TSS above 7%. Gocho (1992) observed around 9% of sucrose content in groundnut seeds. Luo *et al.* (2004) analyzed 13 groundnut cultivars, mainly of Spanish type, and found the sucrose content varied from 5.1 to 5.9%.Wang *et al.* (2007) identified groundnut genotypes with 6.1% sucrose content. Sugar content was higher in groundnut grown in Argentina than that from USA and China (Bett *et al.*, 1994).

Breeding for better quality necessitates deep understanding of relationships among quality traits. Fatty acid biosynthetic pathway involves modifications such as elongation and desaturation. Hence, any modification in the pathway influences the whole fatty acids profile. Present correlation studies revealed significant and positive association of oil with palmitic acid (r = 0.286*) and linoleic acid (r=0.365**), however, negative

Table 2. Hundred kernel weight (HKW) and quality attributes of groundnut genotypes

Genotypes	HKW (g)	Oil (%)	Fatty acid (%)								Total soluble sugars (%)	Stability index (Oleic : Linoleic ratio)
			Palmitic (16:0)	Stearic (18:0)	Oleic (18:1)	Linoleic (18:2)	Arachidic (20:0)	Eicosenoic (20:1)	Behenic (22:0)	Lignoceric (24:0)		
ICGV15001	39.60	49.23	7.87	1.86	83.81	2.07	0.98	1.89	1.93	0.59	4.90	40.48
ICGV15003	41.10	48.80	7.48	1.67	82.49	2.73	1.00	2.11	0.87	0.90	6.59	30.21
ICGV15004	34.80	49.79	7.03	1.78	82.05	2.36	1.08	2.30	0.90	1.28	5.42	34.76
ICGV15036	43.30	49.01	6.73	2.33	82.37	3.03	0.87	2.59	1.67	1.04	5.73	27.18
ICGV15037	41.30	49.02	7.20	1.85	83.97	2.21	1.13	1.58	1.90	1.10	4.84	37.99
ICGV15039	44.70	48.95	6.95	1.51	84.38	1.58	1.25	1.76	2.10	0.80	6.79	53.40
ICGV15041	36.40	48.75	7.72	1.32	84.71	2.11	1.00	1.80	1.52	1.13	5.88	40.14
ICGV15042	41.30	49.21	7.57	1.60	82.29	2.19	1.43	1.98	2.17	0.76	5.37	37.57
ICGV15050	26.00	48.06	8.24	1.21	84.62	1.52	1.30	1.30	2.05	0.97	6.22	55.67
ICGV15054	42.40	48.06	10.39	1.25	56.77	24.49	0.87	2.59	2.65	1.01	5.82	2.31
ICGV15170	92.90	49.83	10.89	1.38	52.13	28.67	1.10	2.11	1.80	1.21	6.58	1.81
ICGV05174	57.10	51.04	11.36	0.98	55.93	27.63	0.97	0.95	1.71	0.48	4.79	2.02
ICGV05182	45.20	50.00	12.30	2.55	56.55	24.16	1.26	1.03	2.09	0.21	5.82	2.34
ICGV05184	47.40	49.52	8.26	1.67	68.73	14.28	1.12	3.59	1.67	0.66	5.39	4.81
ICGV05193	73.20	49.83	12.00	1.10	53.90	28.90	1.00	0.82	1.65	0.60	5.29	1.86
ICGV05198	69.60	50.06	12.50	1.40	55.80	26.90	0.74	1.16	2.03	0.77	6.92	2.07
ICGV05200	88.00	49.00	12.96	1.06	55.10	24.53	1.06	2.13	0.52	0.86	4.97	2.24
ICGV06188	70.70	50.37	10.59	1.71	63.74	20.16	0.93	1.26	2.15	1.16	6.56	3.16
ICGV06189	76.00	49.56	11.82	1.83	59.01	24.23	1.04	0.96	0.94	1.00	5.61	2.43
ICGV06233	51.40	49.83	11.64	1.23	55.50	26.78	1.18	0.83	2.19	0.88	6.52	2.07
ICGV06227	89.50	49.20	10.63	2.50	62.26	22.75	1.19	0.75	1.83	0.60	5.65	2.73
ICGV06211	72.10	49.37	11.10	1.04	63.11	19.87	1.03	0.78	1.96	1.10	6.73	3.17
ICGV06214	47.50	49.75	11.44	1.95	55.41	25.64	1.13	1.03	2.29	1.12	5.42	2.16
ICGV06216	75.60	50.91	11.32	1.26	53.59	29.28	1.03	0.82	1.92	0.78	5.32	1.83
ICGV06229	102.60	48.90	10.08	2.52	62.66	20.15	1.15	0.81	1.90	0.74	6.37	3.10
ICGV06212	80.40	48.94	10.55	2.45	58.83	21.29	1.50	1.00	2.91	1.47	5.28	2.76
ICGV07214	68.80	49.88	12.25	1.80	43.38	36.59	1.12	1.14	2.47	1.24	6.09	1.18
ICGV06760	94.90	48.97	10.23	2.97	55.78	24.42	1.73	0.98	2.78	1.12	5.17	2.28
PM-1	42.00	49.04	14.20	1.81	40.86	36.68	1.32	1.19	2.69	1.24	5.96	1.11
ICGV07359	65.60	48.45	12.35	1.62	49.12	30.32	1.36	1.14	2.68	1.40	6.58	1.62
ICGV06201	68.80	49.04	11.18	1.89	59.28	21.57	1.68	0.98	2.43	0.99	6.67	2.74
ICGV06188	77.80	50.49	10.47	1.10	59.45	21.01	1.25	1.60	3.22	1.90	5.74	2.82
ICGV07758	88.00	48.34	11.00	1.66	56.22	25.04	1.50	0.98	2.59	1.01	4.37	2.24
ICGV91114	44.20	49.78	13.23	2.79	41.38	34.63	1.68	1.04	3.89	1.36	5.24	1.19
ICGV07210	65.90	49.19	13.67	2.51	37.39	38.17	1.92	1.10	3.87	1.37	5.21	0.97
ICGV06227	84.80	48.51	9.65	1.98	66.04	16.82	1.65	0.93	2.14	0.79	6.68	3.92
ICGV07363	97.90	48.70	8.76	1.90	68.63	13.67	1.98	0.97	2.93	1.16	6.70	5.02
ICGV01114	44.80	48.59	13.35	2.20	45.10	33.72	1.42	0.74	2.39	1.08	5.02	1.33
ICGV07768	82.20	49.99	8.46	1.40	66.39	16.83	1.60	1.08	2.85	1.38	5.81	3.94
TG-51	63.60	50.61	12.64	2.45	45.71	34.37	1.04	1.52	1.52	0.75	5.11	1.32
TPG-41	76.70	49.03	10.68	2.91	56.53	23.55	1.59	1.02	2.64	1.08	6.92	2.40
ICGV07362	82.10	49.21	8.94	3.04	63.73	16.39	1.96	1.17	3.39	1.39	6.33	3.88
ICGV95070	66.00	49.24	8.73	1.53	68.02	15.56	1.31	1.29	2.18	1.38	6.69	4.37
ICGV00199	51.10	50.47	10.69	2.66	53.10	26.77	1.51	1.13	2.72	1.42	5.98	1.98
ICGV06211	83.70	49.05	11.41	1.40	50.47	30.49	1.54	0.87	2.76	1.07	6.81	1.65
TG-26	48.90	50.26	14.29	2.21	41.21	37.59	1.35	0.64	1.84	0.88	6.93	1.09
Gangapuri	43.90	50.52	11.38	2.66	45.55	33.50	1.77	0.87	2.94	1.34	7.22	1.35
PM-2	42.00	49.96	14.14	2.96	41.32	36.05	1.66	0.61	2.44	0.83	6.18	1.14
ICGV06217	75.00	50.66	9.63	1.94	61.46	20.82	1.70	0.83	2.41	1.22	5.39	2.95
ICGV06222	76.10	50.00	12.09	1.93	46.36	31.67	1.61	1.08	3.69	1.56	6.36	1.46

Contd.

Genotypes	HKW (g)	Oil (%)	Fatty acid (%)								Total soluble sugars (%)	Stability index (Oleic : Linoleic ratio)
			Palmitic (16:0)	Stearic (18:0)	Oleic (18:1)	Linoleic (18:2)	Arachidic (20:0)	Eicosenoic (20:1)	Behenic (22:0)	Lignoceric (24:0)		
ICGV06214	58.70	50.49	9.43	2.41	61.26	20.82	2.33	0.65	2.83	1.26	6.17	2.94
ICGV06229	93.30	49.14	10.03	1.82	60.21	21.16	1.98	0.75	2.97	1.07	6.14	2.84
ICGV86504	76.70	50.04	11.12	2.29	59.26	21.69	1.33	0.93	2.29	1.09	6.33	2.73
ICGV06233	67.40	48.82	11.12	1.80	50.57	31.08	1.18	1.13	2.05	1.06	6.42	1.62
ICGV06216	72.20	50.60	10.70	1.88	54.17	28.04	1.18	0.84	2.27	0.91	7.16	1.93
VRI-3	36.70	49.99	12.68	4.59	41.99	34.30	1.86	0.86	2.74	0.99	6.19	1.22
ICGV06234	76.10	49.72	11.36	1.74	51.97	28.82	1.31	1.10	2.71	0.98	5.32	1.80
ICGV07217	75.00	48.91	12.25	2.55	48.58	31.02	1.49	1.09	2.69	1.33	4.83	1.56
SG-99(C)	53.40	48.99	9.88	3.43	58.41	21.87	1.78	0.94	2.34	1.36	6.14	2.67
TG37A(C)	45.80	50.60	13.86	1.98	41.53	36.50	1.35	0.87	2.37	1.54	5.04	1.13
M-522(C)	65.80	49.52	9.65	4.02	62.80	18.13	1.58	1.06	1.70	1.05	6.74	3.46

Table 3. Correlation coefficients among traits of 61 groundnut germplasm accessions

Traits	HKW (g)	Oil (%)	Palmitic (%)	Stearic (%)	Oleic (%)	Linoleic (%)	Arachdic (%)	Eicosenoic (%)	Behenic (%)	Lignoceric (%)	TSS (%)
Oil (%)	-0.03										
Palmitic (%)	0.11	0.29*									
Stearic (%)	-0.07	0.04	0.15								
Oleic (%)	-0.20	-0.34**	-0.93	-0.27*							
Linoleic (%)	0.22*	0.36**	0.93	0.21	-0.99						
Arachdic (%)	0.19	-0.04	0.08	0.55	-0.26*	0.19					
Eicosenoic (%)	-0.32**	-0.24	-0.51	-0.28**	0.50	-0.52	-0.45				
Behenic (%)	0.16	0.02	0.26*	0.29*	-0.43	0.38**	0.66	-0.38**			
Lignoceric (%)	0.10	0.02	0.04	0.11	-0.20	0.15	0.39**	-0.09	0.54		
TSS (%)	0.09	-0.001	-0.06	0.08	0.005	-0.002	0.14	-0.18	0.07	0.07	
O/L ratio	-0.52	-0.33**	-0.70	-0.23	0.82	-0.83	-0.26	0.46	-0.34	-0.17	-0.07

HKW: Hundred kernel weight; TSS: Total soluble sugars
* = Significant at 0.05 level; ** = Significant at 0.01 level.

correlation with oleic acid (r = – 0.339*) and O/L ratio (r = – 0.335**). The relationship of saturated fatty acids (palmitic and stearic) was positive and significant with behenic acid (r = 0.258*; r=0.287*) while negative with oleic and eiocosenoic. Linoleic showed positive significant association with behenic acid. O/L ratio showed negative associations with all except oleic and eicosenoic. The findings of the present investigation, in general, were in agreement to the earlier reports (Sarvamangala *et al.*, 2011; Önemli 2012; Azharudheen and Gowda, 2013). A negative relationship between stearic and oleic acid (-0.275*) indicates that one cannot increase much without decrease in other as both are formed from the same source, palmitic acid. Also, the negative association between the two indicates that increased oleic acid results in reduced palmitic and stearic acid which is desirable from health and stability point of view. Among the germplasm accessions, combining several favourable traits i.e. lines with exceptionally high oleic acid (>80%), high O/L ratio (27.18 to 55.67), lowest palmitic (6.73 to 8.24%) could be used in future groundnut quality breeding programmes.

Cluster analysis based on HKW and eleven seed quality traits divided 61 accessions of groundnut into two main clusters (Fig.1). Cluster I consisted of 9 accessions viz, ICGV15001, ICGV15003, ICGV15004, ICGV15036, ICGV15037, ICGV15039, ICGV15041, ICGV15042 and ICGV15050 and these were observed to have less HKW varying from 26.00 (ICGV15050) to 44.70 g (ICGV15039), very high oleic acid more than 80% which also leads to high O/L ratio of upto 55%. O/L ratio plays an important role in maintaining the storage and nutritional quality (and flavor) of peanuts. It is considered as an indicator of oil stability and shelf life index (Campos-Mondragón *et al.*, 2009). The higher the O/L ratio, more stable the oil. Cluster II comprised of 52 accessions and these accessions had oleic acid in the range of 37-68% which leads to low O/L ratio in

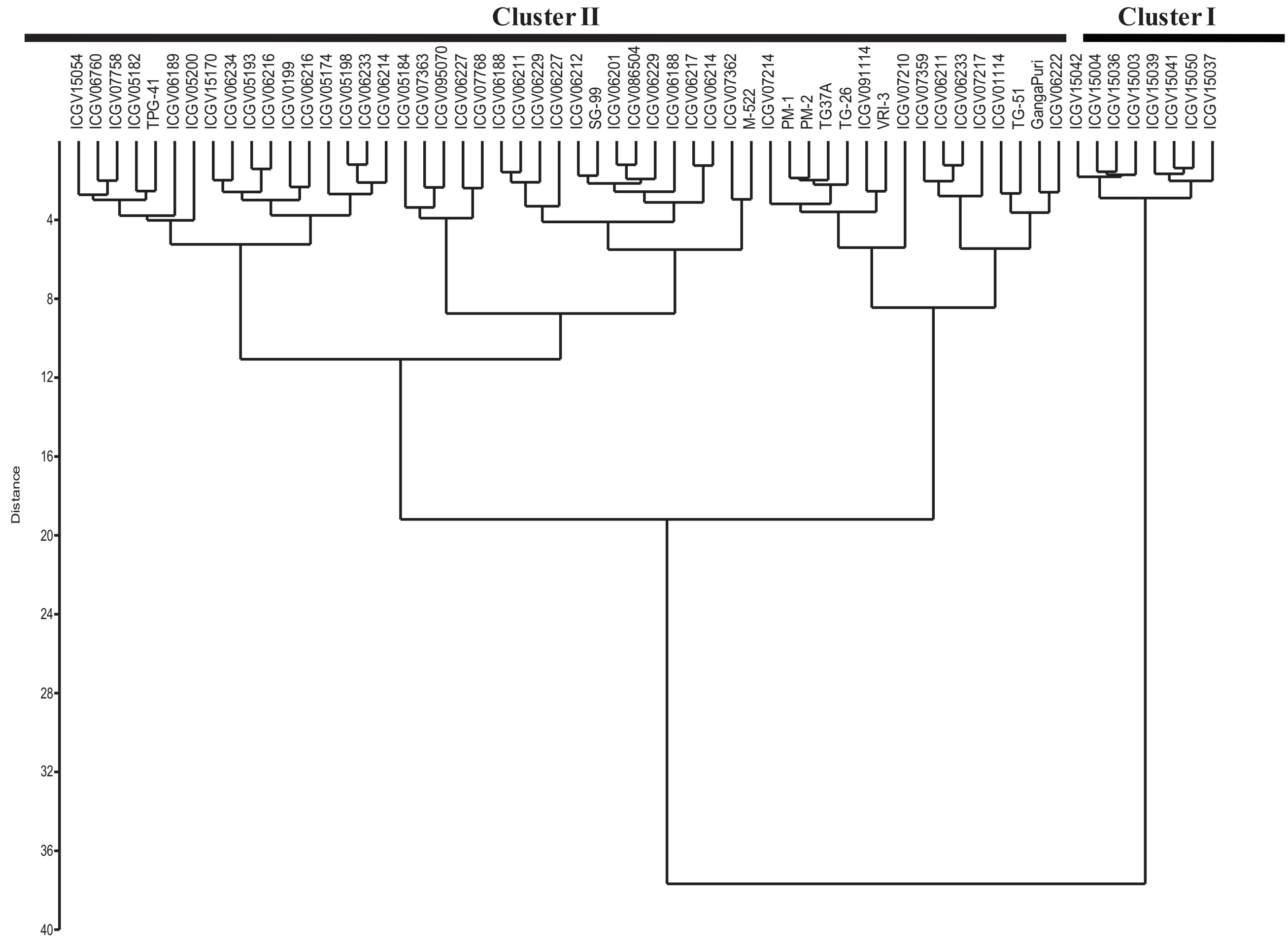

Fig. 1. Cluster analysis based on hundred kernel weight (HKW) and eleven seed quality traits in 61 accessions of groundnut

the range of 0.97-4%. Low O/L ratio indicates that the keeping quality of oil is low. Also, cluster I showed saturated fatty acid composition to be below 10% whereas cluster II had saturated fatty acids in range of 10-16%. Accessions with greater similarity for seed quality traits were placed in the same cluster. Scanty information is available in literature on cluster studies based on quality attributes in groundnut. In addition to this, clustering pattern revealed that the present germplasm has sufficient genetic variability for fatty acid and TSS content which can be used as a donor lines for further genetic improvement.

Conclusion

Groundnut accessions viz., ICGV15003, ICGV15039 and ICGV15050 possessing a combination of high oleic acid (75–80%); high O/L ratio (27.18 to 55.67) and with comparable total soluble sugar content to checks have been identified in the present study which could be helpful in fulfilling the demands of the peanut industries. These lines could be used by the breeders for the development of superior quality lines.

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